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# PREFAȚĂ

Materialele Simpozionului Ştiințific Internațional „*Conservarea diversității plantelor*”, ediția a II-a reprezintă sinteza investigațiilor prioritare realizate atât în țară, cât şi peste hotare, având ca subiecte, botanica structurală şi biotehnologia, conservarea diversității plantelor, introducerea plantelor şi utilizarea durabilă a resurselor vegetale, amenajarea spațiilor verzi urbane şi rurale, instruirea şi educația ecologică a populației.

Diversitatea biologică asigură funcționalitatea optimă a ecosistemelor naturale, existența şi dezvoltarea biosferei în general.

Datorită intensificării impactului antropic asupra biosferei, numărul speciilor de plante periclitate sporeşte din an în an, se reduc simțitor terenurile acoperite cu vegetație naturală, ariile naturale protejate nu-şi pot îndeplini funcția de stabilizare a sistemelor ecologice. Realizarea Planului de acțiuni în cadrul Convenției cu privire la diversitatea biologică (Rio de Janeiro, 1992), necesită eficientizarea semnificativă a măsurilor în vederea conservării biodiversității şi habitatelor naturale, utilizării raționale a resurselor biologice, restabilirii ecosistemelor degradate şi speciilor periclitate.

Sperăm că rezultatele ştiințifice expuse în materialele simpozionului vor servi ca sursă de informare şi promovare a cunoştințelor în societate, contribuind astfel la sporirea nivelului de educație a societății.

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## CUPRINS

### I. STRUCTURAL AND FUNCTIONAL DIVERSITY OF VEGETAL ORGANISMS.

## II. TAXONOMY. CONSERVATION OF THE PLANT KINGDOM

## IV. LANDSCAPE ARCHITECTURE

## V. ENVIRONMENTAL EDUCATION

# I. STRUCTURAL AND FUNCTIONAL DIVERSITY OF VEGETAL ORGANISMS

## NATURAL SILICONCONTAINING BIO NANOMATERIAL AS AN ALTERNATIVE TO COPPER CONTAINING PLANT PROTECTION PRODUCTS DURING INTRODUCTION

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We propose to replace the widely used in plant protection autecology approach to "plant - parasite - environment" based on a study of features of the contact of the organism with the environment, synecological approach based on the research of the relationship between components of ecosystems and the environment. A positive result is achieved through an integrated use of natural silicon nanomaterial and fungi producing biologically active secondary metabolites. Positive effect of cilicon is due to improved soil structure pore, activation of microbial activity, increasing plant resistance to biological stress and increased water consumption resulting from increases in the concentration of SiO2 in these plants. It does not exclude the possibility that silicon performs a physiological function, which role may increase under adverse environmental conditions. The presence of silicon in plant cell walls increases their strength, plant resistance to lodging, to frost, preventing infection, increases the photosynthetic activity, suggesting the active participation of silicon in such physiologically active compounds as nucleic acids. Silicon increases the resistance of plants to soil salinity, softens the toxic effects of manganese, significantly increases the yield of crops. Silicon stimulates nitrogen fixation by plants.

Proposed synecological approach provides a description of the fungi, and also a comprehensive analysis of the dynamics of changes depending on seasonal and anthropogenic influences. This takes into account the peculiarities of fungi (high speed of growth and reproduction, the active metabolism of a wide range of environmental factors, genetics, and biochemical plasticity), which makes them not only as indicator of organisms, estimated the real state of the "microbial – plant" system, but also enables the use of the identified patterns of stability of fungi population on different part of plants (leaves, steams and root) to develop approaches to the management structural and functional organization of an biogeocoenosis. This approach involves improvement of existing plant protection systems and becomes the determining factor in biological agriculture; technology of bio agriculture has been widely adopted around the world and ensures the transition of agricultural production to a new level, from outecological to more advanced and ecologically safe and synecological. Preliminary studies allowed to analyzed the impact of abiotic and biotic nature, which significantly affect the fungi population on leaves allow their use for regulation of the quantitative and qualitative composition of fungi population developing on vascular plants.

Therefore, we propose to include synecology approaches to protection of plants during its introduction and utilization of natural bio nanomaterial based on silicon and fungi, that producing biologically active secondary metabolites. Environmentally friendly bio nanomaterials highly selective action was comprehensively studied as means of introducted plants protection, the optimal norms and doses of application, was determined considering the biological differences between different varieties, edaphic and climatic conditions.

## MORPHOLOGICAL CHARACTERISTICS OF STONES IN A SELECTED COLLECTION OF WILD GENOTYPES OF APRICOT *(Prunus armeniaca* L.*)* GROWING IN ARARAT REGION, ARMENIA

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**Summary.** *Main objective of this work is focused on the survey of basic morphological traits variability of selected wild Apricot (Prunus armeniaca* L.*) genotype stones grown in the Ararat Region of Armenia, where 50 individual genotypes were experimentally studied. From every genotype were randomly withdrawn 50 stones and measured their length (resulting data range 11.95 – 35.66 mm), width (6.49 – 21.55 mm) and thickness (1.25 – 14.96 mm). Significant differences were detected as well with the color and shape of separate stone parts. In the case of stones length and width a distinctive positive correlation was found (r = 0.489$^{+}$), while the correlation coefficient for relation between the stones length and thickness was 0.498$^{+}$, and the correlation coefficient 0.936$^{+}$ characterized the* *relation between width and thickness of stones. Discriminative analyses confirmed significant differences among the studied genotypes, which indicate the suitability of these data to be used for selection process of the best apricot genotypes as genetic resources for further breeding and/or for use in practice (based on stone size and oil production).*

## Introduction

**Current trends of Apricot (***Prunus armeniaca* L.) cultivation are not explicitly oriented only on fruits but there is taken into consideration practical utilization of other plant parts as well. For example in India and many other countries of the dry and warm regions are intentionally cultivated such wildly growing apricot trees in the agro-forestry. They are exploited as resources for bio-energetical purposes and for feeding of farming animals (Singh and Chaudhary, 1993). Small fruits are processed owing to their sour taste and used to produce jam and other foodstuffs or distilled beverages (Gupta and Sharma, 2009). The stones are economically important source as well, although in some countries they are considered for waste material. Kumar and Bhan (2010) studied 167 wild genotypes and published ranges for the medium length (14.64 - 26.48 mm) and medium width (8.63 - 14.65 mm). Stone weight share on total fruit weight represents 5.33 - 17.82%. In several countries is from apricot seeds produced highly esteemed oil with yields of 50.05 – 57.97% (Kumar and Bhan, 2010), 45.6 – 46.3 g (Gupta and Sharma, 2009) and/or 35-45% (Dang et al., 2009). From the biochemical standpoint this oil is ranked as an important product, as it contains valuable fatty acids (7.7% palmitic C16:0, 0.48% palmitoleic C16:1, 0.93% stearic C18:0, 62.07% oleic C18:1, 27.76% linoleic C18:2 a 1.42% linolenic C18:3. The Apricot *(Prunus armenica* L.*)* was known in Armenia during ancient times, and has been cultivated there for so long that it is often thought to be native there. According to NSSRA Apricot *(Prunus armenica* L.*)* cultivation area in Armenia is over 11 000 ha). Apricot seed oil is applied in food, pharmaceutics and cosmetic branches. Such activities are important factors of producing more apricots and expanding of production areas. Therefore the economical aspects of the wildly growing apricot genotypes have their importance for Armenia, at least in the case of stone and seeds production and moreover in Armenia the production of apricot *(Prunus armeniaca* L.*)* is developed comparing other types of fruits production.

## Materials and methods

This work aimed on the survey of basic morphological traits variability of selected wild apricot genotypes grown in the Ararat Region of Armenia.

In the experimental collection were included 50 genotypes and from each genotype were randomly selected 30 stones. In laboratory by use of METRICA Digital Measurer were measured the length, width and thickness (mm) of stones than the stones photographed for the consecutive image analyses using Panasonic DMC-FZ50. The statistical program used for analysis is SAS 9.2.

## Results and discussions

In Table 1 are demonstrated the parameters measured with all selected stones – medium ranges of the length (11.95 – 35.66 mm), width (6.49 – 21.55 mm) and thickness (1.25 – 14.96 mm). Variation coefficient values are documenting middle degree of variability for these traits. Kumar and Bhan (2010) studying 167 wildly growing genotypes determined the medium stone length in range of 14.64 - 26.48 mm and medium width 8.63 - 14.65 mm. Gupta and Sharma (2009) with bred apricot varieties reported the stones length from 16.8 to 19.7 mm and their width from 11.0 to 11.1 mm, while the seed share on the stone weight defined in the range of 30.7 – 33.7%. When comparing the apricot stones morphological parameters of the wild genotypes collection from Ararat region and those reported by Kumar a Bhan (2010), there is a high degree of conformity.

In the Table 2 are demonstrated the mean and standard error of morphological traits for tested apricot individuals, where are evident differences among genotypes (as documented in Figure 5 as well).

Between the length and width of stones was found a strong positive correlation ($r = 0.489^{+}$). The correlation coefficient $0.498^{+}$ defines the relationship between the stone length and thickness, and the correlation coefficient $0.936^{+}$ between the width and thickness of stones.

Significant differences were determined in the shape of stones gained from the tested collection of wildly growing apricot genotypes, as seen on Figures 1-4 as well as stone colors.

Table 1

**Variability of basic morphological traits of stones in the whole tested collection of Apricot (*Prunus armeniaca* L.) genotypes**

| *Trait* | *n* | *min* | *max* | $\bar{x}$ | *CV%* | *Gupta and Sharma (2009)* | *Kumar and Bhan (2010)* |
|---|---|---|---|---|---|---|---|
| Stone Width | 1500 | 6.49 | 21.55 | 17.26 | 13.04 | 16.8 – 19.7 | 12.26 – 21.49 |
| Stone Height | 1500 | 11.95 | 35.66 | 25.36 | 16.22 | 15.8 – 16.4 | 14.64 – 26.48 |
| Stone Thickness | 1500 | 1.25 | 14.96 | 10.38 | 18.65 | 11.0 – 11.1 | 8.63 – 14.65 |

Figure 1. Stone shapes comparison of Apricot *(Prunus armeniaca* L.) genotypes from a side view *(Photo: G. Badalyan, 2010)*

Image 2. Stone shapes comparison of Apricot (*Prunus armeniaca* L.*)* genotypes from a front view (Photo: G. Badalyan, 2010)

Figure 3. Stone shapes comparison of Apricot (*Prunus armeniaca* L.*)* genotypes from a rear view (Photo: G. Badalyan, 2010)

Figure 4. Stone shape and colour comparison of Apricot (*Prunus armeniaca* L.) genotypes (Photo: G. Badalyan, 2010)

Table 2

**Some morphological traits and standard error of stones variability of tested collection of Apricot (*Prunus armeniaca* L.) genotypes stone**

| GENOTYPE | Stone width | Stone height | Stone thickness |
|---|---|---|---|
| **PA01** | 16.41 ± 0.27 | 30.40 ± 0.75 | 10.76 ± 0.18 |
| **PA02** | 19.04 ± 0.47 | 24.05 ± 0.36 | 11.11 ± 0.36 |
| **PA03** | 18.29 ± 0.17 | 23.90 ± 0.29 | 10.37 ± 1.01 |
| **PA04** | 18.99 ± 0.34 | 23.53 ± 0.47 | 11.38 ± 0.21 |
| **PA05** | 17.41 ± 0.37 | 28.62 ± 0.99 | 10.37 ± 0.24 |
| **PA06** | 17.44 ± 0.37 | 29.26 ± 0.85 | 10.40 ± 0.12 |
| **PA07** | 7.91 ± 0.32 | 13.20 ± 0.66 | 2.06 ± 0.17 |
| **PA08** | 17.70 ± 0.41 | 22.98 ± 0.22 | 11.22 ± 0.19 |
| **PA09** | 18.17 ± 0.20 | 22.10 ± 1.09 | 11.14 ± 0.16 |
| **PA10** | 15.86 ± 0.23 | 21.20 ± 0.43 | 9.76 ± 0.17 |
| **PA11** | 18.39 ± 0.41 | 22.17 ± 0.43 | 11.21 ± 0.24 |

| | | | |
|---|---|---|---|
| **PA12** | 17.85 ± 0.67 | 28.52 ± 0.81 | 10.92 ± 0.33 |
| **PA13** | 17.71 ± 0.50 | 30.48 ± 0.81 | 10.34 ± 0.21 |
| **PA14** | 17.38 ± 0.43 | 28.45 ± 0.55 | 11.16 ± 0.40 |
| **PA15** | 17.32 ± 0.50 | 28.93 ± 0.26 | 10.64 ± 0.21 |
| **PA16** | 17.44 ± 0.44 | 28.68 ± 0.67 | 10.44 ± 0.16 |
| **PA17** | 16.72 ± 0.29 | 28.06 ± 0.30 | 10.24 ± 0.14 |
| **PA18** | 16.51 ± 0.27 | 27.42 ± 0.50 | 10.01 ± 0.15 |
| **PA26** | 16.19 ± 0.34 | 19.86 ± 0.30 | 10.53 ± 0.27 |
| **PA27** | 17.65 ± 0.26 | 23.48 ± 0.28 | 10.64 ± 0.17 |
| **PA28** | 17.63 ± 0.52 | 21.48 ± 0.38 | 11.45 ± 0.36 |
| **PA29** | 17.51 ± 0.40 | 21.65 ± 0.52 | 10.72 ± 0.29 |
| **PA30** | 17.98 ± 0.39 | 22.68 ± 0.36 | 10.74 ± 0.18 |
| **PA31** | 19.14 ± 0.17 | 25.99 ± 0.34 | 11.27 ± 0.21 |
| **PA32** | 17.63 ± 0.39 | 21.62 ± 0.35 | 11.22 ± 0.42 |
| **PA33** | 17.97 ± 0.46 | 22.22 ± 0.50 | 11.89 ± 0.39 |
| **PA34** | 16.54 ± 0.80 | 23.44 ± 0.52 | 10.31 ± 0.27 |
| **PA35** | 18.89 ± 0.32 | 22.61 ± 0.34 | 11.24 ± 0.23 |
| **PA36** | 9.37 ± 0.40 | 14.72 ± 0.43 | 2.61 ± 0.29 |
| **PA37** | 16.88 ± 0.47 | 29.24 ± 0.96 | 10.04 ± 0.17 |
| **PA38** | 17.87 ± 0.47 | 22.31 ± 0.44 | 11.07 ± 0.33 |
| **PA39** | 17.56 ± 0.33 | 29.21 ± 0.41 | 10.34 ± 0.16 |
| **PA40** | 17.18 ± 0.29 | 28.45 ± 0.75 | 10.72 ± 0.21 |
| **PA41** | 17.70 ± 0.37 | 23.65 ± 0.48 | 10.45 ± 0.36 |
| **PA42** | 19.07 ± 0.44 | 22.09 ± 0.42 | 12.24 ± 0.45 |
| **PA43** | 17.96 ± 0.36 | 24.12 ± 0.39 | 10.45 ± 0.17 |
| **PA44** | 18.41 ± 0.19 | 27.49 ± 0.35 | 10.56 ± 0.16 |
| **PA45** | 17.90 ± 0.23 | 26.19 ± 0.38 | 10.29 ± 0.11 |
| **PA46** | 16.85 ± 0.43 | 27.59 ± 0.43 | 10.80 ± 0.48 |
| **PA47** | 16.68 ± 0.26 | 27.17 ± 0.45 | 9.93 ± 0.17 |
| **PA48** | 17.29 ± 0.21 | 28.46 ± 0.47 | 9.96 ± 0.14 |
| **PA49** | 18.07 ± 0.32 | 29.14 ± 0.27 | 10.45 ± 0.15 |
| **PA50** | - | - | - |

From the study of morphological traits inter-dependences in all combinations resulted a positive correlation (Table 3). Very high dependency has been found between the width and thickness of stones (0.936), a middle strong dependency is between the stone length with both, the width and/or thickness (0.489/0.498). These data are different as those reported by Kumar and Bhan (2010), what is explained by different genotype collections in both cases.

Table 3

**Correlation coefficients of linear dependence among the tested morphological stone traits of Apricot (*(Prunus armeniaca* L.*)* genotypes**

| *r* | *Confindential interval* $r_{95\%}$ | $r^2$ | *t* | *Probability of t (p)* | *Kumar and Bhan (2010)* |
|---|---|---|---|---|---|
| | **Stones lenght (mm) and width (mm)** | | | | |
| 0.489 | 0.244<= r >= 0.675 | 0.239 | 3.889 | 0.0003 | 0.719$^{++}$ |
| | **Stones lenght (mm) and thickness (mm)** | | | | |
| 0.498 | 0.2561<= r >= 0.6825 | 0.248 | 3.9880 | 0.0002 | 0.233$^{+}$ |
| | **Stones width (mm) and thickness (mm** | | | | |
| 0.936 | 0.890<= r >= 0.963 | 0.876 | 18.483 | 0.0000 | 0,411$^{++}$ |

Computing of all experimental data resulted in a principal component analysis (PCA), where according to some stone morphological traits of apricot *(Prunus armeniaca* L.*)* there is indicated, that all samples are divided into three dissimilar groups. There is a small group consisting of 2 genotypes (PA07 and PA36) eliminated from other 48 genotypes in the second group and third group. Anyway inside of these two groups there were genotypes that behave different and are little spread across the center of group.

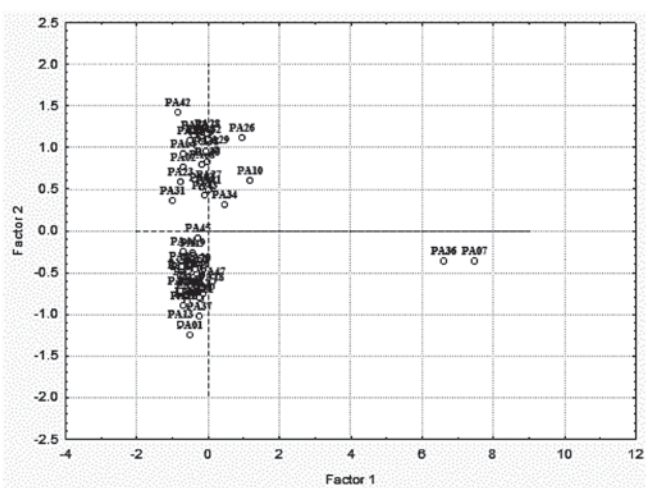


Figure 5. PCA for 50 evaluated genotypes selected from wildly growing apricots in the Ararat Region, Armenia

## Conclusions

The experimental results confirmed, that the wildly growing apricot genotypes;

a) produce stones with different variability of basic morphological traits;

b) stones could be utilized in Armenia as potential resources for oil production, what can contribute to more effective utilization of domestic biological resources for socio-economic regional development;

c) prospectively it is suggested to continue this experimental research oriented on the study of further relations among the stone shape/color and other economically important fruit traits including the quality aspect as well;

d) another possibility is exploit the specific shape and color of stones for genotypes identification;

e) suitable genotypes could be included into breeding process and the new-bred varieties use in agro-forestry and land-forming practice.

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# THE PRODUCTION OF *STEVIA REBAUDIANA* BERTONI PLANTING MATERIAL BY MICROPROPAGATION

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**Summary.** *For the in vitro propagation of Stevia rebaudiana Bertoni for the obtention planting material, Murashige and Skoog (MS) basal medium supplemented with 0.5 mg/l BAP was used for the multiplication phase. In order to reduce costs in the multiplicaton phase, agar was successfully substituted with wheat starch or liquid medium was used together with paper as mechanical support. For in vitro rooting, hormone-free MS medium was used and a maximum number of microcuttings were inoculated/vessel in order to establish the rooting percentage while using, with maximum efficiency, the space in the culture vessels. The ex vitro acclimation of rooted plantlets was carried out by using hydroculture. Cuttings were excised from the acclimated plants, which in turn were rooted in float hydroculture.*

## Introduction

*Stevia rebaudiana* Bertoni, fam. Asteraceae contains the alkaloids steviol, stevioside and rebaudoside, its sweatening capacity being 300 times that of sugar. It is an alternative to using saccharine.

This species is difficult to propagate by seeds, which have about 10% germination rate. Several authors successfully propagated this species *in vitro*. Such, M. Hossain et al. (2008) tested full-strength as well as diluted MS and the cytokinins BAP and kinetin for multiplication. Among the variants tested, MS medium with 1 mg/l BAP proved to be the most effective for axillary shoot proliferation. In the *in vitro* rooting phase, MS with 1.5 mg/l NAA ensured the regeneration of a high number of roots, whereas ½ MS ensured the regeneration of long roots.

Sung Jin Hwang (2005) obtained the highest proliferation rates (23.4 ± 2.1 shoots/explant) on MS medium with 2 mg L-1 IAA and 0.5 mg L-1 kinetin. The shoots were then transferred on MS rooting medium supplemented with 3% sucrose and 2 mg L-1 IBA and the rooted plants were transferred into soil for acclimation, where they had 98.4% survival rate.

Ahmed et al. obtained maximum shoot proliferation on MS media with 1.5 mg/l BAP and 0.5 mg/l kinetin.

Anbazhagan et al (2010) used as nutritive media MS with various concentrations of plant hormones or combinations of these. BAP was used in concentrations of 0.2, 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 mg/l, kinetin (Kn) at 0.5, 1.0, 2.0, 3.0 mg/l and combinations of BA + Kn and BA + IAA. In case of using BAP the highest proliferation rates were obtained at 2 or 2.5 mg/l.

The single-step rooting and acclimation of *Stevia* plantlets obtained *in vitro* was tested by Ciorchină et al., (2000) on two variants of half-strength MS media with different concentrations of NAA and IBA. *Ex vitro* rooting and acclimation was carried out in hydroculture or "float hydroponics" in other horticultural species propagated *in vitro* (Fira et al., 2009; Clapa et al. 2011).

The aim of this research was the elaboration of a technological process for the production of planting material by vegetative propagation in species *Stevia rebaudiana* Bertoni consisting of the folowing technological sequences: *in vitro* multiplication on Murashige & Skoog medium containing very low amounts of growth regulators (0.5 mg/l benzyladenine), *in vitro* rooting on Murashige & Skoog nutritive media without growth regulators and the use of a high number of microcuttings/culture vessel in the *in vitro* rooting phase in order to economize space in the culture vessels and in the growth chamber, the *ex vitro* acclimation in liquid substrate of the *in vitro* – rooted plantlets, making cuttings from the plantlets acclimated in hydroculture (without being planted to soil) and the rooting of these cuttings in float hydroculture and then planting these rooted plants to soil mix in pots and the obtention of container-grown planting material.

## Materials and methods

The plant material originated from *in vitro* cultures initiated at the Botanical Gardens of Chisinau (Derid et al., 1996, Ciorchina et al., 2010).

For *in vitro* multiplicaton and rooting of *Stevia rebaudiana* several experimental series were used (Table 1).

1. In all the experimental variants, modified MS was used as basal medium (Table 1). The culture vessels were 720 ml jars with screw caps and bacteriological filters made of autoclavable plastic sponge. 100 ml medium/ vessel were used. All the components were added before autoclavation. The vessels with nutritive media were sterilized in the autoclave at 121 °C for the agar-gelled media and for 30 minutes for the media gelled with starch.

Table 1

**Experimental variants**

| *Component* | *Concentration* | | | |
|---|---|---|---|---|
| | *Variant 1* | *Variant 2* | *Variant 3* | *Variant 4* |
| MS salts | full | full | full | full |
| Myo-inositol | 100 mg/l | 100 mg/l | 100 mg/l | 100 mg/l |
| Vitamin B1 | 1 mg/l | 1 mg/l | 1 mg/l | 1 mg/l |
| Vitamin B6 | 0.5 mg/l | 0.5 mg/l | 0.5 mg/l | 0.5 mg/l |
| Nicotinic acid | 0.5 mg/l | 0.5 mg/l | 0.5 mg/l | 0.5 mg/l |
| BAP | 0.5 mg/l | 0.5 mg/l | 0.5 mg/l | - |
| Sugar | 30 g/l | 30 g/l | 30 g/l | 30 g/l |
| Plant Agar | 6 g/l | - | - | 6 g/l |
| Wheat starch | - | 75 g/l | - | - |

1. In the first variant the nutritive medium was gelled with agar, the multiplication cycle was of 2 months. 2 cm long shoot fragments were used as explants, containing 3-4 nodes, originating from plant material cultured on media of the same composition. 5 explants/vessel were inoculated.

2. In the second variant agar was replaced with 75 g/l wheat starch as a cheap alternative to the use of agar. The explants were 2-node fragments, 5 inoculi/ 720 ml jar.

3. In the third variant liquid medium was used and, as mechanical support, 7 layers of paper were used (7 paper towels cut as round slices). For this variant, incubation time was of 3 months due to the apparent stagnation of the cultures at the beginning of the culture cycle.

4. For *in vitro* rooting hormone-free MS media were used (the fourth variant). 1-1.5 cm long shoot fragments were used. A variable number of microcuttings were inoculated in the vessels, the maximum possible, in order to establish the rooting percentage in the conditions of using the

space in the culture vessels with maximum efficiency. The culture cycle was of 1.5 months (6 weeks).

In order to calculate multiplication rates, the shoot fragments with 3 nodes resulting from every culture vessel, similar with the initial explants were counted.

The rooted plantlets were acclimated *ex vitro* in hydroculture, in transparent plastic cups, using water as liquid substrate. The water from the cups was changed every time it got brown.

The acclimated plantlets were cut and the cuttings were rooted by the float hydroculture method. The shoots were inserted into standard plastic cell trays for liner cultures, which where equipped with polystyrene floats and set to float in water in improvised small tubs so that about ½ from the basal portion of the bunches of shoots were submerged in the water. For the experiments regarding the rooting of cuttings no fertilizers and no plant growth regulators were used and no oxygenation by bubbling. The water was not changed in the whole period of the rooting experiment. The tubs were resupplied with water only once during the one-month rooting phase because water level decreased.

The acclimated and rooted plantlets were transferred into solid substrate in order to obtain container-grown planting material.

## Results and discussions

The *Stevia* plants proliferated abundantly on the agar-gelled multiplication medium (Figure 1). Robust, branched plantlets resulted, with a large number of shoots/plantlet. The average multiplication rate on the medium gelled with agar was 61,4 times (Figure 2).

Figure 1. *Stevia rebaudiana* on the nutritive medium gelled with agar

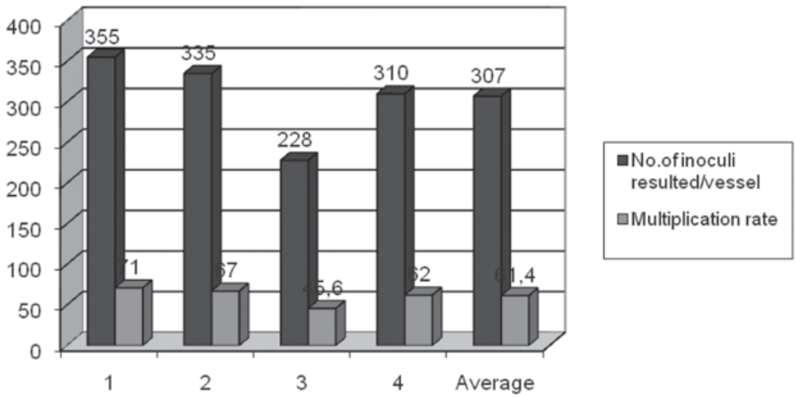



Figure 2. The number of inoculi resulted/vessel and multiplication rates in *Stevia rebaudiana* propagated in vitro on medium gelled with agar

In the experiment regarding the use of starch as gelling agent at the concentration of 75 g/l the multiplication rate was of 47.2 times after the 2 month multiplication cycle (Figure 3b). The amount of starch was later reduced to 50 g/litre of medium without negatively affecting plant development.

In the cultures grown on liquid media there was also abundant shoot growth and proliferation, without intense hyperhydricity (Figure 3a). The average number of microcuttings that resulted/vessel was 494.5 and average multiplication rate was 98.9 (Figure 4).

a b

Figure 3. a) *Stevia rebaudiana* on the liquid multiplication medium with paper as solid support; b) *Stevia rebaudiana* on the multiplication medium gelled with 75 g/l starch

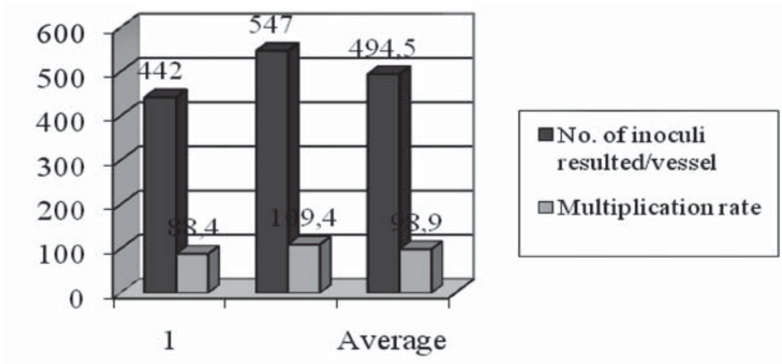



Figure 4. The number of inoculi resulted/vessel and multiplication rates in *Stevia rebaudiana* propagated *in vitro* on the liquid medium

The *in vitro* rooting of *Stevia rebaudiana plantlets* was efficient, the rooting percentage was relatively high, the plants grew spectacularly and branched *in vitro* (Figure 5, Figure 6). The average *in vitro* rooting percentage was 80.6%.

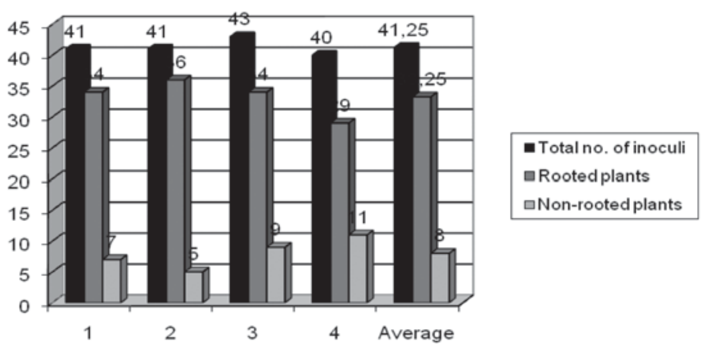



Figure 5. *In vitro* rooting of *Stevia rebaudiana*

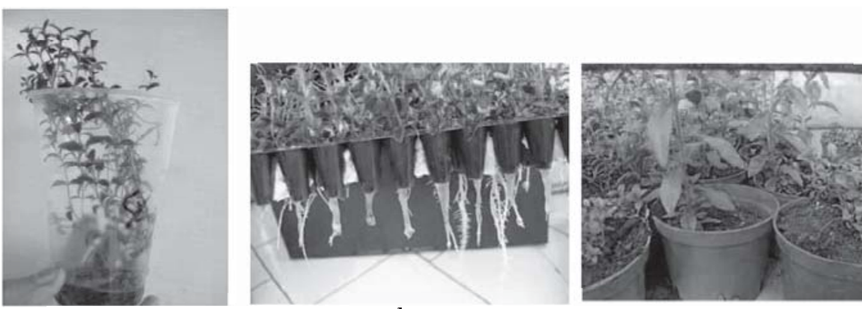
Figure 6. *Stevia* rooted *in vitro* on hormone-free MS medium

The plants rooted on the hormone-free MS medium were acclimated successfully, after one month in culture, by the hydroculture method in plastic cups. At the end of the acclimation phase the plants were well-grown (about 15 cm in height) and branched abundantly, exceeding the height of the cups (Figure 7a).

The shoots from the acclimated plantlets were cut and the resulting cuttings (minimum 4 cm in length) were rooted in float hydroculture in one month, with a rooting percentage of 100% (Figure 7b).

It is a remarkable fact that the plantlets which were obtained *in vitro* but were not rooted could not be rooted and acclimated *ex vitro,* neither in the plastic cups nor in “float hydroponics”. The non-rooted shoots underwent necrosis in a few days in both situations.

The plantlets that were rooted and acclimated (in both variants) were planted into solid substrate, into pots and their survival rate was 100% (Figure 7c).



a b c

Figure 7. a) The ex vitro acclimation in hydroculture of the plantlets rooted in vitro; b) The rooting of cuttings in “float hydroponics”, taken from the plants acclimated in hydroculture; c). Stevia rebaudiana planted into soil mix, in pots

## Conclusions

Species *Stevia rebaudiana* Bertonican be propagated *in vitro*, with excellent effectiveness.

For multiplication, Murashige & Skoog 1962 (MS) medium can be used in combination with the BAP cytokinin at the concentration of 0.5 mg/l and, for rooting, the same basal medium is suitable but without plant growth regulators.

Both Plant Agar and wheat starch proved to be very suitable gelling agents for the *in vitro* culture of this species.

For *ex vitro* acclimation, the shoots must be rooted *in vitro*. The rooted shoots can be acclimated *ex vitro* by the hydroculture method in plastic cups, in water. Rooting is carried out in one month.

From the acclimated plants, cuttings can be taken and rooted, in one month, in float hydroculture, using water as liquid substrate. Rooting rate is 100 % and is finished in about one month.

The plants rooted and acclimated by both methods were transferred in pots with soil mix and container-grown planting material was obtained.

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# THE APPLICATION OF HYDROCULTURE FOR ROOTING CUTTINGS IN SOME HORTICULTURAL SPECIES

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**Summary.** *The greenwood cuttings harvested from various horticultural species were rooted in immersion hydroculture as well as in float hydroculture. The liquid substrate used in the experiments was water, no fertilizers, no plant growth regulators and no other biostimulators were used and aeration by bubbling was not provided. The species in this study were Rosa sp (cv `Red Bells`), Tamarix sp., Cotoneaster sp., Salix babylonica, Chrysanthemum sp, Tradescantia sp, Melothria scabra, Lycopersicon aesculentum and Rubus fruticosus. All the species gave positive results, most of them with rooting percentages of more than 90 %. The rooted cuttings were transplanted to potting mix, where they developed very well.*

## Introduction

Some of the advantages of propagation by cuttings are the fact that the resulting plants are genetically and phenotypically identical to the mother plant; also, by this method some species that generate a low number of seeds are more efficient to propagate and the plants grow faster to sizes suitable for decorative purposes, as compared to the plants obtained from seeds. As compared to propagation by seeds, this propagation method also has a series of disadvantages, as they need a higher amount of space and culture substrate. As rooting substrate, generally, perlite, vermiculite, bark, pumice, sand and peat are used in various proportions, alone or with various growth regulators (A. H. S., 1999: Dirr and Heuser, 2006; Zaharia, 1994). These impediments can be overcome by the use of float hydroculture described in this paper.

In the framework of the In vitro culture Laboratory of the Fruit Research Station Cluj the technology of float hydroponics was modified and extensively used for the ex vitro rooting and the acclimation of some horticultural species, especially thornless blackberry, using water as liquid substrate for rooting (Fira, 2009: Clapa, 2010; Fira, 2010). The same extremely simple technique was successfully tested for the rooting of the cuttings in some important horticultural species.

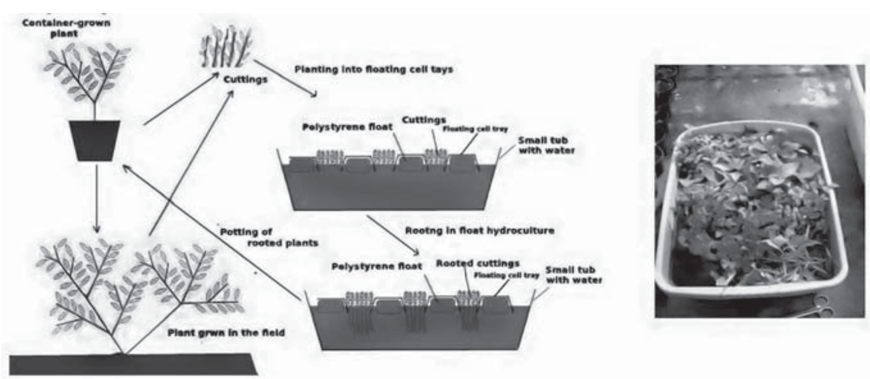
"Float hydroponics" or "float hydroculture" is a simple and efficient hydroponics technology established in the USA and used nowadays for lettuce production on an industrial scale. The floats into which the plants are inserted float on the surface of a complex nutrient solution in special basins (Tyson, 1999; Sheikh, 2006).

## Materials and methods

The species that we studied were *Rosa sp* (cv `Red Bells`), *Tamarix sp*., *Cotoneaster sp*., *Salix babylonica*, *Chrysanthemum sp*, *Tradescantia sp*, *Melothria scabra, Lycopersicon aesculentum* and *Rubus fruticosus.*

The plant material consisted of greenwood cuttings harvested from container-grown plants cultured in the greenhouse, most of them had been propagated in vitro previously (exceptions were *Tamarix sp*., *Cotoneaster sp., Salix babylonica* which were harvested from the field). The cuttings were made in summer. The mini-cucumber (*Melothria scabra*) cuttings had 3-4 nodes. The blackberry cuttings had 2 nodes, the rose cuttings had 3 nodes, the Tamarix cuttings were 3-5 cm in length, the Chrysanthemum cuttings had 4-6 cm. The cultivation period was of one month.

The bunches of cuttings were inserted in standard cell trays (several cuttings/cell) of the types used normally in horticulture for starting liner cultures from seeds or cuttings. The cell trays were equipped with polystyrene floats and placed on the surface of the water in small plastic tubs in such a way that the cuttings were immersed in the water in the tubs on a portion of about 1/2 from the base (Figure 1).




a b

Figure 1. a) A scheme representing rooting in float hydroculture;
b). Cuttings being rooted in float hydroculture

For the experiments regarding the roting of cuttings no fertilizers, growth regulators or other biostimulators were used and aeration by bubbling was not provided. The water in the tubs was not replaced during the whole period of the experiments and the tubs were refilled only once a month because water level decreased.

Alternatively, for rooting, hydroculture in immersion was also used; in this case the cell trays were not equipped with polystyrene floats but they were immersed in plastic trays containing a layer of water with the thickness of 1-1.5 cm. In this case, rooting was carried out in open air.

## Results and discussions

### Rooting in float hydroculture in the greenhouse

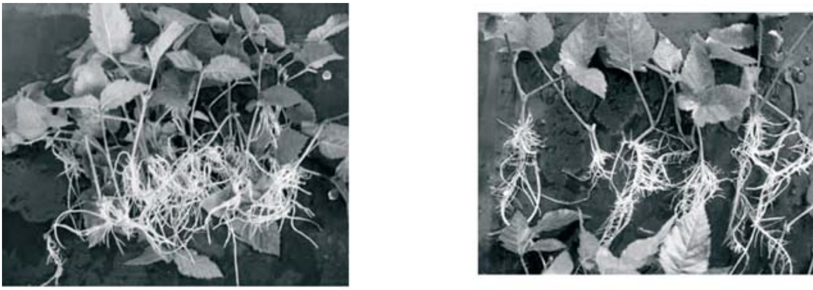
The rooting of blackberry cuttings in float hydroculture was finished in four weeks. 66% of the single-node cuttings rooted well, 17% rooted poorly and 17% did not root. The two-node cuttings rooted well in the proportion of 77%, 9% rooted poorly and 14% did not root (Figure 2).


a b

Figure 2. a) The rooting percentages in blackberry, single-node cuttings; b) the rooting percentages in blackberry, two-node cuttings

In rose cv. ‘Red Bells’, from the total of 120 3-node cuttings 97 rooted well, 10 rooted poorly and 3 did not root. Rooting percentage was over 90% (Figure 3b).

In Chrysanthemum 100% of the cuttings rooted and a large number of roots/plant were obtained, the average number of roots obtained/plant was 12. Most of the cuttings had more than 10 roots and the maximum number of roots/plant was 17 (Figure 3c).



a

b

c

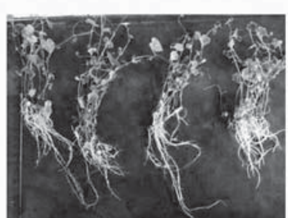
Figure 3. Cuttings rooted in float hydroculture: a) blackberry; b). rose c) *Chrysanthemum*

The rooting rate of *Tradescantia* cuttings was also 100%, the length and number of roots was small, the average number of roots/plant was 3.77 (Figure 4a).

In the Mexican mini-cucumber (*Melothria scabra*) 100% rooting rate was obtained. The roots regenerated from the last bazal node (Figure 4b).

The tomato cuttings also rooted in 100%. The roots were very long and vigorous (Figure 4c).

a



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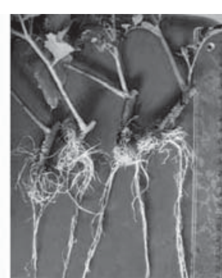
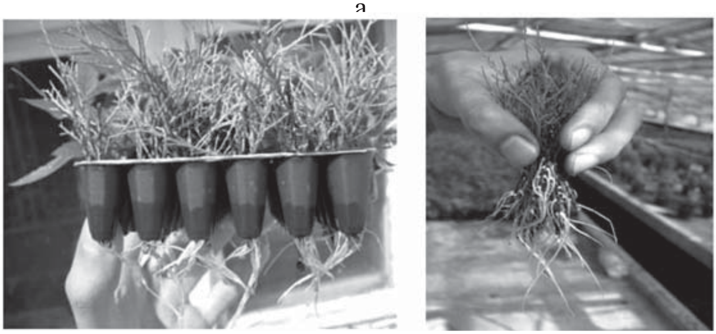


c

Figure 4. Cuttings rooted in float hydroculture: a) *Tradescantia*; b). Mexican mini-cucumber c) Tomato

*Salix babylonica* and *Tamarix sp*. Also rooted with 100 % eficiency and the roots were very vigorous and long (Figure 5).

a



b

Figure 5. Cuttings rooted in float hydroculture in the greenhouse: a) willow; b). *Tamarix*

**Rooting in float hydroculture in open air**

The rooting rate of *Cotoneaster* in float hydroculture in open air was 95.5%. From the total number of 43 cuttings 41 got rooted and 2 did not root. In this species, a remarkable characteristic was root length (Figure 6). The roots were extremely vigorous (Figure 7).

The tomato cuttings also rooted with 100% rooting rate, like in the float hydroculture experiment in the greenhouse.

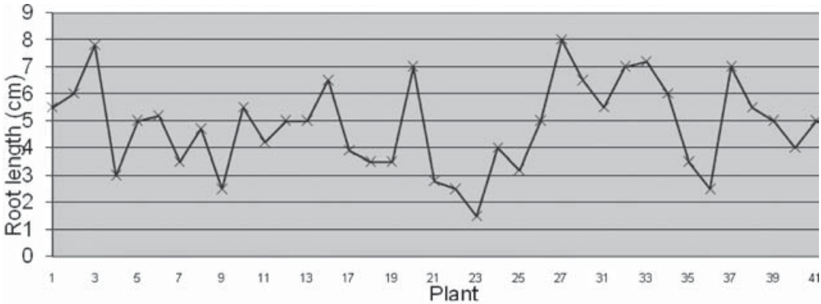



Figure 6. Root lengths in *Cotoneaster* cuttings

**Rooting in immersion hydroculture in open air**

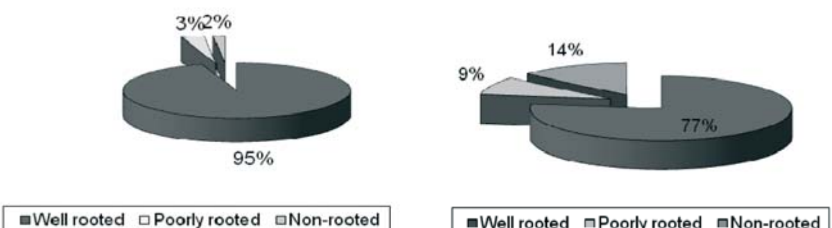
The rooting of rose cuttings, cv. 'Red Bells' in open air was carried out with good results, from the total of 61 cuttings 58 rooted well, resulting plants suitable for being planted into pots, two rooted poorly and one did not root (Figure 8a).

The rooting of blackberry cuttings, the thorny elite in open air gave mediocre results, from the total number of 48 cuttings 35 rooted well, 5 rooted poorly, 7 underwent necrosis and 1 did not root (Figure 8b).

The rooting rate of the 29 *Tamarix* cuttings was 100%.

a b

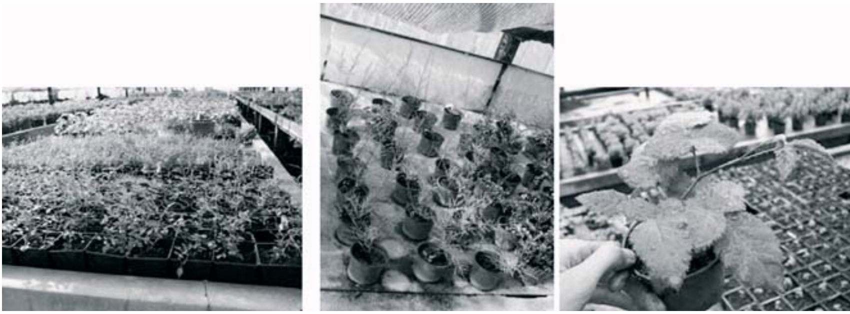
Figure 7. *Cotoneaster sp., a)* cuttings rooted in float hydroculture *b)* container-grown planting material




a b

Figure. 8 a) Rooting percentages in rose in open air; b) Rooting percentages in the blackberry in open air

The cuttings rooted in all three variants were transplanted to pots, they developed very well and container-grown planting material was obtained (Figure 9).



a b c

Figure 9. Container-grown planting material obtained from cuttings rooted in float hydroculture: a) rose, b) tamarix, c) blackberry

## Conclusions

The rooting of greenwood cuttings in float hydroculture or immersion hydroculture can be carried out efficiently in a high number of horticultural species that root easily.

It is recommended that the greenwood cuttings should be 5-7 cm in length, with minimum 2-3 nodes (minimum 2 nodes in the blackberry and tomato and minimum 3 in the rose cuttings).

This method is easy, cheap and efficient and saves space, materials and manpower.

In a small tub with the edges measuring 34X37 cm a cell tray can be inserted, with the edges of 26X27 cm in length, containing 56 cells, each cell with 3 cm long edges, 448 cuttings can be planted for rooting, respectively 8 cuttings/cell.

Float hydoculture can be used for rooting cuttings of some species even in open air, such eliminating the need for greenhouses or tunnels.

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# FLOWER TRAITS VARIABILITY OF DATE PLUM (*DIOSPYROS LOTUS* L.) GENOTYPES GROWN IN SLOVAKIA FROM SEEDS

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**Summary.** *This work aimed at the variability determination of date plum (Diospyros lotus L.) male and female flowers. In the experimental collection were included genotypes of date plum grown from seeds in Arboretum Mlynany (Slovakia). During the bloom stage flowers were withdrawn from the tested genotypes. The male and female fowers were evaluated separately. Morphological traits determination was based on image analysis. rom these analyses resulted data for the male/female flowers as follows: number of sepals 3-5/3-7, sepal height 1.97/5.45 (mm), sepal width 2.13/4.98 (mm), crown height 6.00/6.47 (mm), crown diameter 4.21/5.33 (mm), number of crown sepals 2-6/3-7, number of stamens in the 1st row of male flowers 6-9/7-9 and number of stamens in the 2nd row of male flowers 6-9/0. In the evaluation process dealing with the tested traits dependences has been found a partial agreement among the correlation coefficients of the male and female flowers only in the cases of calyx sepals height and crown height (0.476 – 0.481), calyx sepals height and stamen length in the 1st row (0.137 – 0.152) and crown height and stamen length in the 1st row (0.360 – 0.301), respectively. The rest of traits the when compared bilaterally, exerted different values of correlation coefficients. It means, that the dependencies between the male and female flowers*

*are variable. For male flowers between the calyx sepals height (mm) and the crown diameter (-0.285) as well as between the crown height (mm) and crown diameter (-0.400) were statistically detected significant negative correlations.*

## Introduction

Natural copses of date plum (*Diospyros lotus* L.) are widely occurring in Japan, China, India and Iran. In cultural form this species is spread in Korea, Pakistan, Afghanistan, Turkey, Albania, Spain, France and Poland (Kuliyeva, 1962). Date plum is a typical dioecious tree with deciduous leaves. In natural conditions these trees achieve the height up to 5 m (Ayaz and Kadioglu, 1999). Date plum fruits are of globular form with a diameter around 8-16 mm (Brezhnev and Korovina, 1981). Generally interesting by this species is the biology of blooming and the flowers morphological structure. There are joined together 1-3 staminate flowers, pedicel lenght is up to 6 mm, number of calyx lobes 4 or 5, corolla is reddish to pale yellow, urceolate, ca. 4 mm; number of corolla lobes 4 and stamens 16. Pistillate flowers are subsessile, pale green to reddish; they have 4 calyx lobes, corolla urceolate, ca. 6 mm, corolla lobes 4 or rarely 5, staminodes 8, ovary 8-locular, glabrous except for apex, styles 4. Fruiting calyx lobes 4, ovate, apex obtuse. Berry pale yellow, becoming bluish black with a glaucous bloom, subglobose to ellipsoid, 1-2 cm in diameter. Seeds are brown, compressed, approximately 10 × 6 mm in diameter (Shu-kang *et al*., 1996).

Female flowers subsessile, solitary on short, pubescent, bracteate pedicels 2-3 mm. long; calyces green, 7-8 mm. long, densely rufous-pubescent on the adaxial surface of the calyx tube, accrescent in fruit and sometimes persistent on the branchlets, the 4 or 5 lobes foliaceous, 6-7 mm. long at anthesis; corolla reddish-brown, broadly urceolate, ca. 5 mm. long, the lobes 2-3 mm. long, ± recurved; staminodia 8, curved over the surface of the ovary, pubescent with long, silvery hairs; ovary ± globose, glabrous or pubescent at apex, the 4 (or 5) styles glabrous or finely pubescent, connate basally (Spongberg, 1977).

Male flowers produced on the current year's growth, held ± nodding beneath the leaves. Staminate flowers 6-7 mm. Long at anthesis, short-pedicellate, 3-5 together (or fewer through abortion) in rufous-pubescent, short-pedunculate, the bracts caducous; calyces green, finely pubescent, the 4 (or 5) deltoid lobes 1.5-2 mm. long; corolla 4.5-6 mm. long, white, ± campanulate and weakly 4- (or 5-) ribbed, the lobes pinkish or yellowish, recurved, ca. 2 mm, long; stamens 16, rarely fewer, epipetalcus in 2 whorls, the largest stamens ca. 4 mm. long; gynoecia abortive or rudimentary (Spongberg, 1977).

## Materials and methods

In the experiments was studied the male and female flowers variability of date plum (*Diospyros lotus* L.). In the tested collection were included genotypes of date plum grown from seeds in Arboretum Mlynany of the Slovak Republic. As all genotypes were cultivated from the seeds in one locality, the tested collection of trees was perfectly adapted on the local conditions. In the blossom-time were from the genotypes withdrawn samples of flowers and then determined their morphological traits – number of calyx petals, height and width of calyx petals (in mm), height and width of crown (mm), height and width of crown petals (mm), number of crown petals, number of stamens in the 1st/2nd rows, length of stamens in the 1st/2nd rows. To evaluate the determined morphological traits, the image analysis was applied using the software AxioVs40 V 4.8.2.0.

## Results and discussions

Plant populations cultivated from seeds are well adapted on different conditions including that of Botanical gardens in Slovakia (Grygorieva *et al*., 2009). The gained data and those reported in literature are signalling, that the date plum owing to its biological, nutritional and phytotherapeutic value of fruits and ather plant parts is a suitable species to be used in Slovakia as well, and therefore were made the experiments described in this paper.Four acids: palmitic acid (16:0), palmitoleic acid (16:1), linoleic acid (18:2), and linolenic acid (18:3) were identified as the major acids in significant amounts (P = 0.05) during development.

Ripe fruits of date plum are consumed in fresh state, sometimes sprinkled with lemon juice. These fruits are widely exploited for preparation of salads, cakes, marmalades, syrups, jams and distilled spirits (Kremer, 1995). In some countries are given as feed to utility animals (Holdeman, 1998). In China medicine the date plum is traditionally applied due to neuro-protective effect of this fruit to patients suffering apoplexy (Bei *et al*., 2007). Loizzo *et al*., 2009 studied their extract and their antioxidant and antiproliferative properties. antioxidative and antiproliferative effects. Eight compounds were isolated from D. In extracts from fruit were determined the gallic and elagic acids,lotus and identified as gallic acid, methylgallate, ellagic acid, kaempferol, quercetin, myricetin, myricetin 3-O - β -glucuronide, and myricetin-3- O - α -rhamnoside. D caempferol, quercetin, myricetin and other important biologically active components. Azadbakhta *et al*. (2010) experimentally proved the hypo-glycemic activity in water extract of date plum fruits. Around with the fruits are the date plum flowers interesting as well from the view of their economic exploitation.

To gain more complex data, we have taken into account both, the male and female flower traits (Table 1). From the morphometric analyses resulted the following outcomes: number of sepals 3.91/4.34, sepal height 1.97/5.45 (mm), sepal width 2.13/4.98 (mm), crown height 6.00/6.47 (mm), crown diameter 4.21/5.33 (mm), number of crown sepals 4.17/4.05, number of stamens in the 1st/2nd row of male flowers 7,91/7,42, length of stamens in the 1st/2nd row of male flowers 3.36/2.79 (mm).

Table 1

**Variability of tested traits in the collection of date plum (*Diospyros lotus* L.) seedlings grown up in the Slovakia**

| *Tested flower traits* | *Male flowers* | | | | | *Female flowers* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | *min* | *max* | *x* | *V%* | *n* | *min* | *max* | *x* | *V%* |
| Calyx sepals height(mm) | 66 | 1.23 | 2.96 | 1.97 | 49.83 | 74 | 2.35 | 8 | 5.45 | 25.45 |
| Calyx sepals width (mm) | 66 | 1.32 | 3 | 2.13 | 16.59 | 74 | 3.29 | 7.42 | 4.98 | 21.55 |
| Calyx sepals number | 66 | 3 | 5 | 3.91 | 10.71 | 74 | 3 | 7 | 4.34 | 20.09 |
| Crown height (mm) | 66 | 4.44 | 8.16 | 6.00 | 18.05 | 74 | 4.21 | 8.26 | 6.47 | 14.55 |
| Crown diameter (mm) | 66 | 3.66 | 4.98 | 4.21 | 7.15 | 74 | 3.73 | 8.51 | 5.33 | 17.30 |
| Number of crown sepals | 66 | 2 | 6 | 4.17 | 17.65 | 74 | 3 | 7 | 4.05 | 13.47 |
| Stamen numbers in the 1$^{st}$ row | 66 | 6 | 9 | 7.91 | 6.55 | 74 | 7 | 9 | 7.84 | 5.98 |
| Stamen numbers in the 2$^{nd}$ row | 66 | 7 | 9 | 7.42 | 7.11 | - | - | - | - | - |
| Stamen length in the 1$^{st}$ row (mm) | 66 | 2.08 | 4.06 | 3.36 | 8.98 | - | - | - | - | - |
| Stamen length in the 2$^{nd}$ row (mm) | 66 | 1.83 | 3.68 | 2.79 | 14.25 | - | - | - | - | - |

There were found significant differences between the tested genotypes in amount of outgrowing male buds (Figure 1), number of crown sepals in the female (Figure 2) and male flowers (Figure 3). Significant differences were detected in the shapes of calyx and crown of female (Figure 4) and male flowers (Figure 5).

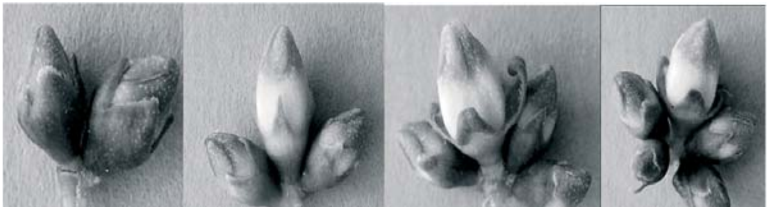

Figure 1. Number of buds growing in male inflorescences of date plum (*Diospyros lotus* L.) genotypes cultivated from the seeds. Photo: Olga Grygorieva, 2010

Comparison of our results with those in literature (Spongberg, 1977; Shu-kang *et al.*, 1996) showed for several traits striking differences. These discrepancies could be primarily connected with testing different genotypes collections.

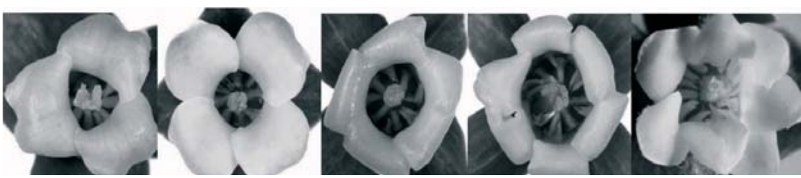

Figure 2. Number of sepals in female flowers of date plum (*Diospyros lotus* L.) genotypes cultivated from the seeds. Photo: Olga Grygorieva, 2010

Figure 3. Number of sepals of male flowers of date plum (*Diospyros lotus* L.) genotypes cultivated from the seeds. Photo: Olga Grygorieva, 2010

Figure 4. Comparison of the female flower calyces and crowns of date plum (*Diospyros lotus* L.) genotypes cultivated from the seeds. Photo: Olga Grygorieva, 2010

Figure 5. Comparison of the male flower calyces and crowns of date plum (*Diospyros lotus* L.) genotypes cultivated from the seeds. Photo: Olga Grygorieva, 2010

Among the tested traits has been described high positive dependency as documented by the correlation analysis results in Table 2.

In the evaluation process dealing with the tested traits dependences has been found a partial agreement among the correlation coefficients of the male and female flowers only in the cases of calyx sepals height and crown height (0.476 – 0.481), calyx sepals height and stamen length in the 1$^{st}$ row (0.137 – 0.152) and crown height and stamen length in the 1$^{st}$ row (0.360 – 0.301), respectively. The rest of traits the when compared bilaterally, exerted different values of correlation coefficients. It means, that the dependencies between the male and female flowers are variable. For male flowers between the calyx sepals height (mm) and the crown diameter (-0.285) as well as between the crown height (mm) and crown diameter (-0.400) were statistically detected significant negative correlations.

## Conclusions

From the study of morphological traits variability of date plum (*Diospyros lotus* L.) flowers resulted the following knowledge:

a) For all tested male and female flowers traits was confirmed a high variability degree.

b) In the genotypes population grown up in Slovakia from the seeds were detected significant genotypic differences for all evaluated traits.

c) Date plum (*Diospyros lotus* L.) could be declared for an economically usable species in several branches for food and feed production as well as for pharmaceutical purposes.

d) Further possibilities of date plum exploitation: as ornamental tree species with motley flower colours, and an additional nectar and pollen source for the pollinators.

## Acknowledgments

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Table 2

**Linear dependency correlation coefficients of evaluated flower traits of date plum (*Diospyros lotus* L.)**

| Male flowers | | | | Female flowers | | | |
|---|---|---|---|---|---|---|---|
| **r** | **Interval of confindence $r_{95\%}$** | **t** | **Probability of t (p)** | **r** | **Interval of confindence $r_{95\%}$** | **t** | **Probability of t (p)** |
| **Calyx sepals height (mm) x Calyx sepals width (mm)** | | | | | | | |
| -0.060 | -0.2980<= r >= 0.1844 | 0.48 | 0.6305 | 0.494 | 0.2995<= r >= 0.6493 | 4.82 | 0.0000 |
| **Calyx sepals height (mm) x Crown height (mm)** | | | | | | | |
| 0.427 | 0.2070<= r >= 0.6068 | 3.78 | 0.0003 | 0.481 | 0.2845<= r >= 0.6398 | 4.66 | 0.0000 |
| **Calyx sepals height (mm) x Crown diameter (mm)** | | | | | | | |
| -0.284 | -0.4927<= r >= -0.0457 | 2.37 | 0.0206 | 0.495 | 0.3004<= r >= 0.6500 | 4.83 | 0.0000 |
| **Calyx sepals height (mm) x Stamen length in the 1st row (mm)** | | | | | | | |
| 0.137 | -0.1080<= r >= 0.3674 | 1.11 | 0.2706 | 0.152 | -0.0784<= r >= 0.3685 | 1.31 | 0.1935 |
| **Calyx sepals width (mm) x Crown height (mm)** | | | | | | | |
| -0.175 | -0.4007<= r >= 0.0693 | 1.42 | 0.1582 | 0.339 | 0.1203<= r >= 0.5271 | 3.06 | 0.0031 |
| **Calyx sepals width (mm) x Crown diameter (mm)** | | | | | | | |
| 0.476 | 0.2652<= r >= 0.6444 | 4.33 | 0.0001 | 0.794 | 0.6916<= r >= 0.8658 | 11.10 | -0.0000 |
| **Calyx sepals width (mm) x Stamen length in the 1st row (mm)** | | | | | | | |
| -0.101 | -0.3352<= r >= 0.1442 | 0.81 | 0.4181 | 0.264 | 0.0387<= r >= 0.4652 | 2.33 | 0.0226 |
| **Crown height (mm) x Crown diameter (mm)** | | | | | | | |
| -0.400 | -0.5855<= r >= -0.1751 | 3.49 | 0.0009 | 0.319 | 0.0986<= r >= 0.5110 | 2.86 | 0.0055 |
| **Crown height (mm) x Stamen length in the 1st row (mm)** | | | | | | | |
| 0.360 | 0.1294<= r >= 0.5539 | 3.08 | 0.0030 | 0.301 | 0.0786<= r >= 0.4960 | 2.68 | 0.0090 |
| **Crown diameter (mm) x Stamen length in the 1st row (mm)** | | | | | | | |
| -0.096 | -0.3304<= r >= 0.1495 | 0.77 | 0.4430 | 0.301 | 0.0781<= r >= 0.4956 | 2.68 | 0.0091 |

# PALE-PURPLE CONEFLOWER (ECHINACEA PALLIDA (NUTT.) NUTT) IN UKRAINE: PARTICULARITIES OF BIOLOGY, GROWING AND QUALITY OF RAW MATERIAL

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**Summary.** *This paper considered the features of biology, growth and quality of raw material Pale-Purple Coneflower in Ukraine. The results of a study of first selection variety pale-purple coneflower "Krasunya preriy" (Prairie's Beauty) derived by breeding selection are analyzed in article. Data on investigation results of the morphological features of pale-purple coneflower are discussed. It has been established that growth activity was not rather high during the first year of vegetation. It is pointed out that mass flowering begins in May of the second year of vegetation and lasts from early spring to the late autumn, that it is very important for the organization of nectar obtained. The fact that in raw material of pale-purple coneflower containing of hydrooxycinnamon acids (on chicory acid) slightly less in comparison with raw material of purple coneflower is stressed.*

Lately Pale-Purple Coneflower (Echinacea pallida (Nutt.) Nutt) has enjoyed wide popularity according to its unique medicinal qualities. From nine species only three have been introduced into the crop: Purple Coneflower (Echinacea purpurea (L.) Moench), Narrow Leaved Purple Coneflower (Echinacea angustifolia DC.) and Pale-Purple Coneflower (Echinacea pallida (Nutt.) Nutt). It should be noticed that biology and technology of purple coneflower cultivation are studied better, two other species are on the whole confused and this does not give objective characteristics for their introduction and usage. That was the reason for studying of pale-purple coneflower in the condition of Ukraine. Our researches were begun in 1991 by the means of mobilization of population-specific diversity of pale-purple coneflower both from the places of its area and outside one [1,2,6,7].

Carried out morphological, anatomical, histological analyses allowed to emphasis on more interesting and typical patterns, especially patterns received from a number of firms in Germany.

Cytological analysis of chromosomal numbers of indices showed that in somatic cells of plants there was tetraploid arrangement of chromosomes (2n = 44). The population was formed by means of individual selection of the best species on the base of which the first in Ukraine variety of pale-purple coneflower "Krasunya preriy" (Prairie's Beauty) was brought fourth by us. Under the studying of biology of this variety it has been established that growth activity was not rather high during the first year of vegetation.

They are in cotyledons on the average for 7-9 days. After that (on the 25th-32nd day after seedlings) the first real leaf appears. But the root system develops very slowly for 60 days. All this does not provide competitiveness of pale-purple coneflower before weeds. Beginning from July significant acceleration of growth is observed that goes on until the end of vegetation. For this period pulpy vertically-thicken rhizome is being formed. The diameter is two times thicker and average length is 28-29 cm. It promotes the increase of plant drought-resistance, the whole number of ecological, social and economical advantages bound up with result of digging out, washing and drying of raw materials. For the first year the flowering of solitary plants is only when autumn is damp and warm. Mass flowering begins in May of the second year of vegetation when every unbranched shoot forms one inflorescence Flowering lasts on the average 76-80 days, begins early spring from to the late autumn and it is very important for the organization of nectar obtained for beekeeping [3,5,7].

Pale-purple coneflower differs good fruit setting. On the average to 275 achenes are formed on one plants with mass of 1000 pieces varying from 3,49 to 8,22g. Indices of laboratory germination and energy of sprouting accordingly vary from 3, 5 to 60% and 8-68%, it testifies about necessity of presowing stratification of seeds and treatment for the field germination increasing. Plants of the second year of vegetation have the increase of root system mass by root growing in the diameter. The beginning of bud setting begins in September. The third year of vegetation is more intense growth of aboveground mass. Plants have maximal sprout height and their quantity to 11 pieces a specimen [3,4].

On substance quantity of phenol origin (at the analyses of UV-spectrum) raw material of pale-purple coneflower yield to in raw material from purple coneflower especially on contain in rhizomes with roots and leaves, differences in inflorescence and stems are not very significant. There is less containing of hydrooxycinnamon acids (on chicory acid) in raw material of pale-purple coneflower in comparison with raw material of purple coneflower. Heightened quantity of given combination typically for inflorescence and rhizomes with roots and lowed quantity are for leaves and stems [3].

On the studying particularities the technology of cultivation of pale-purple coneflower by the means of direct sowing into open ground for the receiving of maximal yields of raw material of high quality is worked out.

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# MORPHOLOGICAL CHARACTERISTICS OF POLLEN *BETULA VERRUCOSA* EHRH. (SYN. *B. PENDULA*) DEPENDING ON HABITAT


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**Summary.** *As a result of carrying out by means of scanning electronic microscopy of the comparative analysis of morphological traits of two samples of pollen Betula verrucosa Ehrh. from different habitats, it is revealed reliable distinctions between length of a polar axis, equatorial diameter and the area of*

*apoporial field. The length of the polar axis of the samples of dry pollen grains from Kiev defined from 16.49 to 22.26 µm and from the samples of dry pollen grains from Ivankov from 16.88 to 22.51 µm. The length of the equatorial diameter from 18.95 to 26.96 µm and from 20.95 to 28.08 µm accordingly.*

## Introduction

For last century the ecological situation all over the world has appreciable worsened and, moreover, does not improve. Pollution of an atmosphere and hydrosphere anthropogenic industrial wastes, emissions of every possible types of transport, influence of the radiation factor on all alive, electromagnetic influence, genetically modified products, pathogenic bacteria and viruses – that in any way it is impossible to name favorable for a life not only the person, but also the animal and vegetative worlds. According to the World Health Organization, 40% of diseases all over the world are caused by ecological factors of a physical, chemical and biological origin. In result the person is ill or his organism cannot resist even to insignificant negative influences any more, animals die out, plants disappear or change the properties [Kyoto protocol, 1998; Ilkyn, 1971; Yablokov, 2002; Yagodkina, 2009].

Allergic diseases are known to the people more than two thousand years, but only for last decades the problem of an allergy has accepted scale of a global medical-social problem. Now allergic diseases on the prevalence take the third place after cardiovascular and oncological, and in some ecologically adverse regions come out on top [Fedoskova, 2004]. The numerous epidemiological researches, spent for different regions of the world, convincingly show increase in prevalence of a pollen allergy both among adults and children. Pollinosis suffer to 39% of the population of a planet [Shamgunova, 2010]. But pollen of plants in itself cannot be the direct reason of pollinosis [Shichzhen, 2010]. The reason is presence of allergens. One of the first places among wood plants which cause pollinosis, belongs to a silver birch (*Betula verrucosa* Ehrh.). The tree has a wide circulation: Europe, except for Iberian Peninsula, Northern Africa, Forward and the Central Asia, also introduced everywhere in a zone of a temperate climate. Its young leaves, not revealed buds, birch sap and even pollen [Mironenko, 2002] possess curative properties. During the period with 1997 for 2007 year it has been published 335 scientific works devoted to studying of birch pollen [Hilaire, 2007]. By researches it is shown, that buds of a *Betula verrucosa* Ehrh. keep the medical properties, growing in different, on a level of influence of negative factors of an environment, regions [Garkava et al., 2010]. But birch pollen on the contrary – changes properties under influence of factors of an environment. First of all the form and density of pollen grains change during their stay in an atmosphere [Hilaire, 2007]. Having got in an atmosphere, pollen settles on a surface after precipitation. Then pollen tubes start to sprout and burst, releasing tiny particles with allergens [El-Ghazaly et al., 1999]. Or water-soluble allergens can be washed up also from untouched settled pollen grains, and then to rise in air [Schappi, 1997]. Taking into account that a birch is wind pollinated tree and from one inflorescence is on the average allocated 10, 044000 pollen grains in the size 10-25 μm [Piotrowska, 2008; Blackmore, 2003]; its pollen contains about 40 proteins, 6 from which possess properties of allergens [Kalinina, 2007], then on the one hand birch pollen has the reason to be allergic. And on the other hand, pollen of a birch is not «full» allergen. The main allergen of a birch, so-called Bet v 1, glycoprotein – a protein-polysaccharide complex which acts as signal substance for germination of pollen on stigma a pestle and probably renders protection against pathogenic microorganisms [Emilson et al., 1996, El-Ghazaly et al., 1999]. And only getting on mucous membranes of a nose, an eye of the person birch pollen turns on strong allergen as the human body perceives it as object carrying alien.

In references the morphological description of pollen *Betula verrucosa* Ehrh. is resulted [Erdtman, 1943; Kupriyanova, 1972; Blackmore, 2003]. Pollen grains are monad; pollen class: small (10-25 μm), isopolar; shape: spheroidal; equatorial outline: circular. P/E ratio: suboblate to oblate. Aperture type: 3-porate, annulate, operculate, oncus. Ectoaperture – pore more or less circular to slightly elliptic, margins smooth and distinct, with a distinct aspis. Nexine and sexine separated to form a distinct, dome-shaped vestibulum. Endoaperture – pore of similar diameter to the ectopore. Aspides distinctly protruding. Exine: Thin – 0.8-1.4 μm. Sexine up to three times as thick as nexine. Sexine 1 of short columellae which are not usually visible under LM. Sexine 2 a the tectum, twice as thick as sexine 1. Sexine 3 of scabrae on ridges (SEM, or just visible with oil immersion). Ornamentation: granulate, rugulate. In LM psilate, scabrate in SEM. Scabrae short and conical, on short, irregularly arranged micro-rugulate ridges. The ridges may be more or less distinctly defined. Columellae circular, often in irregular, short rows which correspond with the ridges. Tectum: eutectate; cell no.: 2-celled. Additional info: LM: psilate, unknown; pollen wall: columellate; footlayer continuous; endexine absent; intine standard; chemical components: primexine matrix absent, pollenkitt absent, tryphine absent, pollen coating vesicles absent, lipids absent, polysaccharide vesicles absent, starch present; Ubisch bodies: present. Dry pollen: shape: irregular; outline: irregular; infoldings: irregularly infolded; annotations: tectum very mighty. Dry pollen infoldings irregular infolded but only interapertural areas sunken. Color of grains are yellowish. As if to the size of pollen grains of a birch in references cited the diverse and incomplete data: 24.3 μ [Jentys-Szaferowa, 1928]; 21.8 μ [Welten, 1944]; 22.1 μ [Eneroth, 1951]; 25.1 μ [Koperowa and Srodon, 1965]; 20-22 μm [Sofiev, 2007]; 21.34 μm x 18.17 μm [Piotrowska, 2008].

With the purpose of revealing changes in pollen of a birch under influence of ecological factors it has been carried out a comparative estimation of morphological traits of pollen grains *Betula verrucosa* Ehrh. from different places of growth.

## Materials and methods

Pollen of a *Betula verrucosa* Ehrh. has been prepared prior to the beginning of anthesis during the period from April, 18 till April, 24, 2011 in Kiev region territory. For research 2 samples of birch pollen have been selected from the Kiev region, namely: 1. Kiev (pollen is collected from the birches growing in a park zone); 2. utc. Ivankov the Kiev region, concerning to III Chernobyl zone according to definition of a belonging of territory as such the Ministry of Ukraine on questions of extreme situations and on affairs of protection of the population from consequences of Chernobyl accident [Ministerstvo…, 2008] also is on distance of 80 km to a southwest from Kiev (pollen is collected from the birches growing near highways and apartment houses). These regions have been chosen in view of their different latitude of a site, a different radiating background and different anthropogenic loading. Also differences will consist in date of preparation of catkins of a birch and as result of a degree of their maturity (Fig. 1). Maturity defined on color of birch catkins, and also on a degree of blooming of leaves: more mature catkins have greenish-yellow, then light yellow painting and was much longer (70 mm, a maximum of 100 mm agree Piotrowska, 2008).

For researches used preliminary dried up pollen. Morphological traits of pollen grains were measured. Scanning electronic microscope ZEISS EVO LS 15 was used for research of morphological traits. A thin layer of pollen grains were placed on an objective little table of a microscope on special sticky basis. Morphological traits were measured and estimated for 40 pollen grains (i.e. on 20 for each sample). For measurements used license program AxioVs40 V 4.8.2.0 (Carl Zeiss, Jena, Germany). Polar axis (P – the straight line between the distal and proximal poles of a pollen grain), length equatorial axis (E – pollen width, the distance between the poles in equatorial part of pollen), length of an apoporial field edge of pollen grains, angel arrangements of apertures to a contour of a pollen grain, internal diameter of apertures were measured.

Figure 1. Maturity of catkins of *Betula verrucosa* Ehrh.
(Photo: T. Shevtsova 2011)

Great volume of sample suffices at measurement of pollen grains for each kind has been accepted equal 60, paid off on sample with the greatest factor of a variation at confidential probability q=0.99 and relative discrepancy $\varepsilon$ no more than 5% [Urbach, 1963]. An estimation of reliability of distinctions between average values and dispersions samples carried out accordingly by t-test and f-test, at 3% a significance value. At the analysis of the data also used nested ANOVA. Results were processed in system STATISTICA 6.1.

**Results and discussions**

The above-stated parameters of pollen grains *Betula verrucosa* Ehrh. have been measured. Results are shown in table 1. In Figure 2 it is submitted photos of birch pollen.

Apparently from Table 1 the most part of traits, namely, the length of a polar axis both equatorial diameter, the area of apoporial field and an angel of an arrangement of apertures of pollen grains, reliable differ among themselves with a significance value 0.05. These results are well illustrated on Box & Whisker Plots (Fig. 3).

Table 1

**Variability of morphological traits of pollen grains of *Betula verrucosa* Ehrh., (µm)**

| *Sample* | *n* | *min* | *max* | *x* | *σ* | *V %* | *t* | *Paldat (2003)* | *Polleninfo* | *Покровская И.М. (1950)* |
|---|---|---|---|---|---|---|---|---|---|---|
| Length of the polar axis (P) | | | | | | | | | | |
| Kiev | 60 | 16.49 | 22.26 | 18.87 | 1.34 | 7.08 | $2.31^{+}$ | 17.0-(19.5)-24.0 | 21.0-(22.6)-25.0 | No data |
| Ivankov | 60 | 16.88 | 22.51 | 19.48 | 1.56 | 8.02 | | | | |
| Length of the equatorial diameter (E) | | | | | | | | | | |
| Kiev | 60 | 18.95 | 26.96 | 23.26 | 1.92 | 8.25 | $2.86^{++}$ | 22.0-(24.5)-28.0 | 22.0-(24.0)-25.0 | 15.0-(19.6)-21.0 |
| Ivankov | 60 | 20.95 | 28.08 | 23.98 | 1.66 | 6.94 | | | | |
| Length of an apoporial field edge | | | | | | | | | | |
| Kiev | 60 | 22.62 | 31.05 | 26.42 | 1.92 | 7.28 | $2.22^{+}$ | No data | No data | No data |
| Ivankov | 60 | 22.58 | 32.71 | 27.40 | 1.83 | 6.68 | | | | |
| Angel arrangements of apertures | | | | | | | | | | |
| Kiev | 60 | 83.80 | 125.85 | 105.40 | 7.61 | 7.22 | $3.23^{++}$ | No data | No data | No data |
| Ivankov | 60 | 86.55 | 115.23 | 101.13 | 6.86 | 6.78 | | | | |
| Length of the internal diameter of apertures | | | | | | | | | | |
| Kiev | 60 | 2.06 | 4.27 | 3.26 | 0.44 | 13.37 | 0.51 | No data | No data | No data |
| Ivankov | 60 | 2.53 | 3.89 | 3.25 | 0.33 | 10.19 | | | | |

*n – number of measurements; min – the minimal value; max – the maximal value; x – arithmetic mean of sample; σ – standard deviation; V – coefficient of variation (%); t – t-test; *P < 0.05; **P < 0.01.*

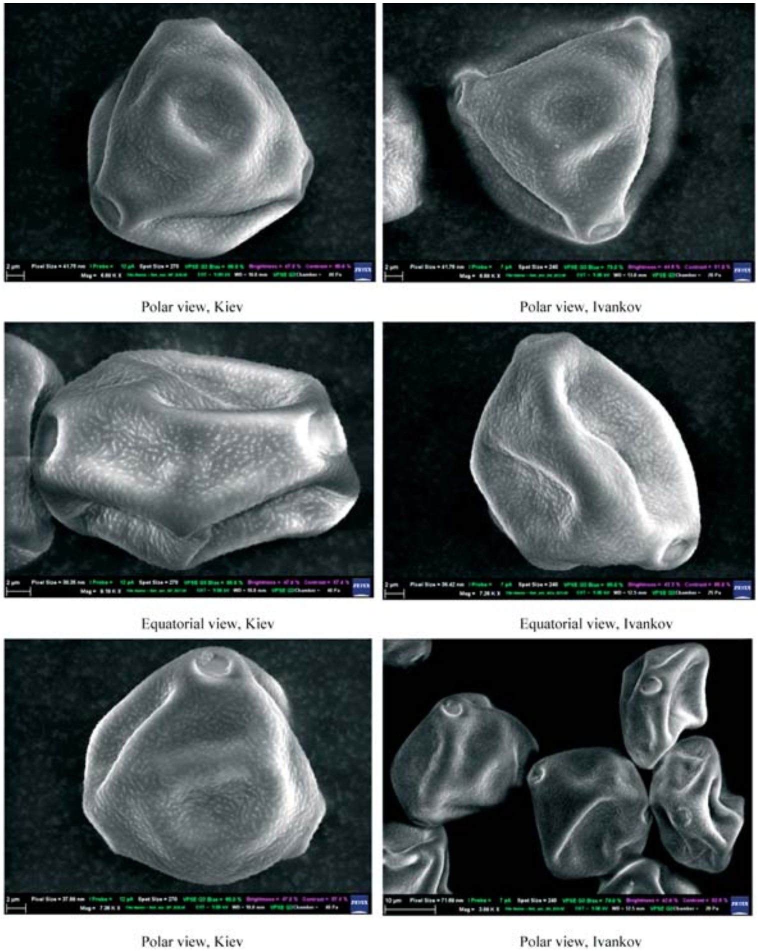
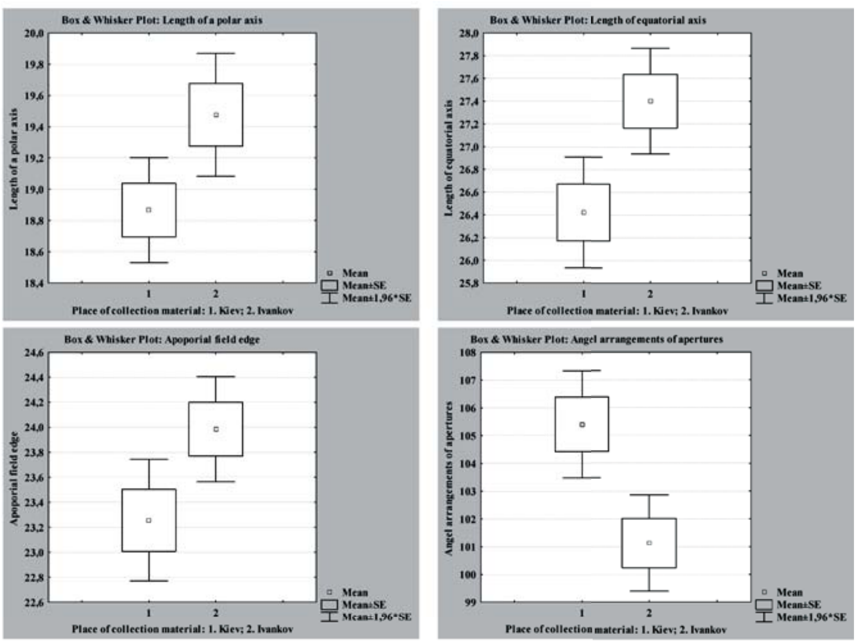



Figure 2 Comparison of morphological traits samples of *Betula verrucosa* Ehrh. pollen grains: (Photo: R. Ostrovsky, T. Shevtsova 2011)

The received data do not contradict the literary data. The analysis of the received data has shown, that length of a polar axis both equatorial diameter and the area of apoporial field of pollen grains *Betula verrucosa* Ehrh. which have been collected in Ivankov, is reliable more, than the pollen collected in Kiev. A place of gathering utc. Ivankov there is to the north, rather than Kiev on 29′ N. However gathering of catkins in Ivankov passed for 6 days later, than in Kiev, that for the general period of active flowering a birch (5-10 days) is a significant difference in date of gathering. Besides the level of anthropogenic loading in Ivankov is much lower, than in Kiev, that also matters. As if to radiating influence its action on morphology of pollen of a birch is not revealed by us.

The received results give the basis to speak what to study a plant, in our case pollen, at a level of a species is insufficiently. It is necessary to do it at least on a population of species. The nature has taken care of a variety of all alive. This variety is shown and in geographical conditions of growth of a plant, and in various climatic factors, and in a degree of influence of the human factor. Under the theory of chaos there are no two identical objects in the universe. Therefore there are no two identical pollen grains from the same stamen.



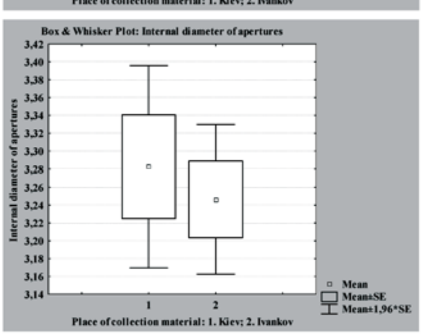




Figure 3. Box & Whisker Plot for each morphological traits of birch pollen

## Conclusions

Thus, morphometrical parameters of pollen grains *Betula verrucosa* Ehrh. from two places of growth have been investigated by us. Work has been focused on the comparative analysis of morphological traits and characteristics of conditions of research objects growth. It is revealed, that a main role on influence on morphology of pollen and change of its properties two factors have played: anthropogenic loading of a place of growth of objects of research and date of gathering of a material. Both of these factors have come to light more favorable in Ivankov. Reliable distinctions between values of morphological traits are confirmed statistically.

In the subsequent researches it is necessary to study the same characteristics for pollen of a birch from other habitats. Revealing of reliable distinctions of one kind in territory of one region or the neighboring regions, will enable to make more a substantiated conclusion about variability of birch pollen under influence of adverse factors.


## Acknowledgment

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# BIOLOGY FLOWERING AND MORPHOLOGICAL SPECIFIC FEATURES OF *WITHANIA SOMNIFERA*

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**Summary.** *Withania somnifera is an annual plant in Republic of Moldova. Flowering the plant depends on climatic conditions. Flowers are small, actinomorphic with radial symmetry. There are 3200-4000 pollen/anther and 16250-20000 pollen/flower. Each ovary contains 26-32 ovules. In the Republic of Moldova Withania somnifera flowers open between the hours of 5.30-9.00.*

## Introduction

Studying biology introducent flowering herbs light pours from several factors talking about success or failure of plant introduction. On *Withania somnifera* least known flowering and reproductive biology. It is one of the herbs used in India as it holds a position of importance similar to ginseng in China [1]. In India *Withania somnifera* act as perennial bloom 2 times a year from August to November and February-March. In Republic of Moldova behaves as an annual plant blooms once a year and the second decade of June to August. Both in India and the Republic of Moldova as flowering according to climatic conditions. Following investigations on flowering in *Withania somifera* found that in India during the summer when the temperature is above $35^0$ C and relative humidity 40% flowers open between 9.00-11.00 am, while in winter when the temperature is below $28^0$C and relative humidity of 60% flowers open between 3.30-05.00 am [2, 7].

In Moldova, average summer temperatures ranging between $25^0$C and $30^0$C, and humidity between 55% -75%. Under these conditions the flowers open between 5.30-9.00 am.

## Materials and methods

Research on the biology of flowering were made in 2009-2011. Following investigations on the plant during the vegetation was found that vegetative phase lasts until mid-June after starting generative phase. Fructification and seed maturation through while flowering.

For phenological observations were labeled 10 plants at different stages of flowering. The dynamics of flowering inflorescence was monitored as labeling her the first day of inflorescence opening first flowers by removing the last flowers open each day until the last flower of inflorescence. Dynamics flowering was investigated seasonal and for 24 hours. Flowering was studied independently from each flower, to blossom special and all flowers plant.

## Results and discussions

Flower buds begin to appear in mid-June. Flowers are small, actinomorphic with radial symmetry. They are placed at armpit shoots each 5-12. The flowers are greenish yellow. Flowers bloom in succession (Figure 1). Usually, the first group of 1-2 flowers blooming flowers. This is due to weather conditions. Flowers are small (0.4 to 0.6 cm), actinomorphic, pentamerous, hermaphrodite. At first develops calix consists of 5 sepals (from 0.4 to 0.5 cm) which are joined later started remaining united at the base to near the middle of sepals. Sepals increase the size of

Figure. 1. Flower appearance in *Withania somnifera*

the fruit that eventually covers. The day begins opening petals that are also five in number. They grow faster than the sepals [2]. Each flower has five stamens attached to the base of corolla tube. Tetrasporangiate anthers are elongated, which is a introse and dehisce through longitudinal. The pollen grains are slightly sticky, tricolporate with reticulate exine sculpturing. Pollen have size of 42 ± 2 μk. They consist of two cells, at the time of stadding.

Stamens are of two types: long (as pistil) and short (shorter than the pistil). Flowers with long stamens are more than those with short stamens. The ratio of long and short stamens varies according to climatic conditions. In India the number of flowers with long stamens is greater in summer, while winter usually have flowers with short stamens. In Moldova flowers with long stamens and those with short stamens grow on the same plant. The ratio of flowers with stamens stamens long and short is 4:1. The flowers with long stamens self-pollination occurs while the plants with short stamens often occurs cross-pollination or pollination by insects (bees or ants). The flowers with long stamens, pistil length and even touch it pollinate. Flower remains open two days after the petals and stamens and sepals fall cover already pollinated pistils. This formation occurs after pollination fruits [6, 8].

The fruit is covered with red berries vesicular bags coming from the calyx, which grew around the fruit. Seeds are yellow, small, with a characteristic odor.

Pistils consists of a wet, capitate and papillose stigma, 0,4 cm long straight and solid style and superior ovare (0,1-0,2 cm). The ovary is bilocular with a large number of ovules that are arranged on the axile of the placentation.

Nectariferous glands are located on the inner surface of the basal part of corolla and ovary. There are a number of trichomes, locate the filament also secrete a certain amount of nectar. Trichomes present on the outer surface of calyx and corolla. Nectarines flowers attract insects from the surface [4, 5].

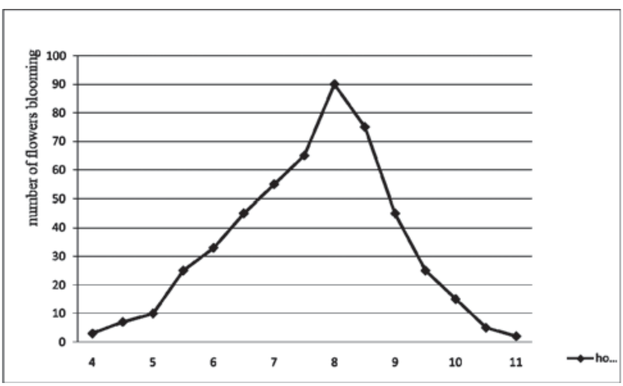


Figure 2. Dynamic flowering plant *Withania somnifera* for 24 hours

Following investigations on the biology of Cruden from *Withania somnif*era bloom was observed that one of 3200-4000 pollen/anther and pollen per flower 16250-20000. Each ovary of the flower contains 26-32 ovules. The ratio of pollen and ovules is 625:1. *Withania somnifera* is known to not all pollen is viable. In India maximum pollen fertility of 96% was observed in October-November and February - March. Lowest pollen fertility was observed in the months May to June, 65%. In our maximum pollen fertility was observed in July. Pollination by insects takes place mornings 9.00-12.00 hours. Bees are a flower between 15-25 seconds [3].

Piece of *Withania somnifera* remains two days. After pollination androceum blossom petals fall and already pollinated pistils and sepals cover.

Biology bloom from *Withania somnifera* is composed of:

- Start training button.
- Start and blossom.
- Extend the flowering inflorescences.
- Seasonal dynamics of flowering and 24 hours.

Main flowering biology investigations were performed according to methodology of Пономарев (1960).

Inflorescence flowering dynamics was investigated from the first day of the first flowers bloom on a plant until the last flowering inflorescences on the same plant.

Seasonal dynamics has been studied since the first and until the last day of flowering. Dynamics of 24 hours was investigated during mass flowering.

The investigation results are presented in figures 2 and 3.

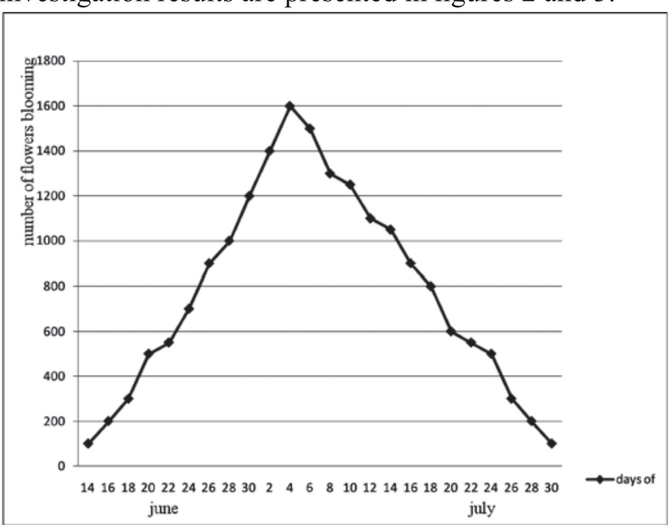


Figure. 3. Seasonal dynamics of the Withania somnifera flowering in 2011

The dynamics of 24 hours was observed that maximum flowering of flowers is at 8.00 am. Starting at 10.30 am dynamic opening flowers decreases rapidly (Figure 2).

Seasonal dynamics is different each year. For flowering necessary environmental conditions, namely temperature and humidity. Following investigations in 2009 found that maximum flowering is in August (14) - 1300 flowers on a plant. Maximum flowering plants - 1800 in 2010 were observed at 22 to 24 July. Conditions of 2010 were favorable for plant growth and development. In 2011 maximum was flowering in early July (4) with a total of 1600 flowers bloom on a plant (Figure 3).

In the Republic of Moldova plant *Withania somnifera* contains 2892 ± 700 flowers on a plant. All flowers are fertile. From each flower develops a fruit each.

## Conclusions

1. In the Republic of Moldova *Withania somnifera* flowers open between the hours of 5.30-9.00.
2. Florists bud formation begins in mid-June.
3. The plant is self-pollination but may also occur with insect pollination. Bees visit flowers between 9.00-12.00 hours.
4. Maximum peak of flowering for 24 hours is between 8.00-8.30 am.
5. Seasonal dynamics for 2011 show that maximum flowering was in early July (4) with a number of flowers in 1600.

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# COMPARATIVE ANATOMY OF THE LEAF PETIOLE AT THE DISTANT HYBRIDS $F_1$ - $F_2$ CYDONIA X MALUS

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**Summary.** *In the article the structural peculiarities of the leaf petiole at 13 intergenric hybrids Cydonia x Malus was described. After the petiole structure the hybrids into three groups was classified: triploid quince type, triploid apple type, intermediate type, diploid and tetraploid combining anatomical characters of both parental forms.*

## Introduction

The hybrids $F_1$ and $F_2$ obtained between quince and apple (*Cydonia* x *Malus*) [6] combines differently the structural peculiarities of vegetative and generative organs of genitors [2, 4, 5]. The purpose of the paper is concluded in researching the morpho-anatomical structure of petiole leaf at diploid and tetraploid hybrids of quince x apple $F_1$-$F_2$, comparative with the parental forms and of the other *Cydolus* descendants (offspring) of $F_1$ and $F_2$. In the argument that this leaf petiole anatomical structure is considered more conservative compared with other vegetative organs, in anatomical studies on the systematic and diagnostic criteria are used as distinctive.

## Materials and methods

For obtaining comparative results of morpho-anatomical structure of petiole, leaves were used as biological material of 12 diploid intergeneric (2n = 2x = 34, 4-74, no. 1, no. 25), triploid (2n = 3x = 51, 2-69, 4-72, 7 - 72, 1-69, 13-72, 18-72), tetraploid distant hybrids (2n = 4x = 68, no. 25, 33-72, 1-72) of apple x quince, apple (sort Djonatan) and quince (sort Turunciuc). Under study was taken the median part of leaf petiole, at the end of July, from the middle of petiole and also from the middle of tree crown, being the main conservative part of vegetative organ (petiole) [8]. Microanatomic preparations were prepared and investigated by Furst [7] and Nikitin, Pankova [3]. Comparative anatomy of the leaf petiole was analyzed on living and preserved in material fixator FAA (formalin, acetic acid, ethyl alcohol).

## Results and discussions

Researches has been focused on the structure of the leaf petiole of genitors, offspring $F_1$ and $F_2$, comparing the structure of the leaf stems of these plants with that of the diploid and tetraploid hybrids the quince x apple $F_1$-$F_2$. Hybrid plant leaf petiole reach 19-22 mm in length, which more resembles to the male plant leaf petiole length. In the structure of the leaf petiole at both parents and the $F_1$ and $F_2$ hybrids reveals the following tissues: epidermis, collenchyma, fundamental parenchyma, sclerenchyma and conducting fascicles consisting from phloem cells and xylem. On the outside of petiole, in transversal section shall be distinguished epidermal cells and fundamental parenchyma cells inside with the cells from inferior and superior epidermis colenchymatic as lamellar.

Studied hybrids, as distinct from of hybrids triploid $F_2$ - $F_1$ and genitors, differ in certain anatomical characters quantitative and qualitative. One group of hybrids is characterized by anatomical structure of petiole leaf similar to that of paternal form (trough-shaped of transversal section). In general, diploid hybrid plants are characterized by slower growth, especially of the leaves. Hybrid forms 4-74 is notable from other hybrid plants and the genitors by the thickness of the petiole leaf both in the radial direction, and tangential direction and is with 25-31% lower than the radial thickness of the apple and quince petiole and with 23 to 27% less than the tangential thickness of that organ to the genitors. The thickness of petiole leaf petiole in radial direction of leaf petiole from tetraploid and triploid hybrid plants is higher by 12-40% and with 5-30% higher in tangential direction than those anatomical characters in apple and quince. After other leaf petiole anatomical characters (thickness of the xylem, phloem, conducting fascicles), another group of hybrids occupies an intermediate position between the parental forms. From the percentage terms, the xylem from leaf petiole at apple occupies 18%, at diploid - 21%, to tetraploid 20%, at quince - 27%, the hybrids of quince type - 25%, while the hybrids as apple type - 17.5% (Figure 1).

The same peculiarity can be observed at the percentage content of all tissues in the leaf petiole of *Cydolus* distant hybrids. The triploid and tetraploid hybrids are characterized by a greater thickness of tissue in the colenchymatic in adaxial part of the petiole, registering 21-84% than the same tissue in apple, explaining by the phenomenon of heterosis. In the structure of that vegetative organ are distinguished properties both of female organism and male too.

Analyzing the data from Table 1 we can established that after some anatomical characters of leaf petiole (thickness of the xylem, conducting fascicle, the number of radial rays in xylem) these hybrids occupies an intermediary place between the genitors, and after the majority anatomical parameters of this vegetative organ prevails the characters quantitatively leaf petiole at other parental plants *Cydolus* and genitors.

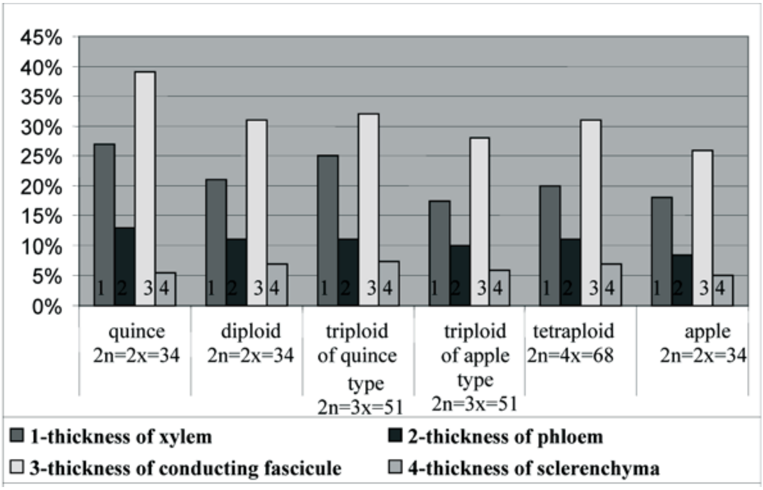


Figure 1. Percentage content of the leaf petiole tissues in distant hybrids F1, F2, apple x quince (Cydonia x Malus) and parental forms

In conclusion we can confirm that studied hybrids are some heterozygous plants, with a complicated genotype, consisting from a genome of a quince and one apple too, in the case of the diploid, and by two genomes if tetraploid.

Table 1

**Anatomical quantitative characteristics of leaf petiole at distant hybrids apple x quince $F_2$ and at parental forms**

| *Anatomical characters* | *Hybrids and parental forms* | | | | | |
|---|---|---|---|---|---|---|
| | *Quince 2n=2x=34* | *nr. 1 2n=2x=34* | *2-69 2n=3x=51* | *18-72 2n=3x=51* | *1-72 2n=4x=68* | *Apple 2n=2x=34* |
| Thickness of petiole in radial direction, µm | 1972 ± 0.9 | 1970 ± 5,3 | 2485 ± 0,6 | 2121 ± 0,4 | 2503 ± 1,1 | 1785 ± 1,1 |
| Thickness of petiole in tangential direction, µm | 1986 ± 0.6 | 1846 ± 5,2 | 2446 ± 0,2 | 2076 ± 0,5 | 2572 ± 1,2 | 1880 ±1,3 |
| Thickness of xylem, µm | 528 ± 0.3 | 366 ± 0,8 | 428 ± 0,2 | 476 ± 0,2 | 455 ± 0,4 | 316 ±0,3 |
| Thickness of phloem, µm | 233 ± 0.2 | 151 ± 0,1 | 256 ± 0,4 | 203 ± 0,2 | 205 ± 0,4 | 151 ± 0,4 |
| Thickness of conducting fascicle, µm | 761 ± 0.2 | 517 ± 0,3 | 683 ± 0,5 | 669 ± 0,3 | 660 ± 0,4 | 465 ±0,4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Thickness of sclerenchyma, μm | 108 ± 0.2 | 153 ± 0,4 | 135 ± 0,3 | 159 ± 0,2 | 135 ± 0,4 | 92 ±0,2 |
| Thickness of adaxial collenchyma, μm | 158 ± 0.4 | 161 ± 0,2 | 239 ± 0,2 | 216 ± 0,2 | 208 ± 0,3 | 130 ± 0,3 |
| Thickness of abaxial collenchyma, μm | 125 ± 0.2 | 154 ± 0,3 | 151 ± 0,2 | 179 ± 0,2 | 187 ± 0,6 | 113 ±0,2 |
| Dimension of angle circle conducting system (in degrees) | 224 ± 0.7 | 263 ± 0,9 | 258 ± 0,3 | 239 ± 0,7 | 240 ± 1,1 | 271 ±1,0 |
| Thickness of adaxial, parenchyma, μm | 483 ± 0.3 | 379 ± 0,2 | 499 ± 0,8 | 470 ± 0,2 | 450 ± 0,8 | 283 ± 0,9 |
| Thickness of abaxial, parenchyma, μm | 266 ± 0.3 | 440 ± 0,3 | 683 ± 0,4 | 377 ± 0,2 | 683 ± 0,4 | 585 ± 0,6 |
| Number of the radial rays in xylem, unit. | 52 ± 0.9 | 70 ± 0,8 | 71 ± 1,2 | 60 ± 0,9 | 69 ± 1,1 | 72 ± 1,1 |

Following such specific characters of petiole, as they are: thickness of conducting tissue, dimension of 239-263° of the angle of a circle, presence or absence of additional conducting fascicle, well expressed prominences in adaxial parts of leaf petiole and other quantitative and qualitative characters, the hybrids shall occupies an intermediate position within the parental forms, as distinct from other hybrids *Cydolus*, after the majority of the petiole leaf anatomical parameters, similar to the maternal plant (quince) or paternal plant (apple) [2, 10].

The study complex anatomical-comparative of leaf petiole at polyploid hybrids allows us to establish the distinctive and common peculiarities in this group of hybrids, in comparison with plants of other groups and genitors.

## Conclusions

1. The morpho-anatomical peculiarities of the structure leaf petiole at diploid and tetraploid hybrids $F_2$ apple x quince were established. The intergeneric hybrids combine the characteristics of morpho-anatomical structure of leaf petiole of both specific genitors, but the preponderance belongs to maternal plant (quince).

2. The hybrid forms are different from other hybrid plants by the qualitative and quantitative characters: the dimension of the circle of angle of tissue conducting, absence of additional conducting fascicles, weak expressed the prominences in adaxial part of petiole.

3. In the basis of petiole structure we can conclude that the heterozygous

plants have a complicated genotype, consisting of two genomes: one apple and one quince. Diploid and tetraploid hybrids inherited, intermediately, leaf petiole structural characters, because they were merged in equal proportion the gametes or reduced unreduced of genitors.

4. The particularities of the anatomy structure of the leaf petiole at intergeneric distant hybrids serve as additional criteria in systematic and diagnostic type of hybridity *Cydolus* population of new plants that can be used later in fruit plant breeding.

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## ANATOMICAL CONSIDERATIONS ON ANNUAL SHOOTS ON SOME CULTIVAR HYBRIDS OF ROSA L.

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**Summary.** *Our observations include a comparative study of stem and leaves anatomy during anthesis phase. The differences concern the number of conducting bundles from stem, their disposition on a perfect circular shape (as most of them),*

*tortuous (as 'Rose Gaujard', 'Independence'– some bundles are completely detached from the central cylinder) or in a spiral shape with some fascicles completely detached from the central cylinder (as 'Laminuette', 'Luchian,' Radiance').*

## Introduction

Cultivated roses are interspecific hybrids, introgresive with polyphyletic and heterogeneous origin. Species which led to creation of cultivars hybrids roses are better studied from anatomic point of view. Information about hybrids is scattered [Parmentier P., 1897; Napp-Zinn K., 1973-1984; Fahn A., 1978; Toma C. et al., 1997; Irina Toma and Toma C., 2005]. In this context, based on a large collection, we investigated the evolution of anatomical characteristics of annual shoot from some horticultural varieties belonging to different groups with different habitus [T. Cairns et al., 2000; Lidia Adumitresei and Irina Stănescu, 2009].

Varieties were chosen so as to follow their main genetic evolution. Thus, we studied a remontant hybrid ('President Briand'), some tea hybrids ('La France', 'Radiance', 'M-me A. Meilland', 'Rose Gaujard' and 'Pristine' – their list is ordered by the time when they were certified), some varieties which have more R. chinensis "blood", some floribunda which are equally closer both to R. chinensis and R. gallica through tea hybrids and to R. multiflora through poliante ('Coup de Foudre', 'Independence', 'Foc de Tabără', 'Laminuette', 'Luchian') and 2-poliantes, closer more to R. multiflora ('Cocktail', 'Perla d'Alcanada') [Ostaciuc I., 1994].

## Materials and methods

The investigated material belongs to collection from Botanical Garden "Anastasie Fătu" from Iaşi. It were been investigated 15 varieties, as following: 'Baby Chateau' (Fl, Kordes, 1936), 'Cocktail' (Po., Meilland, 1957), 'Coup de Foudre' (Fl, Hemeray-Aubert , 1956), 'Foc de Tabără' (Fl, Wagner, 1970), 'Independence' (Fl, Kordes, 1950), 'La France' (Theog., Guillot et Fils, 1867), 'Laminuette' (Fl. Lammerts, 1969), 'Luchian' (F.R. Palocsay & Ş. Wagner, 1972), 'M-me A. Meilland' (Th. Meilland, 1945), 'Paprika' (F.M. Tantan, 1958), 'Perla d'Alcanada' (Min P. Dot, 1944), 'Président Briand' (H.P.C. Mallerin, 1929), 'Pristine' (Th. William A. Warnier (J & C.P.), 1978), 'Radiance' (Th.J. W. Cook & P. Henderson, 1908), 'Rose Gaujard' (Th. Gaujard, 1957).

Fixing samples were realized in ethanol 70% and preserved until the sectioning. Samples sections were made with handling microtome using botanical razor. Their colouring were been made using iodine green and carmine alaunate or iodine green and ruthenium red based on classical method from histo-anatomical studies of plants. For 'Luchian' and

‘Radiance’ cultivar hybrids, the colouring was made with fast green and safranin and they were fixed using Canada balsam. Sections were fixed with glycerogelatin.

Sections were made on following levels: top of shoot (the middle part of stem, under vegetative cone), for leaves (through petiole at the stipella level, through rachis, on middle zone, through petiolule on the first pair of leaflets, through limb, at the median nervure between secondary nervures). Also, it was been realized some superficial sections used for epidermis description.

Microphotographs of anatomical sections were made with Olympus Microscope and a BH-2 JAPAN camera. In some cases, most of them were made with Olympus BX 50 Microscope and a digital camera Olympus E 330.

## Results and discussions

The stem has a circular cross-section contour, in most of investigated cases (as ‘Baby Chateau’, ‘Independence’, ‘Mme A. Meilland’, ‘Coup de Foudre’). The contour could be circular- irregular, modified by prickles sometimes (as ‘Laminuette’ and ‘Foc de Tabără’), or elliptical (as ‘Rose Gaujard’).

At some taxa appear *tector hairs and secretory glands*. Tector hairs appear only at juvenile stages for some cultivar hybrids. Secretory glands are present at the cultivar hybrids (‘Laminuette’, ‘Pristine’, rarely at ‘Cocktail’ and they have always multicellular pedicel and it is pluriseriate which consisting of 4-6 or sometimes even 8 cell series). The secretory glands have a terminal clavate part which is composed by polygonal cells with cellulosic walls; their number is variable, but always in the tens of cells.

In all cases, epidermal cells are covered by *cuticle*. This can be: very thick (‘Rose Gaujard’, ‘M-me A. Meilland’, ‘Coup de Foudre’), very thick with intercellular cuticle blades (very deeply inside for ‘Baby Chateau’ or superficial for ‘Cocktail’, ‘Laminuette’, ‘Independence’), thick (‘Foc de Tabără’, ‘Luchian’, ‘President Briand’, ‘Pristine’), relatively thin (‘Pristine’, ‘La France’).

As shown, most cultivar hybrids were taken the genetic heritage of some more resistant species, with very thick cuticle, with or without intercellular cuticle blades.

Epiderm cells are either izodiametric (as ‘Laminuette’) or tangentially elongated (the ‘Foc de Tabără’, ‘Perla d’Alcanada’). A particular case is rectangular cells from ‘Pristine’. Concerning to *epidermal cells size*, this is usually constant, excepting the prickle area where epidermal cells are slightly radial elongated. From all taxa, it was distinguished ‘Foc de Tabără’, which has epidermal cells with different sizes and ‘Luchian’ which has epidermal cells smaller than other species and cultivar hybrids. External wall of epidermal cells is thicker than walls of other taxa. External walls are very thick for ‘M-me A. Meilland’, ‘Laminuette’, ‘Cocktail’ and ‘La France’.

Stomata are situated either on level of epidermal cells at most of cultivar hybrids or slightly above the level of epidermal cells (as ‘Laminuette’, ‘Foc de Tabără’ and ‘M-me A. Meilland’). Substomata chamber can be reduced as most of cultivar hybrids, with a medium size (as ‘Foc de Tabără’ and ‘M-me A. Meilland’) or with a very large size (as ‘Laminuette’).

*Prickles* are always present stem surface in variable numbers, more frequently (as ‘Foc de Tabără’, ‘Luchian’, ‘Paprika’ and ‘Baby Chateau’). They have different size and forms, which are correlated with the size and shapes of prickles central cells: narrow prickles (from ‘Cocktail’, ‘Pearl d’Alcanada’) all cells are strongly elongated with very thick walls, at wide prickles (‘Baby Chateau’, ‘Coup de Foudre’, ‘Foc de Tabără’, ‘La France’, ‘M-me Meilland’ and ‘Rose Gaujard’) are present cells with less thickened walls than those from marginal layers. Cells shape changes during on prickle contour, and it could have different forms, from circular to highly radial elongated.

The older it gets, the prickles become sclerified and lignified, they become tougher, and epiderm is exfoliated on their flanks.

On the basic surface, it can be form a pluristratified suberous secondary tissue, which will facilitate their detaching from stem.

Primary cortex is differentiated in an external colenchymatic area and an internal area of cortical parenchyma by meatic type.

*Hypodermic colenchyma* is by tangential type and it is presented either as a continuous area, but with different thickness (at ‘Laminuette’, ‘Foc de Tabără’) or as a colenchyma islands (larger or smaller) separated by some assimilating parenchyma islands (as ‘Baby Chateau’, ‘Cocktail’, ‘M-me A. Meilland’, ‘Independence’ and ‘Rose Gaujard’).

Number of cell layers that is included in colenchyma structure is variable depending on taxa, but it is well represented in most of cases. Most of taxa have colenchyma composed by 4-6 cell layers from those all 12-15 cell layers of cortex thickness. A thin colenchyma presents ‘Rose Gaujard’ cultivar hybrid, which has in turn a sclerenchyma very well developed. It stands out among all taxa, ‘Pristine’ cultivar hybrid which has a cortex differentiated in 3 subzones: tangentially colenchyma under epiderm, typically assimilation parenchyma in the middle, colenchymatous moderate parenchyma moderate which is inner colourless with much larger and tangentially elongated cells.

Internal area of cortical parenchyma by meatic type is composed by cells whose sizes growing from under epiderm up to the central cylinder. At the most of taxa, cells are isodiametrical, but there are also cases where only internal cells are visible elongated (as ‘Foc de Tabără’).

Cortex thickness depending from taxon, it is thin at ‘President Briand’ and very thick at ‘Coup de Foudre’, ‘Pristine’ and ‘La France’ cultivar hybrids.

*Central cylinder* consists of a variable number of libero-ligneous conducting fascicles, by open-collateral type with a circular arrangement, and marrow. Usually, central cylinder is relatively thick, on the upper limit is situated ‘Independence’, ‘M-me A. Meilland’ and ‘Pristine ‘ cultivar hybrids.

*Number* of conducting fascicles is variable but constant for each taxon: many (35-40) for ‘M-me A. Meilland’, ‘Cocktail’, and ‘Independence’; relatively few (25-30) at ‘Foc de Tabără’, ‘Baby Chateau’, ‘Rose Gaujard’ and ‘Laminuette’. The cultivar hybrids present limited variations more restrictive than species (for example, 25-35 comparatively with 20-60); although, in most of cases, the stem thickness is greater at cultivar hybrids.

Conducting fascicles are arranged in a perfect circle (as ‘Baby Chateau’, ‘Foc de Tabără’, ‘Cocktail’ and ‘M-me A. Meilland’), or it can be a tortuous circle (as ‘Rose Gaujard’) or a winding circle with some bundles detached from the central cylinder and completely stuck in cortical parenchyma (as ‘Independence’). Finally, conducting fascicles have different locations, some of them protrude in cortical parenchyma, others are overlapping, and others are completely detached from the central cylinder (as ‘Laminuette’, ‘Luchian’ and ‘Radiance’).

Generally, fascicles size can be different for the same taxon, but, rarely, they can be approximately equal as those of the ‘Cocktail’ cultivar hybrid.

A genuine *endodermoid* situated at the periphery of libero-ligneous fascicles were been identified at ‘La France’ and ‘President Briand’ cultivar hybrids.

Concerning to the structure of conducting fascicles from annual shoot, we evidenced following cases for investigated taxa: with primary structure in the third medium zone (as ‘La France’, ‘Perla d’Alcanada’ and

‘Pristine’), transition to the secondary structure made longer for the shoot basis, at the most analyzed cultivar hybrids cambium generates less liber through outward and more wood through inward.

The secondary wood vessels position is sometimes ordered in radial and parallel rows (as ‘Independence’), in other cases it is irregular inside of libriform mass (as ‘Baby Chateau’, ‘Foc de Tabără’, ‘M-me A. Meilland’, ‘Rose Gaujard’, ‘Cocktail’, ‘President Briand’ and ‘Pristine’).

The amount of libriform from secondary wood as follows: abundant (at ‘Baby Chateau’, ‘President Briand’, ‘Pristine’) and reduced (at ‘Independence’ and ‘M-me A. Meilland’).

*Medullary rays* are relatively thin, often uniseriate (at ‘Pristine’, ‘Rose Gaujard’), very thin and with some fascicles which form a continuous ring inside of wood, because here marrow rays are slightly sclerified and lignified (as ‘Cocktail’, ‘Baby Chateau’, ‘Coup de Foudre’). In most of cases, medullary rays are composed by 2-3 cell rows: medullary rays wider than are at ‘President Briand’, ‘Foc de Tabără’ and at some other cultivar hybrids with untypical structure (‘Laminuette’, ‘Luchian’, ‘Radiance’ and *R. chinensis*).

Regarding to the nature of cell walls from medullary rays composition: at liber level, they are parenchymatic-cellulose, and the wood level they are moderately sclerified and lignified (as ‘Independence’, ‘Rose Gaujard’); in some taxa, cell walls of medullary ray from the wood are slightly lignified and sclerified (as ‘Coup de Foudre’, ‘Cocktail’, ‘La France’), or fully lignified (as ‘Baby Chateau’).

Periphloemic *sclerenchyma strings* are generally well represented at stem level. The differences are related to walls of sclerenchyma fibers, which can be: very thick, fully lignified with lumen cells which are almost punctiform (‘Baby Chateau’, ‘Laminuette’, ‘Rose Gaujard’, ‘Foc de Tabără’), strong thick but partially lignified (‘Independence’, ‘M-me A. Meilland’, ‘Cocktail’).

Medullary parenchyma, generally thick, is composed of large cells and small cells, which alternate, forming a characteristic network. Nature of cell walls is cellulosic, but there appear cells with lignified walls, such as hydrocites (as ‘Coup de Foudre’, ‘Independence’, ‘Rose Gaujard’, ‘Laminuette’, ‘Luchian’, ‘President Briand’, ‘Pristine’). In most of cases, hydrocites occur more frequently in perimedullary area, but they can be seen on the periphery of sclerenchyma bundles especially in some cultivar hybrids (as ‘Laminuette’, ‘Rose Gaujard’, and ‘Independence’).

*Oxaliferous cells* are located in different tissues, depending on cultivar hybrids. Generally, they are relatively common, as in other *Rosaceae* species. Also, some taxa have more frequently ursins and some other taxa have simple crystals. These both forms coexist in some taxa, but each of it prevailing in other tissues. Thus, oxaliferous cells are present even in hypodermic colenchyma layer either as ursins ('Independence', 'Coup de Foudre', 'Baby Chateau', 'Cocktail', 'Rose Gaujard', 'Laminuette', 'Perla d'Alcanada') or as simple crystal ('President Briand').

Inside of the cortical parenchyma, oxaliferous cells are present with ursins (at 'Independence', 'Coup de Foudre', 'Baby Chateau', 'La France', 'President Briand', 'Perla d'Alcanada'). Cultivar hybrids which have just few oxaliferous cells at the cortex level are 'Laminuette', 'M-me A. Meilland', 'Foc de Tabără'.

Inside of liberian parenchyma, we identified cells with ursins at 'Luchian' and 'President Briand' cultivar hybrids.

In perimedullary area and at medullary rays level are oxaliferous cells more frequently at 'Cocktail' and 'Coup de Foudre'.

Inside of marrow are also frequent oxaliferous cells (with ursins) at 'Perla d'Alcanada', 'Independence' and 'Laminuette'. Oxaliferous cells are missing from marrow at 'Foc de Tabără' and 'Baby Chateau'.

Hydrocites are present both in marrow (at 'Coup de Foudre', 'Luchian', 'Independence', 'Rose Gaujard') and in perimedullary area (at 'Coup de Foudre', 'Baby Chateau', 'Laminuette' and 'Independence'). Sometimes, they are present on the periphery of perifloemic sclerenchyma (as 'Rose Gaujard').

The petiole, at the level of stipella, present a semicircular contour of cross-section (in most cases), rarely semielliptical, modified by those two adaxial wings represented by stipella with adaxial surface provided with a groove more or less wider. Sometimes, the adaxial surface is almost flat.

*Epidermic cells* are either isodiametrical ('Coup de Foudre', 'Baby Chateau', 'M-me A. Meilland') or slightly tangentially elongated ('Foc de Tabără' and 'Pearl d'Alcanada'). From all observed taxa, we noticed 'Independence' cultivar hybrid which have epidermic cells with unequal size and different shapes, isodiametric or slightly tangentially elongated.

External wall of epidermic cells are thicker than others, pointing out at 'Baby Chateau' cultivar hybrid where it is less thick.

The *cuticle* can be thick ('Independence', 'Coup de Foudre', 'M-me A. Meilland', 'Laminuette', 'Pristine', and 'Rose Gaujard') or thin ('Baby Chateau', 'President Briand', 'Pearl d'Alcanada').

*Tector hairs* are present both on petiole and rachis surfaces of 'Cocktail', 'Laminuette', 'President Briand' and 'Pristine' cultivar hybrids (some of them very long, others are shorter, but relatively in a uniform distribution).

For the most of cultivar hybrids, hairs occur at young leaf especially on the basis and they are more and more rarely up to the top. In all cases, tector hairs have very thick walls and lumen almost filiform.

*Secretory glands* are present in all cultivar hybrids, especially on the stipella extremities, more frequently at ‘Cocktail’, ‘Paprika’ (where they are placed all over the surface of stipella on inferior side), ‘Luchian’, ‘Pristine’ and ‘Laminuette’.

From the structural point of view, secretory glands are consisted of multicellular pedicle, pluriseriate with a variable length and a terminal multicellular clavate formation, with polygonal shaped cells which have thin and cellulosic walls.

Hypodermic colenchyma, by tangential type, is formed by 3-4 cell layers in most of cases, thinner at ‘Baby Chateau’. We have noticed the *angular colenchyma* of ‘Rose Gaujard’ which is different from that from stem. In some cases, colenchyma layer present cells with ursins (‘Coup de Foudre’, ‘Rose Gaujard’), with single crystal (‘Baby Chateau’) or both types (‘Laminuette’, ‘Perla d’Alcanada’).

The fundamental parenchyma is generally reduced, but more abundant at ‘M-me A. Meilland’, ‘La France’ and ‘Pristine’. He is moderate sclerified and lignified at ‘Cocktail’; at ‘Rose Gaujard’ it is composed by cells similar to those from marrow.

Cells with single crystal are more frequent at ‘Cocktail’ and ‘Baby Chateau’ cultivar hybrids.

The *number of conducting fascicles* are different from 3 (‘Cocktail’, ‘Independence’, ‘Laminuette’) to 9 (‘Foc de Tabără’, ‘Baby Chateau’). Sometimes, periphloemic sclerenchyma bundle is interrupted by medullary rays, narrower (‘M-me A. Meilland’, ‘Laminuette’, ‘Baby Chateau’) or larger (‘Rose Gaujard’), which shows us that many bundles merged to form larger one.

*Fascicles size* decreases, usually from the centre to the lateral; in some cases, several fascicles from central area have approximately equal size (‘Rose Gaujard’ and ‘Baby Chateau’).

Secondary structure at the level of conducting fascicles present ‘Cocktail’, ‘Independence’, ‘Baby Chateau’ and ‘Rose Gaujard’; primary and secondary structures at this level present ‘Foc de Tabără’, ‘M-me A. Meilland’, ‘Perla d ‘Alcanada’ and ‘Pristine’.

In all cases, conducting fascicles have sclerenchyma at liber periphery with form of thick cords (‘Cocktail’), which can be interrupted by medullary rays more or less narrow (‘Rose Gaujard’, ‘M-me A. Meilland’, ‘Laminuette’, ‘Pristine‘).

Stipella are wider or narrower and relatively thin; from structural point of view, they are similar with leaflets. We could distinguished those from ‘Cocktail’, ‘Rose Gaujard’, ‘Laminuette’, ‘M-me A. Meilland’, ‘La France’, which forming along to edges a differentiated mesophyll inside of palisadic tissue (unistratified) and lacunous tissue. On stipella surface are present tector hairs (‘Cocktail’, ‘President Briand’, ‘Pristine’ and ‘Luchian’), secretory glands even only on the edges of them (all cultivar hybrids), or all over their abaxial surface (as ‘Paprika’).

The rachis, in the median position, presents the same structure plan as the petiole. The cross-section contour is almost circular but modified by latero-adaxial crests sometimes almost parallel, sometimes slightly divergent, which delimits a ditch more or less widely, but usually shallow. The number of conducting fascicles are maintained as inside of petiole, or central fascicles are grouped to create a larger one; at this level, the structure is mainly of primary origin and partially of secondary origin (as ‘Baby Chateau’, ‘Coup de Foudre’, ‘La France’, ‘Pristine’ and ‘Foc de Tabără’). At this level, we can notice the presence of hydrocites both at xylemic and phloemic poles. Hypodermic colenchyma is almost continuously in all investigated cases. The sclerenchyma is not continuously in periphloemic position; it is interrupted at intervals by groups of parenchymatic cells, sometimes with hydrocites between them. The presence of parenchymatic pod as endodermoid was identified at ‘La France’, ‘President Briand’ and ‘Pristine’ cultivar hybrids.

The leaflets petiolule has a structure similar to that of median nervure of leaflet limb, with particularity on mechanical specific tissue which accompanying conducting fascicle. Thus, sclerenchyma from periphloemic position is missing at ‘Foc de Tabără’, ‘Cocktail’ and ‘M-me A. Meilland’. In all these cases are present only colenchyma elements inside of periphloemic area; at ‘Independence’ cultivar hybrid, colenchyma elements alternating with sclerenchyma cells which have lignified walls. From all cultivar hybrids which have sclerenchyma into periphloemic area, we noticed ‘Rose Gaujard’ which has sclerenchymatic cells with moderate thick walls and a cellulosic nature. Both on rachis and especially on leaflets petiolule are present tector hairs and/or secretory glands with similar structure with those on stem or other leaf parts.

At the level of leaflet limb, median nervure present a structure similar with that of rachis and petiolule, with the particularity that on this level conductive tissues form a single libero-ligneous beam which have usually a primary structure. Secondary structure is registered at ‘Baby Chateau’, ‘Cocktail’ and ‘Foc de Tabără’.

The *periphloemic sclerenchyma* fibers have 'M-me A. Meilland', 'Foc de Tabără', 'Laminuette' and 'Rose Gaujard' cultivar hybrids.

The upper epiderm has external wall thickened and cutinized. The *cuticle* is very thick at 'M-me A. Meilland', 'Camp Fire' and 'Cocktail' cultivar hybrids.

Leaflets limb has a bifacial-heterofacial structure at all investigated taxa, the mesophyll is differentiated in palisadic tissue for adaxial surface and lacunous tissue for abaxial surface.

Palisadic tissue is generally bistratified, sometimes it appears tristratified ('Coup de Foudre', 'Foc de Tabără' and 'Independence'), but in this case, the inner layer is composed by much lower cells.

Lacunous tissue consists of 3-5 layers of cells in most cases; the variation limits are from 2-3 cell layers ('Independence', 'President Briand') up to 4-6 layers of cells ('Baby Chateau'). Based on size and frequency of aeriferous cavities of lacunous tissue, we identified following situations: very lax ('Pristine', 'Rose Gaujard', 'Coup de Foudre') and relatively lax ('Laminuette', 'President Briand'), those small aeriferous cavities are identified at 'Radiance'. Concerning to cells form of lacunous tissue, there are differences between 'Independence' and 'President Briand' which showing rounded cells; in terms of their orientation, it is distinguished 'Rose Gaujard' which have cells oriented in different directions and 'Pristine' which have narrow cells arranged into a horizontal disposition.

The epidermic cells are bigger in superior epiderm than inferior one. Larger cells were found at 'Rose Gaujard', 'Laminuette', 'M-me A. Meilland' and 'Pristine' cultivar hybrids.

Contour of epidermal cells is different from one taxon to another and, in some cases, from upper epiderm to lower epiderm, even at the same taxon: polygonal cells with straight walls were identified inside of upper and lower epidermis ('Independence' and 'Cocktail'); cells with an irregular shape with slightly wavy walls in both epidermis ('Perla d'Alcanada'); polygonal cells with slightly wavy walls in upper epiderm, and irregular shape in lower epiderm with lateral walls almost sinuous ('Rose Gaujard', 'Laminuette', 'Foc de Tabără', 'Coup de Foudre', 'Baby Chateau', 'M-me Meilland', 'Pristine').

*Stomata* are located in the lower epiderm. They are by anomocitic type, characteristic for *Rosaceae* family. Stomata present numerous (at 'M-me A. Meilland', 'Cocktail', 'Independence', 'Baby Chateau', 'Pristine' and 'President Briand'). The phenomenon of clustering of stomata inside of nervures axilla, characteristic for hybrids, occurs in some cultivar hybrids:

‘Rose Gaujard’, ‘M-me A. Meilland’, ‘Pristine’ and ‘La France’. Also, there is sometimes a tendency to approximate stomata cells separated by a single epidermic cell (‘Rose Gaujard’ and ‘Luchian’). Typically, the stomata are located at the level of epidermic cells. We have noticed ‘Cocktail’ cultivar hybrid which have suprastomatic chamber and ‘Coup de Foudre’ which have a large substomatic chamber. The second wall of division from epidermic cells, characteristic for *Rosaceae* family, appears sometimes either at level of upper epiderm (‘Rose Gaujard’, ‘Laminuette’ and ‘Perla d’Alcanada’) or at level of lower epiderm (‘Independence’).

*Oxaliferous cells*, relatively frequent into foliar limb, as well as other *Rosaceae* species, are present in various tissues: palisadic tissue in the form of single crystals and ursins (‘Laminuette’, ‘Luchian’ and ‘M-me A. Meilland’), or only as ursins (‘Coup de Foudre’); into lacunous tissue as single crystals and ursins (‘Laminuette’, ‘Rose Gaujard’ and ‘Cocktail’); into liber in the form of simple crystals and ursins (‘Laminuette’); along to nervures or their lateral nervures where are many oxaliferous cells with ursins (‘Pristine’, ‘President Briand’ – under lower epiderm, ‘Foc de Tabără’, ‘Cocktail’, ‘Coup de Foudre’, ‘M-me A. Meilland’, ‘Rose Gaujard’, ‘Independence’, ‘Perla d’Alcanada’, ‘La France’, ‘Laminuette’ – in both epidermis) or single crystal (‘Baby Chateau’, ‘M-me A. Meilland’, ‘Laminuette’).

## Conclusions

General structure plan has a conservative character.

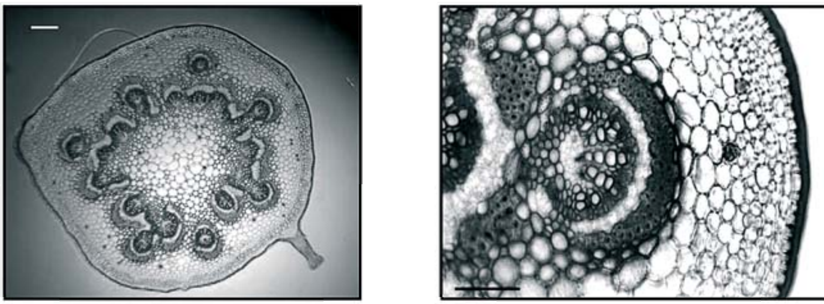
Transition to the secondary structure is due based on either cambium intense activity in most of cases, or later on the shoot basis but only for robust hybrid cultivars (as ‘La France’, ‘Pristine’), but also at some hybrid cultivars with abundant sprout abundant (as, ‘Perla d’Alcanada’).

Phellogen activity during anthesis stage is observed only in some places from prickles basis, which will be removed very soon.

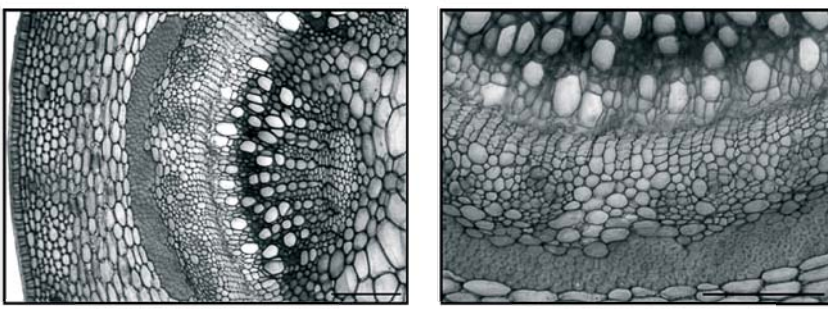
The amount of libriform fibers in secondary wood is more abundant for some hybrid cultivars (‘Independence’, ‘Radiance’, ‘President Briand’ and ‘Pristine’), but it was identified in smaller quantities for the most hybrid cultivars.

Leaf is bifacial-heterofacial, usually with palisadic bistratified tissue, tristratified with the last cells layer much lower (‘Coup de Foudre’, ‘Foc de Tabără’ and ‘Independence’), lacunous tissue consists of 3-5 cells layers, and it is thicker at ‘Baby Chateaux’ cultivar hybrid.

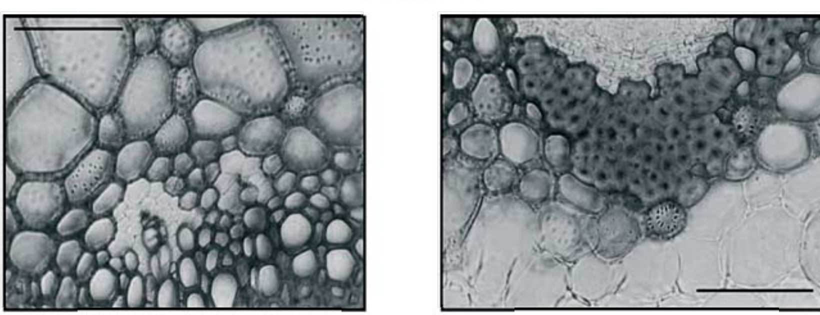
Numerous stomata are at ‘M-me A. Meilland’, ‘Cocktail’, ‘Independence’, ‘Baby Chateau’, ‘Pristine’ and ‘President Briand’. The phenomenon of grouping of stomata inside of nervures axilla, characteristic for hybrids occurs in some cultivar hybrids (as ‘Rose Gaujard’, ‘M-me A. Meilland’, ‘Pristine’ and ‘La France’). Also, there is sometimes a tendency to bring closer some stomata cells which could be separated by a single epidermal cell (‘Rose Gaujard’ and ‘Luchian’).



‘Laminuette’



‘La France’



‘Rose Gaujard’

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## GENETIC DIVERSITY ASSESMENT OF POPULATIONS OF *HYPERICUM PERFORATUM* L. USING RAPD MARKERS

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**Summary.** *Random amplified polymorphic DNA (RAPD) variation profiling was examined in eight populations of Hypericum perforatum L. in RMoldova. Genetic diversity was estimated in 80 samples. 120 bands were obtained for all populations, 85% of which were polymorphic at least within a population. The percentage of polymorphic loci varied from 40.00 to 60.83 and genetic distance between populations ranged from 0.0332 to 0.2777. The results show discrete genetic structuring in the populations studied and provide useful information for future conservation measures*

### Introduction

The genetic diversity is a fundamental component of biodiversity and is closely related to geographic distribution of genotypes that constitutes subspecies, races or ecotypes. The DNA based diversity detected by molecular markers is usually defined as ‘‘genetic variation’’ to differentiate it from the phenotypic variation evolved due to the adaptive potential of populations. The advent of molecular marker techniques, bioinformatics and the use of geographical information system (GIS) could help to develop better methods to survey, sample and assess the genetic diversity [24]. Molecular markers such as restriction fragment length polymorphisms (RFLPs), random amplified polymorphic DNAs (RAPDs), amplified fragment length polymorphism (AFLP), single sequence repeats (SSR) and single strand conformation polymorphism (SSCP) are widely applied to study genetic diversity, varietal or species identification, to establish phylogenetic relationships and genetic mapping.

*Hypericum perforatum* L. (St. John’s Wort, Hypericaceae) is a member of the genus Hypericum, of which there are 400 species worldwide [18]. It is native to Europe, West Asia, North Africa, Madeira and the Azores and is naturalized in many parts of the world, notably North America and Australia. The plant spreads rapidly by means of runners or from the prodigious seed production and can invade pastures, disturbed sites, dirt roads, the sides of roads and highways, and sparse woods. In recent years, the consumption of *H. perforatum*-derived products has increased dramatically, and it is presently one of the most consumed medicinal plants in the world [28]. The plant has a wide range of medicinal applications, including skin wounds, eczema, burns, diseases of the alimentary tract and psychological disorders [3].

## Materials and methods

Leaf tissue of *Hypericum perforatum* L. was collected from eight populations from R. Moldova (Table 1). A total of 80 individual samples were selected for the analysis. Leaf specimens were placed in liquid nitrogen and chilled until DNA was extracted. Total DNA was extracted from 0.5 to 1 g of fresh leaf tissues using the modified CTAB protocol of Doyle and Doyle [8].

Table 1

**List of population identity**

| *No.* | *Population identity* | *N* | *L* | *Population ID* |
|---|---|---|---|---|
| 1. | Chisinau (Schinoasa) | 46°57′ 48,71″ | 28°48′ 00,56″ | C46 |
| 2. | Hincesti | 46°50′ 46,89″ | 28°13′ 15,93″ | H46 |
| 3. | Vulcanesti | 45°44′ 09,65″ | 28°22′ 54,89″ | V45 |
| 4. | Soldanesti | 47°47′ 37,19″ | 28°37′ 22,76″ | S47 |
| 5. | Ungheni | 47°13′ 13,10″ | 27°52′ 58,91″ | U47 |
| 6. | Floresti | 47°54′ 16,89″ | 28°18′ 07,32″ | F47 |
| 7. | Calarasi | 47°22′ 16,71″ | 28°08′ 12,89″ | C47 |
| 8. | Edinet | 48°11′ 56,15″ | 27°17′ 38,60″ | E48 |

PCR-RAPD analysis was carried out according to Williams et al. [27] protocol using 10 primers (Table 2):

Table 2

**List of primers**

| *Primer* | *Sequences, 5'-3'* | *Melting point, °C* | *G+C, %* |
|---|---|---|---|
| OPA1 | CAG GCC TTC | 30 | 66 |
| OPA2 | TGC CGA GCT G | 34 | 70 |

| | | | |
|---|---|---|---|
| OPA9 | GGG TAA CGC C | 34 | 70 |
| 28 | AGG TCA CTG A | 30 | 50 |
| OPA6 | GGT CCC TGA C | 34 | 70 |
| OPG5 | CTG AGA CGG A | 32 | 60 |
| 391 | GCG AAC CTC G | 34 | 70 |
| OPA19 | CAA ACG TCG G | 32 | 60 |
| OPB10 | CTG CTG GGA A | 34 | 70 |
| OPK17 | CCC AGC TGT G | 34 | 70 |

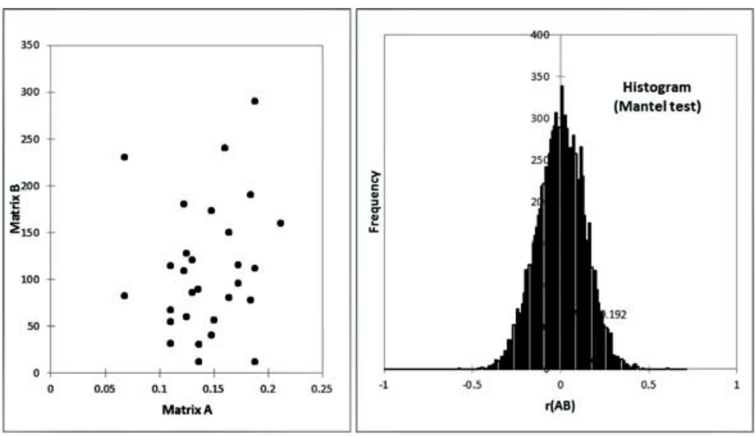
Amplifications were performed on GeneAmp 9700 (Applied Biosistems) with 25 µl reaction mixtures containing 50-100 ng of template DNA, 200 mM each of dATP, dTTP, dCTP and dGTP, 3 units of DreamTaq DNA polymerase, 1 ml (20 pm) of each primer and 5 µl Taq buffer with 1.5 mM $MgCl_2$ (Fermentas). The amplification regime was performed with 40 cycles, each of 60s denaturation (94°C), 60s annealing (33°C) and 120s extension (72°C). The last cycle was followed by incubation for 10 min at 72°C. The amplification products were electrophoresed on 1% horizontal agarose gel (MERCK KGaA, Darmstadt, Germany) in TBE buffer (40 mM Triseborate, 1 mM EDTA, pH 8.0). The gel, after the completion of electrophoresis was stained with ethidium bromide and bands were compared with DNA markers [100-bp DNA ladder and low range DNA ruler (Fermentas)]. The gels were documented using SONY Digital Science Electrophoresis Documentation and UV Sistem Cambrige.

RAPD products were scored for presence (1) and absence (0) of bands. The data matrices were entered into the PopGene Version 1.31 package and pair wise comparison of populations were made [31] and the genetic diversity parameters were determined. Genetic distance [22] between all populations was obtained from PopGene Version 1.31. The genetic distances' matrix was also used to estimate variance components and to test the significance of partitioning of RAPD variation [9] using WINAMOVA. To evaluate the correlation between genetic distance and geographic distance, the product moment correlation coefficients were calculated between the genetic and geographic distance matrices and significance levels of the correlation between these matrices were estimated by MANTEL TEST using XLSTAT 2012.

## Results and discussions

Of the 30 RAPD primers screened, 10 produced repeatable amplification products that yielded a total of 120 scorable markers with molecular size ranging from 100 to 2500 bp. The percentages of monomorphic and polymorphic bands were 15 and 85%, respectively, and the number of scorable bands amplified by each primer varied from 9 (OPA2) to 19 (OPA9). The percentage of polymorphic loci (ppl) varies from 40.00 in *C46* population to 60.83 in *H46* population. The *H46* population had the highest genetic diversity index h 0.23 and *C46* population with lowest (0.17) (Table 3). The estimated average genetic distances between populations indicated that the genetic distances between population pairs were ranged from 0.0332 (between *E48* and *C47*) to 0.2777 (between *F47* and *C46*) (Table 4). Partitioning of variation within and between populations using an analysis of molecular variance (AMOVA) showed that 70.79% of the genetic variability existed as variation within populations ($p < 0.001$; Table 5).

Correlation between genetic distance and geographic distance, the product moment correlation coefficients were calculated (Figure 1).




| | |
|---|---|
| r(AB) | 0.192 |
| p-value (Two-tailed) | 0.153 |
| alpha | 0.05 |

Figure 1. Correlation between genetic distance and geographic distance (Mantel test)

Table 3

**Comparison of populations for various genetic diversity measures**

| *Populations* | *h* | *npl* | *ppl* |
|---|---|---|---|
| C46 | 0.1725 | 48 | 40.00% |
| H46 | 0.2320 | 73 | 60.83% |
| V45 | 0.2149 | 68 | 56.67% |
| S47 | 0.2113 | 70 | 58.33% |
| U47 | 0.2030 | 65 | 54.17% |

| | | | |
|---|---|---|---|
| F47 | 0.1847 | 59 | 49.17% |
| C47 | 0.2142 | 65 | 54.17% |
| E48 | 0.2228 | 69 | 57.50% |
| Mean | 0.2069 | 64 | 53.85% |

h ¼Nei's [22] gene diversity, npl ¼Number of polymorphic loci, ppl ¼ Percentage of polymorphic loci.

Table 4

**Nei's [21] genetic distance between populations**

| *Pop ID* | *C46* | *H46* | *V45* | *S47* | *U47* | *F47* | *C47* | *E48* |
|---|---|---|---|---|---|---|---|---|
| C46 | **** | | | | | | | |
| H46 | 0.1881 | **** | | | | | | |
| V45 | 0.1979 | 0.1310 | **** | | | | | |
| S47 | 0.2023 | 0.1343 | 0.0659 | **** | | | | |
| U47 | 0.2034 | 0.1683 | 0.1609 | 0.1357 | **** | | | |
| F47 | 0. 2777 | 0.1609 | 0.1601 | 0.1353 | 0.0698 | **** | | |
| C47 | 0.2090 | 0.1501 | 0.0850 | 0.0519 | 0.1392 | 0.1193 | **** | |
| E48 | 0.2117 | 0.1583 | 0.0987 | 0.0564 | 0.1433 | 0.1305 | 0.0332 | **** |

Table 5

**Hierarchical analysis of molecular variance (AMOVA)**

| *Variance component* | *SSD (sums of square deviations)* | *MSD (mean square deviations)* | *Variation variance* | *%* | *p* |
|---|---|---|---|---|---|
| Among population | 453.30 | 64.75 | 5.21 | 29.21 | <0.001 |
| Within population | 909.40 | 12.63 | 12.63 | 70.79 | <0.001 |

Assessment of genetic variation is an important step towards executing plant conservation strategies and breeding programmes. Genetic richness can be assessed by estimating the genetic diversity parameters (percentage of polymorphic loci and gene diversity index) [29]. The proportion of polymorphic loci amplified in *H. perforatum* L. was 85%. The high percentage of polymorphism has been reported in *Caesalpinia echinata* Lam. [4], *Euterpe edulis* [5] and in *Calamus metzianus* [26].

In contrast to these studies, relatively lower percentage of polymorphic loci was observed in *Gliricidia sepium* [6] and *Theobroma cocao* [25]. The high percentage of polymorphism suggests that high level of genetic variation in this plant. It is reported that the high levels of polymorphism are an indicative of high levels of outcrossing among individuals and between populations [15, 17].

Nei's gene diversity (h) estimate was found to be 0.20 in the present study. This value is low when compared to wind pollinated, woody and long-lived tree species in which comparatively much variability within population is reported [13] as in *Populus tremuloides* (0.30) [30] and *Quercus petrea* (0.29) [7]. When compared to outcrossing, herbaceous and insect pollinated species, it was found to be similar as in *Lilium martagon* (between 0.15 and 0.26) [23] and *Argyroxiphium sandwicense* (0.19) [10] but higher than those of annual or short lived perennial selfing species such as *Oryza glumaepatula* [2] and perennial *Orobanche cumana* [11].

Among the eight analyzed populations, the highest genetic diversity measures were observed in *H46* population followed by *E48*. The higher gene diversity of *H46* population compared to those of other populations might be due to the high population density compared to those of other populations. Hence, the *H46* population can be considered as *'hot spot'* of genetic variation and important reservoir of potentially useful genes required to provide high priority for management strategies and conservation.

The partitioning of genetic variation using AMOVA showed high amount of diversity in intra-populations (69.20%) than inter-populations (30.80%). Hamrick and Godt [13] have reported that the long-lived, woody and late successional organisms typically represent greater percentage of their variation within populations. The same pattern was observed in the studies on *Azadirachta indica* [16]. Comparative analysis of seed morphometic and allozyme data among four populations of *Azadirachta indica* [*12*] and *Banksia cuneata* [19]. But the studies on *O. cumana* [11] and *O. glumaepatula* [2] indicated a reverse trend in which most of the genetic diversity was found among populations than within populations. It is found that the selfing species are generally supposed to allocate most of the genetic variability among populations [1].

The mean gene diversity of *H. perforatum* (0.1794) was higher than outcrossing woody plants (0.154), which have reported by Moran [21] and Martins-Gorder and Lopes [20].

## Conclusions

The comparison of genetic and geographic distance reveals that the most genetically similar populations are separated by a distance of 10 km, whereas the genetically distant ones are separated by about 250 km. The reasons for low correlation between geographic and genetic distance might be due to the high gene flow, mutation, migration, natural selection and the geographical isolation in a small area [14]. At the population level, the species is under continuous threat of degradation; this situation could compromise the survival of populations and in the long-term species itself would be at risk. All the analysed populations are fragmented remnant forests surrounded by urban or cultivated land and are in continuous pressure due to overexploitation for the furniture industry. Hence, at the species level, actions should be taken to protect.

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# REALIZĂRI ŞI PERSPECTIVE PRIVIND CERCETĂRI BIOTEHNOLOGICE ÎN GRĂDINA BOTANICĂ (INSTITUT) AŞM. ACTUELMENTS AND PERSPECTIVES AN BIOTEHNOLOGICAL RESEARCHES IN BOTANICAL GARDEN (INSTITUTE) AŞM.

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**Summary.** *Article is devoted to the researchers in biotehnology areoc. Are presented the results of investigation of employees achieved over abaut 25 years sinca the creation of this subdivision of Botanical Garden. At the gegenning, works were devoted te recovery of some plants collection on open and protected lands since 1996, along with acquirement development of methods, the level of researches vas thorough according new work program, was studied morphogenetic potential, organogenous and calusogenous processes, ginogenous and androgenesis. Elaboration of technologies for a number of new species (20) with an economic interest for Republic of Moldova. Biotechnology is defined broadly as technologies that involve the use of living organisms, or products from living organisms, as way to benefit humans. The study, regarded in biotechnology light, of the problem concerning culture tissue and organs in higher plants, out of organism, on the artificial nutritive mediums and, in aseptically controlled conditions, opens new possibilities of fundamental and applied investigations.*

Pe parcursul unui sfert de secol în cadrul Grădinii Botanice activează la început grupul de Biotehnologie mai târziu Laboratorul de Embriologie şi Biotehnologie. Studiile biotehnologice au demarat în anul 1986 grupul de biotehnologie condus de dr. V. Caftanat. Blocul Biotehnologic a fost realizat datorită concepției şi planului general de dezvoltare a Grădinii Botanice şi transpunerii lui în viață de directorul instituției date academician A.Ciubotaru, actualul director de Onoare. Pentru documentare şi consultații au fost invitați specialiştii din fosta URSS R. Butenco, T.Batîgina. În anul 1981 proiectarea a fost finisată de arhitecții din Leningrad în 1982 lucrările au demarat. Dar la finile anului 1985 lucrările de construcție s-au încheiat. La prima etapă cercetările au fost consacrate testărilor şi însănătoşirii speciilor din colecțiile Grădinii Botanice circa 25 de taxoni din diferite familii şi genuri au fost tratate prin tehnologia nouă, culturile prezintă o importanță deosebită şi multiplicarea tradițională le este dificilă, au fost însănătoşite un şir de culturi de către colaboratorii care au stat la bazele fondării grupului de lucru şi primele investigații au fost convigătoare.

M.Arhipenco, T. Azema a făcut stajierea în Moscova unde s-au familiarizat şi au însuşit metodele şi procedeele de cercetare, s-au cunoscut cu structura laboratorului Institutului de Fiziologie a Plantelor în vestitul laborator de cultură a țesuturilor vegetale, primul în fosta URSS condus de R. Butenco obținând experiența în organizarea laboratorului, utilajul necesar, vesela etc. Dr. M.Bodrug şi V. Caftanat nemijlocit au fost preocupați de organizarea laboratorului culturii *in vitro.* Au fost tratate de metoda nouă şi insănătoşite colecțiile de plante tropicale: pelargonium, saintpaulia, feriji miniature etc., au fost elaborate tehnici de micropropagare şi însănătoşire a unor culturi floricole de teren deschis, gladiolele, garoafele, crizantemele, irişi au fost inițiate cercetări privind plante noi introducente de interes farmaceutic Stevia rebaudiana Bertoni şi Stahys sieboldii Miq. fiind continuate şi dezvoltate de Dr. T. Azema, E.Derid. A fost pregătiți specialişti în centrele recunoscute G. Şevțova a susținut teza de doctor în Sanct Peterburg cultura *in vitro* a orhideilor. Grupul de biotehnologie a fost întărit cu mai mulți specialişti-biotehnologi s-a încadrat în lucru specialist-chimist cu experiență M. Sofronii fiind preocupată de selectarea componenței şi prepararea mediilor de cultură, activând în cadrul laboratorului până în prezent. Odată cu cercetările citoembriologice şi citogenetice în cadrul laboratorului au fost întreprinse lucrări de promovare a culturii țesuturilor *in vitro* cu ajutorul vestitului Centru din Moscova, unde au fost pregătiți specialişti în domeniu şi efectuate cercetări la culturile valoroase introducente pelinul lămîios şi rauvolfia sub conducerea acad. Prof. R. Butenco.

Din anul 1995 grupul de biotehnologie se află în cadrul laboratorului de Embriologie şi Biotehnologie au fost desfăşurate cercetări biotehnologice în scopul studierii *in vitro* proceselor calusogene, androgene, ginogene devirozării formelor inițiale pentru ameliorare. Studiile fiind inițiate şi realizate de N.Ciorchină sub conducerea acad. A.Ciubotaru. În studiu au fost atrase plante noi pentru R.Moldova (*Stevia rebaudiana* Bertoni, *Aerva lanata* Juss., *Stahys sieboldi* Miq., *Artemisia balchanorum* Krasch., *Actinidia chinensis* Planch., *Polymnia sonchifolia* Poep. et End., *Zizyphus jujuba* Mill., *Rosmarinus officinalis* L., *Ceratostigma plumbaginoides* Bunge., *Witania somnifera* Dunal. Etc. Ca rezultat au fost obținute plante haploide prin cultivarea polenului la *Artemisia balchanorum* Krasch., din care s-a obținut plante omogene şi a fost creată plantația-mamă cu plante donor de material săditor uniform soiul *Balhanca* cu componența uleiului de calitate şi productivitate înaltă.

Culturile studiate prezintă interes economic sporit grație conținutului de substanțe biologic active (SBA), aceste specii sunt de origine alohtonă, adaptarea lor la condițiile pedoclimaterice a Republicii, multiplicarea lor întâmpină o serie de dificultăți, care au fost cu succes depăşite aplicând metodele biotehnologice în ambianță cu cele citoembriologice.

Biotehnologia a avansat cu mare succes în a doua jumătate a secolului XX, metodele biotehnologice au rezolvat şi rezolvă de sine stătător un şir de probleme cum sunt: hibridarea parasexuată, ingeneria genică, microclonarea şi micropropagarea în masă a materialului săditor omogen însănătoşit şi obținerea plantelor haploide androgene şi ginogene etc.

Încă din primele momente ale acumulării cunoştințelor despre natură, omul a înțeles că perpetuarea speciilor şi biodiversitatea sunt asigurate prin reproducere, una din însuşirile fundamentale ale ființelor vii. Prin reproducere se realizează nu numai o propagare a speciilor, pe arii tot mai extinse, ci şi o continuitate a lor în timp, transmițânduse descendenților informațiile genetice, respectiv acumulate în fiecare organism, de-a lungul dezvoltării lui ontogenetice, potrivit evoluției sale în fiecare organism, de-a lungul dezvoltarii lui ontogenetice în evoluția fitogenetică.

Perfecționarea continuă a tehnicilor de înmulțire vegetativă, au determinat biologii să viseze la propagarea plantelor prin utilizarea ca material inițial a unor fragmente din ce în ce mai mici. Astfel, treptat s-a ajuns la imaginarea şi transpunerea în practică a unor tehnici de înmulțire a plantelor superioare având ca plecare, în procesele regenerative, explante minuscule, chiar şi numai celule solitare, aflate în vitrocultură (culturi de țesuturi şi celule vegetale) şi s-a conferit denumirea de *biotehnologia vegetală*, categoria de culturi efectuate în regim aseptic, practicate cu explante prelevate de la plantele superioare (cormofitoinoculi), culturi de embrioni, organe, țesuturi, celule sau protoplaşti, la care se extinde capacitatea de a se înmulți axesuat, pe calea vegetativă, din fragmente sau celule detaşate din conul de creştere, şi care în condiții optime de medii, pot regenera o nouă plantă. Să definim ce este *vitrocultura.* Vitroculturile în sens restrâns privesc inocularea şi creşterea în regim steril, pe medii nutritive aseptice, a unor explante macroscopice şi microscopice (inoculi) organe, țesuturi, celule ce provin din plante superioare.

Vrem să aducem principalele avantaje pentru această metodă avansată, care înlocuieşte tot mai frecvent cele tradiționale, având o capacitate de înmulțire vegetativă foarte înaltă.

1. Înmulțirea rapidă a unui clon de plante prețioase.

2. Obținerea materialului însănătoşit (lipsit de viroze, ciuperci, bacterii şi nematode) micromultiplicarea (microclonarea şi micropropagarea) vegetativă.

3. Tirajarea rapidă a plantelor cu reproducerea (regenerarea) dificilă.

4. Posibilitatea de a multiplica şi obținerea în împrejur plante la un termen determinat.

5. Crearea *Bancului* de plante prețioase. *Germoplasm:*

*a)* utilizarea haploizilor din culturile androgene (androclina) antere şi polen;

*b)* selectarea mutanților rezistenți la boli;

*c)* selectarea mutanților rezistenți diferitor condiții de stres (clone celulare rezistente la temperaturi extreme, la excesul de săruri, la substanțe poluante etc.);

*d)* izolarea şi selecția mutanților cu conținut sporit de aminoacizi pe baza selecției liniilor celulare rezistente la analogii aminoacizilor;

*e)* perfectarea metodologiei de ameliorare a plantelor – polinizarea şi fecundarea *in vitro,* cultura embrionilor, semințelor imature, obținerea hibrizilor somatici prin fuziunea protoplaştilor proveniți de la specii neînrudite, includerea în genotipul plantelor materialului genetic util, prin interacțiunea protoplaştilor cu plasmide, liposomi, utilizarea ADN-ului recombinat în transferul diferitor gene utile la plantele obținute etc.

Direcțiile principale de studiu al laboratorului în domeniul biotehnologiei vegetale.

1. Cercetarea proceselor morfobiologice a explantelor cultivați în cultura *„in vitro”*, particularitățile dezvoltării, diferențierii a unor culturi, medicinale, alimentare, decorative.

2. Accelerarea procesului de introducție prin multiplicare*”in vitro”*, unor culturi noi, reintroducția speciilor rare şi reproducerea culturilor cu înmulțirea tradițională dificilă.

3. Elaborarea biotehnologiilor în scopul obținerii şi însănătoşirii prin micropropagare a materialului săditor în masă. Au fost elaborate tehnologii de multiplicare rapidă şi însănătoşire a speciilor de plante alimentare, tehnice, medicinale, ornamentale (circa 20 de protocoale testate şi aprobate).

*Problemele micropropagării vegetale:*

Creşterea, dezvoltarea şi regenerarea plantelor superioare. Stabilirea şi utilizarea potențialului morfogenetic, evidențierea, selectarea şi crearea condițiilor adecvate, dezvoltării celulelor şi țesutului cultivat, înlocuirea unor tulpini calusare spontane cu cele productive programate şi construite prin ingeneria genică sunt unele probleme cu depăşirea cărora va permite pe deplin aplicarea celor două particularități a țesuturilor vegetale cultivate *„in vitro*" ce determin caracterul tehnologiilor elaborate în baza lor:

1. Capacitatea de a forma biomasa calusară, ce oferă o posibilitate sigură de a obține materie primă, practic în cantități nelimitate cu conținut de substanțe active, în condiții bine determinate, cu parametri stabili.

2. Capacitatea țesutului vegetal experimentat permite (diferite explante: polen, ovul, ovar, calus, fragmente de lăstar, limb foliar, meristem etc.) de a realiza de sine stătător programul dezvoltării şi regenerării unui organism nou (plantă).

Determinarea balanței hormonale de auxine şi citochinine în scopul elaborării şi alcătuirii componenței mediilor, adecvate multiplicării pentru fiecare specie şi soi. Studierea modalității creării condițiilor corespunzătoare de dezvoltare şi cultivare a neoplantulelor pe tot parcursul ciclului *„in vitro","ex vitro".* Ca rezultat s-au finisat şi sunt pregătite pentru publicare recomandări practice privitor la tehnologiile elaborate pentru cultivare în masă la speciile *Aerva lanata, Stevia rebaudiana, Rosmarinus officinalis*. etc.

Sunt pregătite protocoale de înmulțire *in vitro, ex vitro, ex situ* pentru transfer tehnologic la culturile *Artemisia balchanorum Krasch., Actinidia chinensis Plancsh. Polimnia sonchipholia* genul Rosea (soiuri de trandafiri pitici), genul Ceratostigma L. (Ceratostigma plumbaginoides Bunge), genul Crizantema (Chrysanthemum indicum L.), genul Rosmarin L. *(Rosmarinus officinalis L.),* din genul Aerva Pol-pala (*Aerva lanata*). S-a propus la Bursa de invenții la Expoziția Infoinvent 2011 cinci tehnologii pentru culturile sus nominalizate.

Studierea *in vitro* proceselor organogene, calusogene, androgene, ginogene, devirozării formelor inițiale pentru microclonare au arătat că în mare măsură sunt influențate de mai mulți factori: conținutul endogen şi exogen a fitohormonilor, regulatorilor de creştere fiind stimulatori sau inhibitori ale acestor procese, săruri minerale prezente în medii de cultură, concentrația glucidelor, prezența în substrat a unor compuşi organici (aminoacizi), prezența şi natura gazelor, prezența în substrat a unor compuşi organici, factorii fizici – lumina, temperatura, umiditatea şi multe altele de la caz la caz, factorii ce determină separat sau în ansamblu dezvoltarea căilor morfogenetice în condiții normale şi *in vitro* comparând aceste procese. Aşa fel de studiu au fost urmărit la plante noi pentru R. Moldova. Speciile prezintă interes economic sporit, datorite conținutului de substanțe biologic active (SBA), aceste specii sunt de origine alohtonă, multiplicarea şi adaptarea lor la condițiile republicii apar o serie de dificultăți, care au fost depăşite folosind metodele biotehnologice.

Stevia rebaudiana Bertoni, Aerva lanata Juss., Stahys sieboldi Muq., Artemisia balchanorum Krasch., Actinidia chinensis Planch., Polymnia sonchifolia Poep. et End., Zizyphus jujuba Mill., Rosmarinus officinalis L., Ceratostigma plumbaginoides Bunge., Witania somnifera Dunal. etc.

În anii 2007-2009 cercetătorii laboratorului activ s-a implicat în rezolvarea problemelor farmacologice acumulând anterior un bagaj mare de cunoştințe ce ține plante medicinale aplicândule în realizarea proiectului din Programul de Stat propus de prof. V. Gicavîi condus de acad. A.Ciubotaru. Medicina contemporană atrage o mare atenție medicamentelor bazate pe substanțe biologic active (SBA) din plante. Tendința de a folosi cât mai mult fitomedicamentele şi nu medicamentul chimic, deschide o largă posibilitate de-a valorifica fitogenofondul de plante medicinale deja acumulat şi studiat în Grădina Botanică (Institut) AŞM, aplicând cele mai perfecționate metode de selectare, clonare şi multiplicare biotehnologică şi tradițională. O deosebită atenție s-a acordat biodiversității, evidențierii şi selectării ecotipurilor purtătoare de calitate şi cantitate, majoră de substanțe biologic active. În scopul obținerii medicamentului autohton, cantități contate de substanțele biologic active (SBA) au fost transmise pentru testare şi examinare în laboratoarele preclinice şi clinice specializate.

A fost organizat lotul experimental cu 3 specii *Aerva lanata*, *Rosmarinus officinalis Artemisia balchanorum Krasch.* A fost cultivat şi obținut fitomaterial pentru a fi transferat la testare în laboratoarele farmacologice.

Anii 2006-2010 o deosebită atenție s-a tras modernizării şi echipării cu utilaj nou al Laboratorului, în acest sens au fost inaintate şi argumentate 2 proiecte pentru echipament ştiințific în 2007 şi 2009 privind renovarea utilajului ştiințific fiindcă cel vechi era depăşit fizic şi moral din anii ’80. Din aceste proiecte realizate a fost posibil de a procura utilaj circa de un milion de lei.

Membrii laboratorului au elaborat şi au înfaptuit în viață mai multe proiecte de înverzire şi amenajare a teritoriului şi încăperelor obținând surse financiare de la FEN (fondul ecologic național) şcoli, licee, grădinițe, biserici şi mănăstire. A fost elaborat şi la moment în derulare proiectul bilateral comun între AŞM-ANCS din România.

***Pespectivele dezvoltării cercetărilor biotehnologice***

Aplicarea în practică a rezultatelor ale vitroculturilor vegetale va favoriza domeniile agricole, silvice, fitofarmaceutice, precum şi cele de ameliorare şi genetică vegetală, de morfologie şi fiziologie experementală, transformânduse în vitroindustrii, tehnici de clonare şi micropropagare rapidă a plantelor, sau de valorificare în industrie a biomasei produse prin vitrocultură.

Tot odată dovedirea omnipotenţialităţiii celulelor vegetale, prin vitrocultură, se află în continuă extindere cunoştinţele atotpotenţialitatea acestora, lărgindu-se pe măsura adâncirii cercetărilor şi a progreselor ştiinţifice şi tehnice realizate în acest domeniu, sau în domeniile tangente biologiei, în permanenţă existând posibilitatea deschiderii a noi direcţii de investigaţie, pe măsura succeselor obţinute în modificarea ţintită în genomul celular, prin aplicarea de diferite procedee de ingenerie genetică.

## Concluzii

1. Rezultatele obţinute au arătat că organizarea unui laborator de biotehnologie în aşa instituţie cum este Grădina Botanică este o soluţie strategică şi reuşita rezolvării a mai multor probleme, privind regenerarea şi multiplicarea a unor specii preţioase întru obţinera unui material săditor sănătos de calitate şi omogen.

2. Perfecţionarea continuă a tehnicilor de înmulţire vegetativă cu reuşite depline în clonarea cât mai rapidă a exemplarelor celor mai valoroase şi micropropagarea plantelor prin utilizare ca material iniţial a unor fragmente vegetale din ce în ce mai mici.

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# MARKERI BIOCHIMICI ÎN STUDIEREA VARIABILITĂȚII GENETICE A PLANTELOR DE CULTURĂ

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**Summary.** *There were analyzed electrophoretic profiles of sunflower seed storage protein – helianthinin, which is widely used for establishment of genetic variability, level of hybridization and selection of homozygous lines in different breeding programs. Performed investigation gives possibility to estimate genetic variability of ten sunflower genotypes cultivated in Republic of Moldova and nine genotypes from Republic of Belarus. The highest level of biochemical polymorfism was revealed at LC 39 Rf and LC Raus Rf.*

## Introducere

Pentru analiza materialului ameliorativ şi optimizarea tehnicilor de marcare privind variabilitatea intraspecifică şi intrapopulațională se studiază sistemele proteice genetic polimorfe. Heterogenitatea unor astfel de sisteme este determinat de variabilitatea alelică şi poate fi evidențiat prin analiza electroforetică a proteinelor, care permite diferențierea genotipurilor şi evidențierea soiurilor, biotipurilor şi liniilor în baza spectrului. Spectrele proteice permit evidențierea poligeniei, structurii alelice, heterogenității populației şi relațiile filogenetice [16].

Polipeptidele specifice, identificate ca markeri proteici optimizează procedura de creare a liniilor homozigote şi a semințelor de elită pentru a fi introduse în practica agricolă de obținere a hibrizilor cu calități superioare.

Printre markerii proteici la plante un rol important îl au proteinele de rezervă din semințe – prolaminele gramineelor şi globulinele dicotiledonatelor. Acest tip de proteine prezintă un polimorfism înalt, deşi există componente monomorfe bine definite, adecvate pentru analiza filogenetică. Alte grupe de proteine prezente în semințe: enzime, inhibitori ai acestora, precum şi numeroase proteine nucleare şi citoplasmatice extind oportunitățile de utilizare a markerilor proteici [16].

Astfel, semințele sunt considerate sursa cea mai accesibilă şi convenabilă de markeri proteici, reprezentând un subiect esențial pentru tehnicile de marcaj proteic în rezolvarea diferitor probleme ale geneticii, selecției, aprobării soiurilor, testării semințelor etc. Experiența mai multor laboratoare a confirmat faptul, că proteinele din semințe sunt eficiente în calitate de markeri genetici în rezolvarea problemelor fundamentale ale fitotehniei şi sunt mai puțin costisitori [17].

În semințele de floarea-soarelui, conținutul globulinelor variază de la aproximativ 40% până la 90%, în timp ce conținutul de albumine constituie în jur de 10-30% din totalul acestora [5, 6, 8, 10, 14]. Glutelinele şi în special, prolaminele sunt fracții minore. Conform coeficientului de sedimentare sunt considerate două clase majore de proteine globulare: globulina 11S sau heliantinină şi albuminele de floarea-soarelui, fiind cunoscute şi sub denumirea de 2S albumine [2, 8, 15]. Datele din literatură indică variații considerabile a diferitelor fracții de proteine în funcție de coeficientul de sedimentare, care pot fi explicate prin influența factorilor genetici şi de mediu [12].

În prezenta lucrare sunt expuse datele privind heterogenitatea genetică analizată la diverse genotipuri de floarea-soarelui cultivate în Republica Moldova.

## Material şi metode

În calitate de material de studiu au servit 10 genotipuri de floarea-soarelui cultivate în Republica Moldova: 2 linii materne – Drofa ASC şi LC 40 ASC; 4 linii paterne – LC 7 Rf, LC 39 Rf, Xenia Rf şi LC Raus Rf şi 4 hibrizi - Drofa ASC x LC 7 Rf, Drofa ASC x LC 39 Rf, LC 40 ASC x Xenia Rf şi LC 40 ASC x LC Raus Rf şi 9 genotipuri obținute şi cultivate în Republica Belarus.

Extragerea heliantininei dintr-o singură semință a fost efectuată conform metodei optimizate şi utilizate în laborator [3, 4].

Extractul proteic obținut a fost supus separării prin SDS-electroforeză în gel de poliacrilamidă de 14 % [7].

## Rezultate şi discuții

Heliantinina este o proteină globulară oligomerică cu o greutate moleculară de 300-350 kDa [1, 9, 10, 11, 13] şi prezintă heterogenitate la nivelul subunităților în cadrul unui genotip.

Spectrele electroforetice obținute evidențiază trei grupe de benzi. Prima grupă include componentul nedisociat al heliantininei, a doua cuprinde mai multe benzi, notate α şi α' şi a treia grupă reprezintă benzile β. Se observă abundența înaltă a lanțurilor α. Totodată, intensitatea unor benzi β variază, ceea ce denotă proporția lor diferită la genotipurile analizate şi ar putea fi utilizată drept unul din indici al diferențierii lor.

Profilele SDS-PAGE obținute relevă un grad diferit de omogenitate pentru fiecare genotip studiat (figura 1).

Genotipurile materne s-au caracterizat printr-un profil similar care a inclus 9 polipeptide: o bandă a componentului nedisociat, trei de tipul α, una de tipul α' şi 4 de tipul β (fig. 1, 1-2). Spre deosebire de genotipurile materne cele paterne au fost mai polimorfe, (fig. 1, 3-6).

Profilul genotipului LC7 Rf se caracterizează prin prezenţa a 8 benzi (fig.1, 3). Componentul nedisociat a fost reprezentat printr-o singură bandă. Lanţurile α sunt prezentate prin 3 benzi, şi o singură bandă α'. La nivelul benzilor β s-au determinat 3 benzi polipeptidice. Omogenitatea genotipului se consideră 100%.

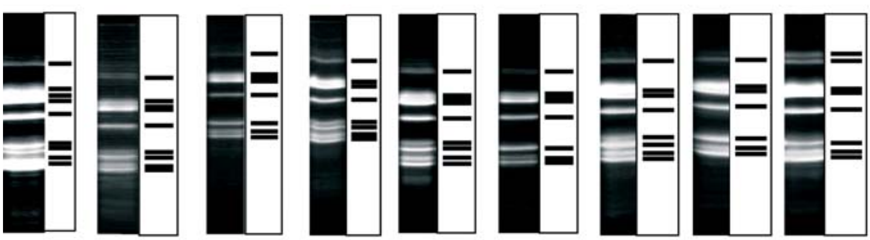


Figura 1. Spectrul heliantininei liniilor parentale de floarea-soarelui
1 – Drofa ASC; 2 – LC 40 ASC; 3 – LC 7 Rf; 4 – Xenia Rf; 5 – LC 39 Rf; 6 – LC Raus Rf

Pentru Xenia a fost depistat un singur profil (fig.1, 4). Profilul se caracterizează prin prezenţa a 8 benzi. Componentul nedisociat a fost reprezentat printr-o singură bandă. Lanţurile α sunt prezentate prin 2 benzi şi o singură bandă α'. La nivelul benzilor β s-au determinat 4 benzi polipeptidice.

La genotipul LC 39 Rf au fost depistate 2 profiluri (fig.1, 5A-5B), diferenţele fiind depistate la nivelul lanţurilor β. Profilul A a fost determinat la 15% probe analizate, celălalt, respectiv 85%. Profilurile se caracterizează prin prezenţa a 7-8 benzi. Componentul nedisociat a fost reprezentat printr-o singură bandă. Lanţurile α sunt prezentate prin 3 benzi şi o singură bandă α'. La nivelul benzilor β s-au determinat 3-4 benzi polipeptidice.

Genotipul LC Raus Rf a demonstrat 3 profile (fig.1, 6A-6C). 26,3% din probele studiate au prezentat profilul A, 42,1% - profilul B şi 31,6% - profilul C. Componentul nedisociat a fost reprezentat prin 1-2 benzi. Lanţurile α sunt prezentate prin 2-3 benzi şi o singură bandă α'. La nivelul benzilor β s-au determinat 3-4 benzi polipeptidice.

Analiza profilurilor hibrizilor de primă generaţie (figura 2) obţinute în baza încrucişărilor liniilor date  a pus în evidenţă diferenţele la nivelul diferitor componente a heliantininei.

Astfel, pentru hibridul Drofa ASC x LC 7 Rf a fost depistat un singur profil (fig. 2, 1). Profilul se caracterizează prin prezenţa a 8 benzi. Componentul nedisociat a fost reprezentat printr-o singură bandă. Lanțurile α sunt prezentate prin 3 benzi şi o singură bandă α'. La nivelul benzilor β s-au determinat 3 benzi polipeptidice.

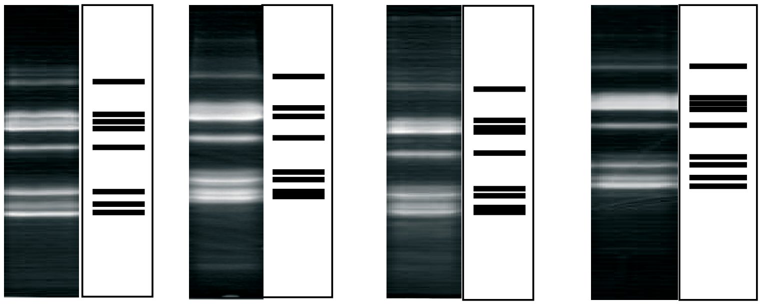


Figura 2. Spectrul heliantininei hibrizilor de prima generație de floarea-soarelui
1 – Drofa ASC x LC 7 Rf; 2 – Drofa ASC x LC 39 Rf; 3 – LC 40 ASC x Xenia Rf; 4 – LC 40 ASC x LC Raus Rf.

La hibridul Drofa ASC x LC 39 Rf a fost determinat un singur profil (fig. 2, 2). Profilul se caracterizează prin prezența a 8 benzi. Componentul nedisociat a fost reprezentat printr-o singură bandă. Lanțurile α sunt prezentate prin 2 benzi şi o singură bandă α'. La nivelul benzilor β s-au determinat 4 benzi polipeptidice.

Genotipurile hibride LC 40 ASC x Xenia Rf şi LC 40 ASC x LC Raus Rf s-au caracterizat printr-un singur profil. Profilul se caracterizează prin prezența a 9 benzi. Componentul nedisociat a fost reprezentat printr-o singură bandă. Lanțurile α sunt prezentate prin 3 benzi şi o singură bandă α̕. La nivelul benzilor β s-au determinat 4 benzi polipeptidice (fig. 2, 3-4).

Profile similare au fost constatate şi pentru  heliantenina izolată din genotipurile de origine Belorusă, oferite de către colaboratorii laboratorului de "Ereditate necromozomială", Institutul de Genetică şi Citologie al Academiei Naționale de Ştiințe a Republicii Belarus. Cele nouă genotipuri beloruse s-au caracterizat pintr-un grad înalt de omogenitate ceea ce denotă puritatea înaltă a liniilor investigate, reprezentând un indice al calității materialului ameliorativ.

## Concluzii

Au fost analizate 540 profiluri polipeptidice ale heliantininei la genotipurile de origine moldovenească şi belorusă. Liniile paterne LC Raus şi LC

39 s-a caracterizat prin cel mai înalt grad de polimorfism genetic prin trei şi respectiv două profiluri atipice. Aceste date urmează să fie în continuare verificate pentru a stabili cauza spectrelor atipice observate (impuritate genetică, contaminări, populaţie heterogenă etc).

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# EFFECT OF *OROBANCHE CUMANA* WALLR. ON FAT CONTENT IN DIFFERENT SUNFLOWER (*HELIANTHUS ANNUUS* L.) GENOTYPES

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**Summary.** *The effects of broomrape (Orobanche cumana Wallr.) attack on seeds fat content were investigated in different sunflower (Helianthus annuus L.) genotypes. Fat contents of all sunflower cultivars were significantly decreased by broomrape infection depending on number of broomrapes per sunflower plant.*

## Introduction

Nowadays, sunflower is one of the most important crops in the world grown as edible oil, after soybean, rapeseed and peanut [26, 14]. Moreover, its oil has excellent nutritional properties and has a relatively high concentration of linoleic acid [6, 15, 29, 2].

Only soybean oil and palm oil are produced in greater abundance. Sunflower oil is considered premium oil due to its high unsaturated fatty acid composition and low content of linolenic acid [23].

In connection with production process of sunflower Brandt *et al.* [4] state that forming of achene yield and quality is a complex process, conditional by function and frequency of many factors, which in their interactions make complex structure of growth, physiological and biochemical processes.

Environmental conditions effects growing and development, yield and oil quality of the plants in different ways. High temperature during growing period especially duration of seed development may influence the composition of fatty acids, and results lower quality of the oil. Despite the identification of fatty acids composition is determined by genetically, they are also changed by environmental conditions. More unsaturated fatty acid consists in cold climates and high altitudes [32].

Seed oil content and fatty acids in plants varies depending on environmental conditions by the time of developing stage. While environmental factors especially the minimum temperature and sunlight (solar radiation) has a significant influence on the concentration of sunflower oleic acid, the effect of maximum temperature has less importance. Linoleic acid content of sunflower is affected negatively by minimum temperature and sunlight [12, 9, 13]. Hossein Zeinalzadeh Tabrizi [14] noted that seed yield and oil content depend on suitable agronomic utilization and tolerance to biotic and abiotic stress factors.

Sunflower broomrape is currently regarded as one of the most important constraints in sunflower production [17]. *Orobanche cumana* Wallr., which is characterized by a high propagation coefficient [30] is the main sunflower root parasite [16, 8, 30, 25] causing significant damages to this strategic oilseed crop in many countries such as Turkey, Romania, Ukraine, Bulgaria, China and the Black Sea countries [11, 24, 25, 20, 16, 30, 18, 31, 10, 22], including Republic of Moldova.

The purpose of this investigation was to quantify seed fat content at different sunflower hybrids under natural infestation with *Orobanche cumana* Wallr.

## Materials and methods

Eleven sunflower genotypes (Fundulea hybrids as well as some foreign companies hybrids) have been tested in fields (naturally infestation with broomrape). The plants were collected at maturity, and grain yield was obtained by harvesting the middle two rows of each plot.

The values of fat content from sunflower kernel were achieved by extraction method. Fat content was set by extraction with petroleum ether by a Soxhlet apparatus [3]. Fat content was evaluated in % of dry material.

Biochemical data were presented as mean, standard deviation (SD) of three biological replicates. Data were subjected to analysis of variance to determine if significant differences were present among infection. Means were separated according to the least significant differences (LSD) at 0,05 and 0,01 levels of probability [33].

Biological material used in this research was obtained after preparing of natural field test for determining the resistance to broomrape and for some hybrids, the effectivity of IMI herbicide-Pulsar used to control weeds in sunflower, as well as, *Orobanche* parasite. Experimental field was prepared for the ”International Symposium on Broomrape (*Orobanche* spp.) in Sunflower”, Chisinau, Republic of Moldova, August 25-27, 2011.

## Results and discussions

Data presented in Figure 1 showed that broomrape infection had negatively effects on fat content of all studied genotypes. The most affected variety was found in Rimi 3 of broomrape stress. In this case seed fat content was significantly (at 5 and 1% levels of probability) found in low (- 22,54%) level compared to control. Minimum decrease (- 2,65%) of this trait was determined in Limagrain 1 hybrid (Table 1).

The impact of the disease on yield has not been clearly, but yield losses up to 1,3 t/ha have been reported [19]. Carson [5] showed up to 60% yield decreases, with consequences on oil yield. The literature has also reported that plant diseases could act on the fatty acids content, but results on this subject stay unknown and controversial in sunflower [21].

Table 1

**Fat content (% dry weight) of sunflower kernels, infected with**

| *Genotype* | *Fat content (% dry weight), standard deviation* | | *Effect of infection, %* | *LSD, level of probability* | | *Sx%* |
|---|---|---|---|---|---|---|
| | *control* | *infected* | | *0,05* | *0,01* | |
| ITC-09 | 58,91 ± 0,13 | 54,28 ± 0,20 | - 7,85 [1, 2] | 0,85 | 1,56 | 0,34 |
| Super 1 | 63,65 ± 0,14 | 61,31 ± 0,08 | - 3,67 [1, 2] | 0,54 | 0,98 | 0,19 |
| Performer | 61,64 ± 0,15 | 59,07 ± 0,12 | - 4,18 [1, 2] | 0,78 | 1,44 | 0,29 |
| Nidera 2 | 59,14 ± 0,23 | 55,66 ± 0,17 | - 5,88 [1, 2] | 0,80 | 1,47 | 0,31 |
| Nidera 3 | 60,49 ± 0,22 | 56,36 ± 0,16 | - 6,82 [1, 2] | 1,15 | 2,11 | 0,44 |
| Nidera 4 | 57,01 ± 0,14 | 55,19 ± 0,12 | - 3,18 [1, 2] | 0,89 | 1,63 | 0,35 |
| Limagrain 1 | 53,68 ± 0,16 | 52,26 ± 0,21 | - 2,65 [1, 2] | 0,55 | 1,02 | 0,23 |
| Alex | 53,42 ± 0,10 | 51,66 ± 0,28 | - 3,30 [1] | 1,09 | 2,00 | 0,46 |
| Novi Sad 5 | 60,29 ± 0,13 | 52,13 ± 0,20 | - 13,53 [1, 2] | 2,13 | 2,07 | 0,45 |
| Novi Sad 6 | 55,32 ± 0,17 | 49,86 ± 0,24 | - 9,86 [1, 2] | 1,50 | 2,75 | 0,63 |
| Rimisol 3 | 62,31 ± 0,19 | 48,27 ± 0,28 | - 22,54 [1, 2] | 1,36 | 2,50 | 0,55 |

[1] – Significant at 5% level of probability; [2] – Significant at 1% level of probability

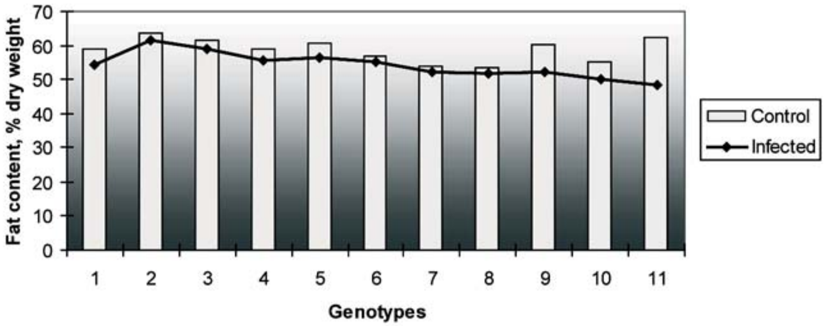


Figure 1. Effect of sunflower broomrape on fat content (% dry weight) in kernels of different sunflower hybrids

(1 – ITC-09; 2 – Super 1; 3 – Performer; 4 – Nidera 2; 5 – Nidera 3; 6 – Nidera 4; 7 – Limagrain 1; 8 – Alex; 9 – Novi Sad 5; 10 – Novi Sad 6; 11 – Rimi 3)

An inverse relationship (Figure 2) was observed between number of broomrape per sunflower plant and seed fat content. This information may be useful for selecting higher yielding varieties for commercial sunflower production.

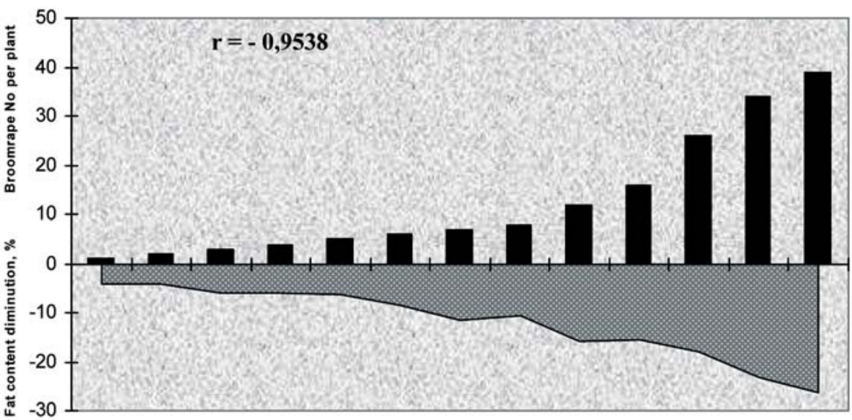


Figure 2. Correlation between kernel fat content diminution (%) and broomrape number per sunflower plant

As we demonstrated, broomrape infection caused a loss of fat content at all eleven studied variants. These results indicate that sunflower plants suffered from an infection of *Orobanche cumana* Wallr. during grain filling and fat synthesis. A variation of seed weight and oil content, characteristic of premature ripening, was observed by Donald et al. [7], Seassau [27] and Seassau et al. [28]. The reduction in the number of grains per head suggests that the disease infection started at a stage previous to that determining the number of grains per head [1] and continued until plant maturity and fat synthesis [21].

## Conclusions

The natural infection of field with *Orobanche cumana* Wallr. had significant effects on fat content at all eleven studied sunflower genotypes. Thus, sunflower seed fat contents of all cultivars were significantly decreased by broomrape infection. Moreover, the observed decrease in seed fat content in infected plants by broomrape, could be the sign that *Orobanche* attack has a negative influence on the nutritional quality of seeds.

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# ANATOMIA CANTITATIVĂ A LAMINEI FRUNZEI VIȚEI DE VIE (*VITIS L.*)

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***Summary.*** *The quantitative anatomy of leaf lamina at 10 species and 14 cultivars of Vitis L. genus is described. The adaxial epidermis consists from a raw of polygonal cells, compactly arranged near one to other. The adaxial epidermis have no stomata. The abaxial epidermis is formed from basal epidermal cells, stomata, auxiliary cells and protector hairs. The stomatal complex of epidermis is of actynocytic type and it is specific for the studied species and cultivars. The stomata density per 1 mm*$^2$ *of foliar area is specific for each species and cultivar, but it is influenced by the environmental physic factors. In 2010 year stomata density varies from 101,34 stomata/mm*$^2$ *at the local cultivar Rara neagră, to the 237,50 stomata/mm*$^2$ *at the Vitis romaneti Rom. The stomata index varies within 4.46%, at the cultivar Grasa de Cotnari, and 8.97%, at the species Vitis cinerea Engelm. Mesophyll is situated, topographic, between adaxial and adaxial epidermis of leaf blade and it is consists of palisade parenchyma, spongy parenchyma and collateral vascular bundles, surrounded by the bundle sheaths. Are more drought resistant the species and cultivars of grapevine at which: average thickness of leaf lamina is greater; surface (area) average of leaf lamina is lower; the ratio area average of leaf lamina to volume average of lamina is lower; palisade parenchyma has average thickness greater than lacunar parenchyma. On the data of several years is elaborated the method for determining the drought resistance of the grapevine on morphoanatomical characters of leaf lamina.*

## Introducere

Studierea anatomiei cantitative a laminei frunzei la mai multe specii şi soiuri ale genului *Vitis L.* ne va permite să stabilim legitățile anatomo-morfologice ale adaptării viței de vie la secetă, să evidențiem caracterele adaptive, care pot fi folosite în lucrările de selecție şi introducție; să elaborăm o metodă de determinare a rezistenței la secetă a viței de vie.

Adaptarea plantelor viței de vie, la diferite condiții de asigurare cu apă, se realizează pe baza variabilității indicilor cantitativi ai anatomiei frunzei, în primul rând, deoarece frunza este cel mai plastic organ al plantei, care receptiv reacționează la schimbările factorilor fizici ai mediului ambiant.

În rezultatul consultării lucrărilor mai multor autori privind rezistența plantelor cu flori la secetă [1-5, 12, 13] am ales un complex de caractere morfoanatomice ale laminei frunzei viței de vie, care au fost cercetate pentru a determina rolul lor în rezistența la secetă a speciilor şi soiurilor viței de vie. Valorile biometrice ale caracterelor morfoanatomice ale laminei frunzei, la speciile şi soiurile viței de vie studiate în anul 2010, sunt prezentate în tabel.

## Materiale şi metode

Materialul de cercetare – frunzele mature (22-24.07.2010) ale speciilor şi soiurilor viţei de vie, programate pentru studiu, a fost colectat în colecţia ampelografică a Institutului Ştiinţifico-Practic de Horticultură şi Tehnologii Alimentare, situată în apropierea municipiului Chişinău.

Anatomia cantitativă a epidermei frunzei la aceste specii şi soiuri de viţă de vie a fost studiată la microscopul optic Ergaval pe replicile (amprentele) epidermei abaxiale şi adaxiale, obţinute din lacul incolor ”Golden Rose”. A fost folosită varianta 2 de obţinere a replicilor epidermei frunzei, desăvârşită de autor [7]. Metodica pregătirii micropreparatelor temporare pentru a cerceta secţiunea transversală a laminei frunzei viţei de vie este descrisă în altă lucrare [6]. La determinarea suprafeţei (ariei) medii a laminei frunzei a fost folosită metoda ampelometrică [14].

## Rezultate şi discuţii

Lamina frunzei viţei de vie este dorsi-ventrală, hipostomatică şi heterobarică.

Epiderma frunzei viţei de vie (*Vitis L.*) este un ţesut de protecţie primar, alcătuit dintr-un singur rând de celule, variate după formă, structură şi funcţii. Acest ţesut înveleşte mezofilul şi formează, pe partea ventrală a frunzei, epiderma adaxială, iar pe partea dorsală a ei – epiderma abaxială. Epiderma adaxială este alcătuită dintr-un rând de celule, în plan, poligonale, situate compact una lângă alta. Celulele au forma de poligon cu 5-8 laturi de diferită lungime.

Pereţii anticlinali exteriori ai celulelor sunt mai îngroşaţi, comparativ cu cei radiali şi sunt acoperiţi cu un strat de cuticulă de diferită grosime la diferite specii şi soiuri. La unele specii şi soiuri de viţă de vie celulele epidermei adaxiale ale frunzei au peri protectori, la altele perii lipsesc. Epiderma adaxială a laminei frunzei la viţă de vie (*Vitis L.*) nu are stomate.

Epiderma abaxială este alcătuită, de asemenea, dintr-un singur rând de celule, dar conţine mai multe tipuri morfologice de celule: *celule epidermale propriu-zise (de bază), stomate, celule anexe, celule vecine* şi *peri (pro)tectori*, variaţi după formă, structură şi mărime.

Funcţia principală a epidermei frunzei este protecţia plantei viţei de vie de pierderea excedentară a apei şi a substanţelor nutritive, apărarea de vătămarea mecanică şi de pătrunderea microorganismelor patogene.

Stomatele, împreună cu celulele secundare (anexe) şi vecine, formează *aparatele (complexele) stomatice.* Pentru epiderma abaxială a laminei frunzei, la speciile şi soiurile viţei de vie studiate, este caracteristic tipul morfologic *actinocit al aparatelor (complexelor) stomatice.* Celulele ane-

*Tabel*

## Valorile biometrice ale caracterelor morfoanatomice ale laminei frunzei viței de vie. Anul 2010

| *Denumirea speciei sau a soiului viței de vie* | *Epiderma adaxială* | *Paren-chimul palisadic* | *Parenchi-mul lacunar* | *Epider-ma aba-xială* | *Lamina frunzei* | *Densitatea stomatelor la 1 mm²* | *Lungimea stomatelor (în µm)* | *Lățimea stomatelor (în µm)* | *Indexul stomatic (în %)* | *Densitatea celulelor epidermei abaxiale la 1mm²* | *Suprafața (aria) medie a celulelor epidermei abaxiale (în µm²)* | *Densitatea celulelor epidermei adaxiale la 1 mm²* | *Suprafața (aria) medie a celulelor epidermei adaxiale (în µm²)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Grosimea în micrometri (µm)* | | | | | | | | | | | | |
| *V.monticola Buckl.* | 18,78 | 63,35 | 109,70 | 16,49 | 208,32 | 204,33 | 29,69 | 18,91 | 8,11 | 2662 | 375,65 | 1767 | 565,93 |
| *Vitis romaneti Rom.* | 17,78 | 66,77 | 103,55 | 15,50 | 203,60 | 239,80 | 28,29 | 17,45 | 8,27 | 2791 | 358,29 | 1878 | 532,48 |
| *V.californica Benth.* | 18,76 | 68,20 | 88,23 | 15,33 | 196,16 | 188,56 | 30,28 | 16,95 | 7,33 | 3164 | 316,05 | 2797 | 357,52 |
| *V.solonis* | 21,75 | 58,09 | 93,00 | 17,54 | 192,20 | 156,40 | 29,10 | 19,60 | 6,69 | 2614 | 382,55 | 1635 | 611,62 |
| *V.rupestris Scheele* | 16,91 | 64,11 | 94,55 | 15,08 | 190,65 | 235,46 | 30,30 | 21,07 | 6,65 | 3567 | 280,34 | 1742,40 | 573,92 |
| *V.silvestris Gmel.* | 18,17 | 47,09 | 102,30 | 15,09 | 186,00 | 182,60 | 32,15 | 19,47 | 7,80 | 2563,20 | 390,13 | 1941 | 515,19 |
| *V.aestivalis Michx.* | 17,78 | 55,05 | 91,00 | 15,97 | 179,80 | 196,00 | 30,06 | 19,91 | 8,14 | 2727,20 | 366,07 | 2160 | 462,96 |
| *V.cinerea (B-9) Engelm.* | 18,64 | 53,38 | 86,15 | 15,87 | 174,04 | 207,15 | 29,69 | 21,14 | 8,97 | 3012 | 332,01 | 1739 | 575,04 |
| *V.amurensis (B-11) Rupr.* | 19,03 | 53,84 | 84,61 | 16,12 | 173,60 | 196,20 | 29,05 | 22,78 | 6,94 | 2994 | 334,00 | 1785 | 560,22 |
| *V.vulpina L.* | 16,65 | 51,52 | 85,32 | 15,15 | 170,26 | 232,64 | 29,50 | 17,66 | 7,90 | 3251 | 307,59 | 1960 | 510,20 |
| Gordin | 22,25 | 64,48 | 100,57 | 18,60 | 211,36 | 250,40 | 30,48 | 17,96 | 8,25 | 3116 | 320,93 | 1807 | 553,41 |
| Copciac | 18,47 | 66,87 | 104,65 | 16,85 | 206,84 | 119,16 | 32,50 | 18,79 | 5,55 | 2324 | 430,29 | 1602 | 624,22 |
| Coarna neagră | 17,15 | 66,77 | 99,18 | 16,85 | 199,95 | 137,33 | 30,94 | 19,28 | 7,12 | 2021 | 494,80 | 2055 | 486,62 |
| Grasa de Cotnari | 19,67 | 63,93 | 89,96 | 17,78 | 191,34 | 136,40 | 29,25 | 17,86 | 4,46 | 3234 | 309,22 | 2051 | 487,57 |
| Galbena de Odobești | 19,64 | 65,10 | 86,75 | 17,43 | 188,92 | 180,20 | 29,92 | 18,35 | 6,75 | 3261 | 306,66 | 1556 | 642,68 |
| Aligote | 18,38 | 62,62 | 88,91 | 17,15 | 187,06 | 172,40 | 28,79 | 18,31 | 6,1 | 2969 | 336,82 | 1583,52 | 631,51 |
| Rara neagră | 18,23 | 65,35 | 86,12 | 16,74 | 186,44 | 101,14 | 31,63 | 20,31 | 3,49 | 2962 | 337,61 | 1852 | 539,96 |
| Fetească albă | 17,08 | 56,20 | 96,53 | 15,70 | 185,51 | 192,17 | 26,58 | 18,17 | 5,51 | 3950 | 253,16 | 1685 | 593,48 |
| Șasla | 16,59 | 50,90 | 101,50 | 15,74 | 184,76 | 237,50 | 27,93 | 19,79 | 7,54 | 3182 | 314,26 | 1798 | 556,17 |
| Kiș-miș alb oval | 19,64 | 56,42 | 92,07 | 16,38 | 184,58 | 183,80 | 29,47 | 16,31 | 5,97 | 3112 | 321,33 | 1309 | 763,94 |
| Feteasca neagră | 21,38 | 58,90 | 83,73 | 18,03 | 182,04 | 149,16 | 32,65 | 17,07 | 6,81 | 2363 | 423,19 | 1900 | 526,31 |
| Pinot fran | 23,28 | 51,84 | 91,33 | 15,09 | 181,54 | 184,80 | 27,89 | 18,21 | 4,98 | 3917 | 255,30 | 1968 | 508,13 |
| Coarna albă | 17,55 | 62,68 | 81,45 | 16,88 | 178,56 | 101,34 | 35,18 | 21,70 | 6,22 | 2443,20 | 409,29 | 2215,20 | 451,42 |
| Feteasca regală | 19,43 | 53,02 | 83,70 | 18,69 | 174,84 | 160,29 | 25,62 | 17,28 | 5,52 | 3116 | 320,92 | 2076 | 481,69 |

xe, la tipul actinocit, se deosebesc după formă şi mărime. Ele formează în jurul celulelor stomatice o rozetă. Pereții laterali ai celulelor rozetei sunt îndreptați spre apertura stomatei.

Valorile biometrice ale caracterelor anatomice ale laminei frunzei, la 10 specii şi 14 soiuri de viță de vie studiate în anul 2010, sunt prezentate în tabel.

Densitatea stomatelor, la unitatea de suprafață (arie) foliară, variază de la 156,40 stomate/mm$^2$, la *Vitis solonis*, până la 239,80 stomate/mm$^2$, la *V.romaneti.* La soiurile viței de vie densitatea stomatelor variază de la 101,34 stomate/mm$^2$, la soiul local Rara neagră, până la 237,50 stomate/mm$^2$, la soiul alohton Şasla. Lungimea medie a stomatelor variază de la 25,62 μm, la soiul Feteasca regală, până la 35,18 μm, la soiul Coarna albă. Lățimea medie a stomatelor variază de la 16,31 μm, la soiul Kiş-miş alb oval, până la 22,78 μm, la specia *V.amurensis.*

Densitatea stomatelor epidermei frunzei, la speciile şi soiurile viție de vie studiate, este specifică şi sortospecifică, dar se schimă sub influența factorilor fizici ai mediului ambiant.

E stabilită următoarea legitate, caracteristică pentru stomate şi celulele epidermei adaxiale şi abaxiale: mărirea densității stomatelor şi a celulelor epidermei adaxiale şi abaxiale a laminei frunzei viței de vie duce la micşorarea suprafeței (ariei) medii a acestor celule.

Indexul stomatic variază de la 4,46%, la soiul Grasa de Cotnari, până la 8,97%, la specia *V.cinerea.*

Densitatea celulelor epidermei abaxiale a laminei frunzei variază de la 2021 celule/mm$^2$, la soiul Coarna neagră, până la 3950 celule/mm$^2$, la soiul Feteasca albă. Suprafața (aria) medie a celulelor epidermei abaxiale variază de la 494,80 μm$^2$, la soiul Coarna neagră, până la 253,16 μm$^2$, la Feteasca albă; adică aria medie a celulelor este invers proporțională cu densitatea lor la unitatea de suprafață. Densitatea celulelor epidermei adaxiale, la toate speciile şi soiurile viței de vie studiate, este mai mică, comparativ cu densitatea celulelor epidermei abaxiale şi, în anul 2010, variază de la 1309 celule/mm$^2$, la soiul alohton Kiş-miş alb oval, până la 2797 celule/mm$^2$, la specia *V.californica.*

Mezofilul este situat, topografic, între epiderma adaxială şi epiderma abaxială a laminei frunzei şi este diferențiat în *parenchim palisadic, parenchim lacunar* şi *fascicule de conducere colaterale,* învelite sau nu cu *țesut mecanic.*

Cristalele oxalatului de calciu, sub formă de *rafide*, se conțin în celulele mai mari (*idioblaste*) ale mezofilului. Ele sunt amplasate în parenchimul lacunar, la limita cu parenchimul palisadic. Dimensiunile rafidelor sunt foarte variate: lungimea lor variază de la 20 μm până la 60 μm, lățimea – de la 15 μm până la 35 μm.

*Parenchimul palisadic* este compus dintr-un singur rând de celule, situate perpendicular la suprafața laminei frunzei. Lungimea medie a lor variază, în anul 2010, de la 50,90 μm, la soiul Șasla, până la 68,20 μm, la specia *Vitis californica*. Lățimea celulelor palisadice variază de la 9 μm până la 12-15 μm. Numai la soiul viței de vie Isabella grosimea (înălțimea) parenchimului palisadic este mai mare (74,40 μm), ca a parenchimului lacunar (51,40 μm) şi devine, în acest caz, un *caracter morfoanatomic calitativ* al rezistenței la secetă a viței de vie. La toate celelalte specii şi soiuri de viță de vie, studiate în anul 2010, grosimea medie a parenchimului palisadic este mai mică, comparativ cu grosimea parenchimului lacunar. Deşi grosimea medie a laminei frunzei la soiul Isabella este numai de 163,31 μm, el se clasează la grupa soiurilor rezistente la secetă. La acest soi de viță de vie rezistența relativă mai mare la secetă este cauzată de grosimea medie mai mare a țesutului palisadic al mezofilului. La celelalte soiuri şi specii de viță de vie rezistența mai mare la secetă este determinată de grosimea totală, mai mare, a laminei frunzei, caracter adaptiv principal al rezistenței la secetă a viței de vie, dar e un *caracter morfoanatomic cantitativ*.

Celulele țesutului palisadic se deosebesc de celulele țesutului lacunar prin formă şi mărime. Deosebirea apare în timpul creşterii frunzei. La celulele palisadice predomină creşterea în direcție perpendiculară la suprafața (aria) laminei frunzei. Celulele țesutului lacunar cresc în direcție longitudinală. Particularitățile ultrastructurale ale acestor 2 țesuturi ale mezofilului sunt influențate mult de topografia şi ultrastructura cloroplastelor. Plastidele celulei palisadice sunt situate în apropierea pereților anticlinali.

*Parenchimul lacunar* este format din 5-7-9 rânduri de celule, variate după formă şi mărime. Deosebim celule aproape rotunde cu diametrul de 15-17 μm; celule ovale cu diametrul mare de 25-35 μm; celule ovale-alungite cu diametrul mare de 40-60 μm; celule tetragonale cu laturile de 25-30 μm; celule lobate şi celule neregulate cu excrescențe, care unesc celulele între ele. În acest țesut contactele topografice între celule se fac în plan orizontal, paralel la suprafața laminei frunzei. Celulele mature ale mezofilului sunt foarte vacuolizate.

Spațiile intercelulare în mezofilul laminei frunzei au origine schizogenă. Spațiile intercelulare, în țesutul palisadic şi în țesutul spongios, apar pe calea separării membranelor primare ale celulelor vecine, care se produce pe placa mediană. Acest proces începe la unghiurile unde se unesc trei celule, apoi se răspândeşte şi asupra altor sectoare ale pereților celulari. După terminarea dividerilor, celulele palisadice se despart una de alta pe pereții anticlinali. Separarea celulelor țesutului lacunar se îmbină cu creşterea locală a lor, fapt care duce la formarea celulelor neregulate.

În tabel speciile şi soiurile viței de vie sunt aranjate în ordinea descreşterii grosimii medii a laminei frunzei, caracter morfoanatomic, care, în literatura botanică şi ampelografică, este considerat că determină rezistența la secetă a plantelor cu flori.

Grosimea medie a laminei frunzei, la speciile şi soiurile viței de vie studiate în anul 2010, variază de la 211,36 μm, la soiul viței de vie local Gordin, până la 170,26 μm, la specia *Vitis vulpina.* Cu cât grosimea medie a laminei frunzei este mai mare, cu atât rezistența relativă la secetă a soiului sau a speciei viței de vie este mai mare.

La grupa speciilor viței de vie cu rezistența relativă mare la secetă noi includem speciile *V.monticola, V.romaneti, V.californica, V.solonis, V.silvestris, V.rupestris,* care au grosimea laminei frunzei în limitele 200-215 μm. La această grupă clasăm şi soiurile locale Copciac, Coarna neagră, Grasa de Cotnari (vezi tab.), care au o grosime medie a laminei frunzei mai mare, ca soiurile Aligote, Kiş-miş alb oval, Pinot fran, care sunt estimate, în literatura viticolă şi ampelografică, ca soiuri rezistente la secetă.

Reieşind din grosimea medie a laminei frunzei, fixate în etanol de concentrația 95%, speciile şi soiurile viței de vie studiate de noi (Codreanu, 2008, 2009; Codreanu, Savin, Cornea, 2010; Codreanu, 2011), pot fi clasificate în 3 grupe: 1) specii şi soiuri cu *grosimea mare a laminei frunzei* – (200-240 μm); 2) specii şi soiuri cu *grosimea medie a laminei frunzei* – (170-199 μm); 3) specii şi soiuri cu *grosimea mică* a laminei frunzei – (< de 160 μm).

## Concluzii

1. Densitatea stomatelor epidermei abaxiale a laminei frunzei, la speciile şi soiurile studiate ale genului *Vitis L.,* este specifică şi sortospecifică, dar e influențată de factorii fizici ai mediului ambiant. În anul 2010, densitatea stomatelor variază de la 101,34 stomate/mm$^2$ de suprafață foliară, la soiul local Rara neagră, până la 239,80 stomate/mm$^2$, la specia *Vitis romaneti Rom.* Epiderma adaxială a laminei frunzei viței de vie nu are stomate.

Studierea densității stomatelor viței de vie este actuală şi necesară pentru Viticultura Republicii Moldova deoarece genotipurile viței de vie, care au densitatea stomatelor mai mică, sunt mai adaptate la condițiile de viață concrete; iar acele genotipuri de viță de vie, care-şi schimbă însemnat densitatea stomatelor, în anul următor după anul secetos, au proprietatea de a se adapta mai bine la condiții noi de viață.

2. Tipul morfologic *actinocit* al aparatelor (complexelor) stomatice

este caracteristic pentru epiderma abaxială a laminei frunzei viței de vie (*Vitis L.*).

3. Indexul stomatic, la speciile şi soiurile viței de vie studiate în anul 2010, variază de la 4,46%, la soiul Grasa de Cotnari, până la 8,97%, la specia *Vitis cinerea Engelm.*

4. Densitatea celulelor epidermei abaxiale a laminei frunzei variază, în anul 2010, de la 2021 celulele/$mm^2$ de suprafață (arie) foliară, la soiul viței de vie local Coarna neagră, până la 3950 celulele/$mm^2$, la soiul Feteasca neagră. Densitatea celulelor epidermei adaxiale a laminei frunzei este mai mică şi variază, în anul 2010, de la 1309 celulele/$mm^2$, la soiul alohton Kişmiş alb oval, până la 2797 celulele/$mm^2$, la specia *Vitis californica Benth.*

5. În rezultatul studierii anatomiei cantitative a laminei frunzei la 15 specii ale genului *Vitis L.* şi 15 soiuri de viță de vie locale au fost stabilite 4 caractere morfoanatomice ale laminei frunzei, care determină rezistența viței de vie la secetă. Mai rezistente la secetă sunt speciile şi soiurile viței de vie, la care: 1) grosimea medie a laminei frunzei este mai mare; 2) suprafața (aria) medie a laminei frunzei este mai mică; 3) grosimea medie a parenchimului palisadic este mai mare ca grosimea medie a parenchimului lacunar; 4) raportul ”suprafața (aria) medie a laminei frunzei : volumul mediu al laminei frunzei” este mai mic.

6. Este elaborată ”*Metoda de determinare a rezistenței la secetă a viței de vie pe baza caracterelor morfoanatomice ale laminei frunzei*”.

7. Caracterele morfoanatomice ale adaptării viței de vie la secetă şi metoda de determinare a rezistenței la secetă a viței de vie vor fi folosite în Viticultura Republicii Moldova.

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# 2. TAXONOMY. CONSERVATION OF THE PLANT KINGDOM

## CONSERVAREA DIVERSITĂȚII BIOLOGICE– REALIZĂRI ŞI PERSPECTIVE

***A. Teleuță, Lazăr Chirică, Ala Rotaru***

*Ministerul Mediului*

### Introducere

Actualmente problema conservării diversității biologice depăşeşte limitele problemelor ştiințifice şi se amplasează la nivelul problemelor stringente ale politicii statelor şi a instituțiilor internaționale, precum mondiale, atât şi Europene.

Potrivit Uniunii Internaționale pentru Conservarea Naturii (UICN), instituția de referință în materie de conservare a biodiversității, jumătate din speciile de animale şi plante sunt amenințate cu reducerea numărului de exemplare, iar un sfert chiar cu dispariția.

În Mesajul Secretarului General al Organizației Națiunilor Unite se menționează, că declinul biodiversității, înregistrat la nivel mondial, rămâne încă alarmant, în ciuda Acordului de la Summit-ul Mondial al Dezvoltării Durabile de la Johannesburg din 2002, care prevedea reducerea semnificativă a ratei de pierdere a biodiversitatii până în a. 2010.

Anume din aceste considerente Deceniul 2011 – 2020 este desemnat de ONU în calitate de "*Deceniu Internațional al Diversității Biologice*".

### Obiectivele globale în biodiversitate în ultimul deceniu

Cel mai însemnat eveniment în domeniul Biodiversității din ultimii ani este numită cea de a X-a reuniune a Conferinței părților la *Convenția privind diversitatea Biologică* din Nagoya, Japonia din a. 2010.

La reuniunea din Nagoya au fost adoptate decizii istorice şi obiective concrete pentru următorii 10 ani (2011 – 2020) privind stabilirea măsurilor urgente în scopul diminuării consecințelor, care duc direct la pierderea biodiversității (reducerea habitatelor, exploatarea excesivă a florei şi faunei, poluarea ecosistemelor naturale, invazia speciilor alogene şi schimbările climatice).

În cadrul Reuniunii Guvernele au convenit asupra unui pachet de măsuri concrete, care vor asigura, ca ecosistemele Planetei să fie protejate în aşa mod, ca să devină o platformă pentru susținerea vieții şi bunăstării umane pe un viitor îndelungat.

Pentru prima dată, în cadrul unei reuniuni au fost aprobate 2 tratate internaționale noi care au o importanță majoră pentru conservarea biodiversității la nivel mondial, precum:

- *Protocolul Nagoya-Kuala Lumpur privind Răspunderea şi reparația*, ca un Protocol suplimentar al celui de la Cartagena privind biosecuritatea, care urmăreşte scopul de protecție a diversității biologice de la riscurile potențiale din partea organismelor vii modificate genetic, rezultate din biotehnologiile moderne;
- *Protocolul privind Accesul şi Partajarea Beneficiilor de la Folosința Resurselor Genetice (ABS)*, care va asigura transparența, securitatea juridică şi previzibilitatea, în ceea ce priveşte accesul la resursele genetice, împărțirea echitabilă a beneficiilor rezultate în urma utilizării resurselor genetice, a derivaților acestora şi a cunoaşterii tradiționale asociate cu resursele genetice.

În cadrul Reuniunii au fost negociate aspecte referitoare la progresul pentru atingerea obiectivului 2020, privirea globală asupra biodiversității, ținte propuse şi indicatori, cooperarea ştiințifică şi tehnică, mecanismul de schimb de informații, transferul de tehnologie, comunicarea, sensibilizarea şi conştientizarea publicului. În cadrul negocierilor, a fost menționat faptul că trebuie consolidate sinergiile dintre cele trei Convenții de la Rio: privind biodiversitatea (**CBD**), schimbările climatice (**CCONUSC**) şi deşertificarea (**CONUCD**) şi organizarea unei reuniuni la nivel înalt, pe marginea acestor trei Convenții, în cadrul Summitului Rio+20 din 2012, pentru atingerea scopului principal pentru o Dezvoltare durabilă.

În cadrul Conferinței Părților Guvernele au convenit asupra adoptării următoarelor documente starategice:

- *Planul Strategic privind biodiversitatea în perioada 2011-2020;*
- *Strategiei pentru mobilizarea resurselor financiare.*

*Planul Strategic al CBD* include *20 de obiective principale*, organizate sub *cinci obiective strategice,* care abordează cauzele pierderii biodiversității, reducerea presiunilor asupra biodiversității, protecția biodiversității la toate nivelurile, creşterea beneficiilor oferite de biodiversitate şi facilitarea consolidării capacităților. În felul acesta a fost stabilită o nouă alianță globală pentru protecția biodiversității.

**Realizări şi perspective în domeniul biodiversităţii**

Obiectivele care sunt menite să asigure condiţii favorabile pentru conservarea diversităţii biologice în Republica Moldova sunt stabilite de tratatele internaţionale, la care suntem parte şi acordurile bilaterale cu statele vecine România şi Ukraina.

Cerinţele internaţionale în domeniul conservării biodiversităţii au servit ca bază la elaborarea actelor legislative: *Legea privind fondul ariilor naturale protejate de stat (1998), Legea regnului animal (1995), Legea regnului vegetal (2007), Legea cu privire la Cartea Roşie a Republicii Moldova (2005), Legea cu privire la resursele naturale (1997), Legea cu privire la reţeaua ecologică (2007), Programului naţional privind constituirea reţelei ecologice naţionale pentru anii 2011-2018, aprobat prin* **(***2011)* şi a unui şir de acte normative.

Au fost stabilite obiective de conservare a biodiversităţii şi de extindere a ariilor naturale protejate de stat în:

- Planul de acţiuni al Guvernului pentru anii 2011-2014 (HG nr. 179 din 23.03.2011).

- Proiectul Programului de Dezvoltare Strategică a Ministerului Mediului pentru 2012-2014.

- Proiectul Strategiei de protecţia a mediului.

A fost lansat Planul de Acţiune Naţional pentru evenimentul „Deceniul Biodiversităţii 2011-2020", prin *Ordinul nr. 59 din 31.05.11.*

Iar, în conformitate cu *Planul Strategic privind biodiversitatea, pentru perioada 2011-2020* au fost obţinute următoarele progrese:

**-** la 25 ianuarie 2012, Republica Moldova a semnat 2 tratate noi în domeniul conservării biodiversităţii: Protocolul de la Nagoya privind accesul la resursele genetice şi distribuirea corectă şi echitabilă a beneficiilor care rezultă din utilizarea acestora (ABS), la Convenţia CBD şi Protocolul Adiţional Nagoya - Kuala Lumpur privind răspunderea şi repararea daunelor la Protocolul de la Cartagena;

- a fost semnat *Memorandumul de colaborare între Ministerul Mediului, Agenţia „Moldsilva" şi Academia de Ştiinţe a Moldovei* privind colaborarea în domeniul silviculturii, conservării biodiversităţii şi gestionării ariilor naturale protejate de stat, semnat la 29.10.2011;

- a fost lansat proiectul UNDP-GEF „Planificarea naţională în domeniul biodiversităţii pentru susţinerea implementării Planului Strategic al CDB pentru a. 2011-2020 în Republica Moldova", în suma de 222 mii

$SUA pentru perioada a.2012 – 2013, care prevede elaborarea Strategiei şi Planului de Acţiune în domeniul diversităţii biologice şi Raportului V la Convenţia CBD;

- a fost lansat Planul de Acţiune Naţional pentru evenimentul „Deceniul Biodiversităţii 2011-2020", prin *Ordinul nr. 59 din 31.05.11.;*

- derulează cu succes proiectul UNEP – GEF „Fortificarea capacităţilor institutionale şi reprezentativităţii sistemului de arii protejate din Republica Moldova", care prevede evaluarea stării ariilor naturale din Moldova şi crearea Primului Parc naţional Orhei;

- au fost organizate activităţi în cadrul Anului Pădurilor 2011 şi Anilor liliecilor 2011-2012.

Prevederile de bază pentru conservarea biodiversităţii şi a ecosistemelor naturale au fost stabilite şi în acţiunile comune cu statele vecine România şi Ucraina, în cadrul programelor regionale privind protecţia mediului – în bazinele Mării Negre, fluviile Dunărea şi Nistru, râul Prut, în zonele umede, terenuri cu landşafturi şi monumente naturale unicale etc.

Se duc negocieri cu România şi Ucraina asupra creării Rezervaţiei a biosferei trilaterale: „Delta Dunării – Prutul de Jos" .

Ministerul mediului a susţinut din Fondul Ecologic finanţarea activităţilor de elaborare a Cărţii Roşii, publicarea monografiilor: "Insectele", „Fluturii", „Flora Basarabiei" etc. şi a unor lucrări de gospodărire a Grădinii Botanice.

## Concluzii

Evidenţiind importanţa protecţiei resurselor biologice, constatăm că mai există obstacole de caracter politic, social şi economic pentru realizarea la nivel cuvenit al prevederilor tratatelor internaţionale cu privire la implementarea politicii mondiale privind stoparea degradării biodiversităţii, ţintă care reprezintă obiectivul principal al Republicii Moldova pentru următorii 10 ani, care este necesar de a fi realizat în comun acord de către organele de stat şi locale, instituţiile ştiinţifice şi organizaţiile non-guvernamentale.

Astfel, se cere conservarea, restabilirea, reconstrucţia şi folosirea raţională a diversităţii biologice şi peisagistice în vederea asigurării dezvoltării social-economice durabile a Republicii Moldova.

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## VEGETAL COMMUNITIES OF *JUNCETEA TRIFIDI* HADAČ 1946 FROM THE HYDROGRAPHIC BASIN OF NEAGRA BROŞTENILOR RIVER (ROMANIA, EASTERN CARPATHIANS)

***Mardari Constantin****

**"Anastasie Fătu" Botanical Garden Iaşi*

**Summary.** *The article presents four vegetal communities (Juncetum trifidi Szafer et al. 1923, Potentillo chrysocraspedae-Festucetum airoidis Boşcaiu 1971, Scorzonero roseae-Festucetum nigricantis (Puşcaru et al. 1956) Coldea 1987 and Violo declinatae-Nardetum Simon 1966) from Juncetea trifidi Hadač 1946 identified in Neagra Broştenilor hydrographic basin. These are analyzed from the chorology, floristic and phytosociological composition, life forms, chorotypes and ecological requests perspectives. All these characteristics have been used to assess some correlations among species diversity, chorotypes and some environmental variables specific to each vegetal community. In this way numerous correlations have been registered, as positive correlations among altitude and alpine floristic elements and negative correlations among altitude and species exigencies for temperature and nutrients from soils.*

### Introduction

Natural primary and also secondary alpine and subalpine (rarely montane) grasslands from *Juncetea trifidi* (syntaxon synonym *Caricetea curvulae*) vegetation class are installed on acid and poor in nutrients and calcium soils [2]. The coenotaxonomic affiliation of some of these vegetal communities is still discussed, being classified in different vegetation units by various phytosociologists. Some of the authors exclude from this vegetation class the alpine acid soil mat grass swards (*Nardetalia*) and include it in *Nardo-Callunetea* vegetation class [5] and others includes these mat grass swards in *Juncetea trifidi* (*Festucetalia spadiceae*) due to the numerous acid indicator species in common [2], classification adopted by us in the current article.

The study area, represented by the hydrographic basin of Neagra Broşteni River includes the central region of Bistrița Mountains, a part of the eastern slopes of Călimani Mountains and Drăgoiasa-Glodu Depression (Suceava county) presenting an area of approximate 350 km$^2$

[15]. The river is about 42 km long, springs from Măgura Mountain (1300 m) and confluence with Bistrița River at Broşteni (627 m). The basin is characterized by increased altitudes: 2030 m - Căliman Izvor peak, 2013 - Căliman Cerbuc peak, Budacu peak - 1859 m and the presence of acid eruptive and crystalline rocks [9]. The climate is characterized by average precipitations oscillating between 600-1100 mm/m$^2$/year, yearly averages temperatures of 0-4ºC, increased nebulosity (6,8-7) and increased relative humidity of atmosphere (>80%) [13].

## Materials and methods

The study is based on phytosociological data collected in 2007-2008 period, in the hydrographic basin of Neagra Broştenilor River, according to the standard Central European phytosociological method [1]. In order to characterize the *Juncetea trifidi* vegetation class in this territory we used 27 relevés including 98 cormophytes species grouped in 4 vegetal associations. All these species and relevés were used to create a matrix presenting 27 columns and 98 rows. In order to realize numerical calculations, the abundance-dominance values of each species have been transformed according to van der Maarel scale [12]. Also for each species are presented: indices expressing the ecological requirements [6], chorotypes [3] and life forms [3]. With all these indices we realized other matrices: the matrix of ecological indices presenting 4 rows and 98 columns, the matrix of chorotypes presenting 8 rows and 98 columns and a matrix of life forms presenting 6 rows and 98 columns. The list of ecological indices, chorotypes and life forms is presented in Table 1. All these matrices of ecological indices, chorotypes and life forms have been multiplied by the first matrix considering its cover scores. The scores of the resulting matrices have been used to calculate the central tendency of each relevé from each vegetal association. With these central tendencies (expressed in numbers) we realized another matrix which present the characteristics of the vegetal associations among which we wanted to discover some possible correlations [11]. For each vegetal association the Shannon diversity index and eveness index have been calculated using PAST software [8]. Also the cluster analysis and correlations calculations have been realized using the same software. The phytosociological nomenclature, coenotaxa classification and cormophytes nomenclature followed some prestigious works in this domain [4, 2, 3]. The assignment to a certain type of natural habitat has been realized taking into account the Interpretation Manual of Romanian Natura 2000 Habitats [7].

## Results and discussions

Vegetal communities represented by natural primary and secondary alpine and subalpine (rarely montane) grasslands from *JUNCETEA TRIFIDI* Hadač identified in the study area are framed in the following syntaxonomic scheme:

CARICETALIA CURVULAE Br.-Bl. in Br.-Bl. et Jenny 1926
Juncion trifidi Krajina 1933
***Juncetum trifidi*** Szafer at al., 1923 em. Krajina 1933
***Potentillo chrysocraspedae-Festucetum airoidis*** Boşcaiu 1971
FESTUCETALIA SPADICEAE Barbero 1970 em. Grabherr 1993
Potentillo ternatae-Nardion Simon 1957
***Scorzonero roseae-Festucetum nigricantis*** (Puşcaru et al., 1956) Coldea 1987
Nardion strictae Br.-Bl. 1926
***Violo declinatae-Nardetum*** Simon 1966

The cluster analysis (Figure 1) was completed using a relative Euclidean (chord) distance measure method. Classification revealed a first level of separation of two clusters corresponding to *Caricetalia curvulae* (including *Juncion trifidi* alliance) and *Festucetalia spadiceae* orders and a second level corresponding to *Potentillo ternatae-Nardion* and *Nardion strictae* alliances. The values of biological and environmental characteristics for each vegetal association are presented in Table 1.

1. ***Juncetum trifidi*** Szafer at al., 1923 em. Krajina 1933 (Table 3, rel. 1-7) includes high altitude vegetal communities edified by *Juncus trifidus* (highland rush) installed in the proximity and on Căliman Izvor and Căliman Cerbuc peaks, on plane or moderate inclined terrains (5-20°) with moderate humid, acid and very poor in nutrients soils. Floristic composition is homogenous and is characterized by a reduced number of species. The herbaceous layer presents coverage varying between 75-95% and includes besides the characteristic and edifying species few other species. The phytosociological structure is characterized by the increased constancy of some species from Juncion trifidi (*Hieracium alpinum*), Caricetalia curvulae (*Pulsatilla alba*, *Primula minima* etc.) and Juncetea trifidi (*Carex atrata, Potentilla aurea* etc.). Also, in the community structure there are species characteristic for the dwarf subalpine shrubs heaths from Loiseleurio-Vaccinietea (*Juniperus sibirica, Rhododendron myrtifolium* etc.) or for the bushes of Pinus mugo from Vaccinio-Piceetea (*Homogyne alpina* etc.). In the vegetal communities of this association are

present some rare and protected species in Romania as *Gentiana punctata* and *Rhododendron myrtifolium*. According to Habitats Directive [14], these communities can be assigned to the 6150 - Siliceous alpine and boreal grasslands habitat type.

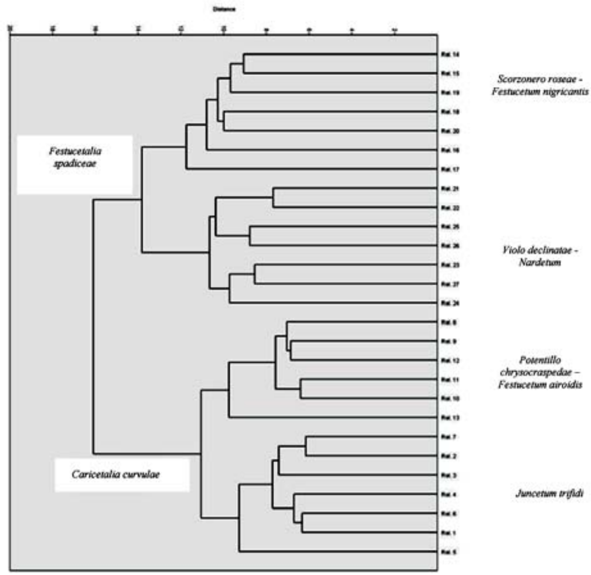


Figure 1. Cluster analysis of the relevés

Table 1

**The values of biological and ecological parameters of the analyzed vegetal communities**

| *Variable* | *Juncetum trifidi* | *Potentillo-Festucetum airoidis* | *Scorzonero roseae -Festucetum nigricantis* | *Violo declinatae -Nardetum* |
|---|---|---|---|---|
| Altitude (m.a s.l.) | 1944,3 | 1910 | 1535,6 | 1476 |
| Number of species (average) | 17 | 17,3 | 29,7 | 22,8 |
| Diversity (Shannon) | 2,62 | 2,73 | 3,30 | 3,00 |
| Eveness | 0,881 | 0,885 | 0,922 | 0,898 |
| H | 79,01 | 77,45 | 82,94 | 85,06 |
| Ch | 15,61 | 17,38 | 9,40 | 9,98 |
| Ph | 5,38 | 4,45 | 0,49 | 1,07 |
| T | 0 | 0,72 | 3,07 | 0,66 |
| G | 0 | 0 | 3,73 | 1,61 |
| Ht | 0 | 0 | 0,36 | 1,62 |
| Circ. s.l. | 45,07 | 32,25 | 14,90 | 16,35 |

| | | | | |
|---|---|---|---|---|
| Alp. s.l. | 23,17 | 21,45 | 7,72 | 7,25 |
| Carp.-balc. | 6,11 | 5,20 | 3,45 | 4,45 |
| Eur. centr. | 7,04 | 2,28 | 17,11 | 4,02 |
| Eur. | 1,02 | 1,53 | 15,47 | 11,55 |
| Euras. s.l. | 16,48 | 33,03 | 38,02 | 45,75 |
| Cosm. | 1,11 | 3,51 | 1,66 | 6,82 |
| End. carp. | 0 | 0,75 | 1,67 | 3,81 |
| T | 2,8749 | 2,9708 | 4,6348 | 4,4082 |
| U | 5,0567 | 5,2019 | 5,3433 | 5,4065 |
| R | 3,3912 | 3,2354 | 4,1839 | 3,8434 |
| N | 2,2563 | 2,0860 | 2,8217 | 3,0577 |

H (Hemicryptophyte); Ch (Chamaephyte); Ph (Phanerophyte); T (Therophyte); G (Geophyte); Ht (Hemithrophyte); Circ. s.l. (Circ.+Circ.-arct.-alp.); Euras. s.l. (Euras.+Euras.-arct.-alp.+ Euras.-arct.-alp.-eur.); Alp. s.l. (Alp. eur.+Alp.-carp.+Alp.-carp.-balc.); T (Ellenberg index for temperature); U (Ellenberg index for humidity); R (Ellenberg index for soil Ph); N (Ellenberg index for available nitrogen during vegetation period).

2. ***Potentillo chrysocraspedae-Festucetum airoidis*** Boşcaiu 1971 (Table 3, rel. 8-13) includes aslo high altitude vegetal communities edified by *Festuca supina* (tufted fescue) installed in the proximity and on Căliman Izvor, Căliman Cerbuc and Budacu peaks, on terrains characterized by various aspects and slopes, with moderate humid, very acid and very poor in nutrients soils. Floristic composition is homogenous and is characterized by a reduced number of species. The herbaceous layer presents coverage varying between 85-95% and includes besides the characteristic and edifying species few other species. The phytosociological structure is characterized by the increased constancy of some species from Juncion trifidi (*Juncus trifidus*), Caricetalia curvulae (*Campanula alpina*, *Primula minima* etc.) and Juncetea trifidi (*Carex atrata, Phleum alpinum* etc.). Also, in the community structure there are species characteristic for the dwarf subalpine shrubs heaths from Loiseleurio-Vaccinietea (*Juniperus sibirica, Vaccinium myrtillus* etc.) or for the bushes of Pinus mugo from Vaccinio-Piceetea (*Pinus mugo, Deschampsia flexuosa, Lycopodium selago* etc.). In the vegetal communities of this association is present a rare and protected species in Romania: *Rhododendron myrtifolium*. According to Habitats Directive [14], these communities can be also assigned to the 6150 - Siliceous alpine and boreal grasslands habitat type.

3. ***Scorzonero roseae-Festucetum nigricantis*** (Puşcaru et al., 1956) Coldea 1987 (Table 4, rel. 1-7) represents plants communities sporadically spread in the studied territory, grouping together grasslands edified by *Festuca nigrescens* presenting *Scorzonera rosea* as characteristic species,

installed on terrains characterized by various aspects and slopes, with moderate humid, acid and relative poor in nutrients soils situated in the proximity of the Păltiniş village and Căliman Cerbuc and Budacu peaks. Floristic composition is characterized by an increased number of species. The herbaceous layer is very diverse, presents coverage varying between 90-100% and includes besides the characteristic and edifying species many other species as *Hieracium pilosella, Briza media, Euphrasia stricta* etc. The phytosociological structure is characterized by the increased constancy of some species from Potentillo ternatae-Nardion (*Campanula serrata, Hieracium lactucella* etc.), Nardion (*Carex pallescens, Hypericum maculatum* etc.), Festucetalia spadiceae (*Hieracium aurantiacum, Carlina acaulis*) and Juncetea trifidi (*Potentilla aurea, Phleum alpinum* etc.). Also, in the community structure there are species characteristic for the montane grasslands of Molinio-Arrhenatheretea (*Festuca rubra, Agrostis capillaris, Thymus pulegioides, Stellaria graminea* etc.). In the vegetal communities of this association are present numerous rare and protected species in Romania as *Scorzonera rosea, Gentiana acaulis, Arnica montana, Dianthus barbatus subsp. compactus, Phyteuma orbiculare* and *Traunsteinera globosa*. According to Habitats Directive [14], these communities can be assigned to the 6230* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) habitat type considered as a priority for conservation.

4. ***Violo declinatae-Nardetum*** Simon 1966 (Table 4, rel. 8-14) includes plants communities frequently met in the studied territory grouping together grasslands edified by *Nardus stricta* (mat grass) presenting *Viola declinata* as characteristic species, installed on terrains characterized by various aspects and slopes, with moderate humid, acid and poor in nutrients soils. The phytocoenoses described in this article were situated in the proximity of the Păltiniş and Drăgoiasa villages and Căliman Cerbuc and Budacu mountains. Floristic composition is relative homogenous and characterized by a decreased number of species comparing to the previous association. The herbaceous layer is diverse, presents coverage varying between 90-100% and includes besides the characteristic and edifying species, other species as *Campanula serrata, Luzula sudetica, Deschampsia caespitosa, Veratrum album, Veronica officinalis* etc. The phytosociological structure is characterized by the increased constancy of some species from Nardion (*Carex pallescens, Arnica montana* etc.), Potentillo ternatae-Nardion (*Campanula abietina, Luzula sudetica*), Festucetalia spadiceae (*Hieracium aurantiacum, Antennaria dioica*) and Juncetea trifidi (*Potentilla aurea, Juncus trifidus, Festuca supina* etc.). Also, in the community structure

there are species characteristic for the montane grasslands from Molinio-Arrhenatheretea (*Festuca rubra, Anthoxanthum odoratum, Centaurea phrygia*). In the vegetal communities of this association are present numerous rare and protected species in Romania as *Scorzonera rosea, Arnica montana* and *Dianthus barbatus subsp. compactus*. According to the Interpretation Manual of Romanian Natura 2000 Habitats [7], these communities can not be assigned to the 6230* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas habitat type because *Nardus stricta* species presents too great values of abundance-dominace.

Table 2

**The most significant correlation coefficients and significance levels in Juncetea trifidi associations from Neagra Broştenilor river basin**

| | | r | p |
|---|---|---|---|
| Altitude | Alpine | 0,996 | 0,003** |
| Altitude | T | - 0,980 | 0,019* |
| Altitude | N | - 0,971 | 0,028* |
| Altitude | H | - 0,959 | 0,040* |
| Altitude | Ch | 0,959 | 0,040* |
| Altitude | Ph | 0,975 | 0,024* |
| Number of species (average) | Diversity | 0,989 | 0,010* |
| Number of species (average) | Eveness | 0,995 | 0,004** |
| Number of species (average) | Eur. | 0,959 | 0,040* |
| Number of species (average) | R | 0,973 | 0,026* |
| Number of species (average) | G | 0,999 | 0,0003*** |
| Diversity (Shannon) | Eveness | 0,988 | 0,011* |
| Diversity (Shannon) | Carp.-balc. | - 0,982 | 0,017* |
| Diversity (Shannon) | Eur. | 0,973 | 0,026* |
| Diversity (Shannon) | R | 0,952 | 0,047* |
| Diversity (Shannon) | Ph | - 0,950 | 0,048* |
| Diversity (Shannon) | G | 0,984 | 0,015* |
| Eveness | Carp.-balc. | - 0,956 | 0,043* |
| Eveness | G | 0,994 | 0,005** |
| Circ. | Alp. | 0,955 | 0,044* |
| Circ. | U | - 0,978 | 0,021* |
| Circ. | Ph | 0,975 | 0,024* |
| Alp. | Eur. | - 0,968 | 0,031* |
| Alp. | T | - 0,991 | 0,008** |
| Alp. | Ch | 0,962 | 0,037* |
| Alp. | Ph | 0,989 | 0,010* |
| Alp. | N | - 0,954 | 0,045* |
| Eur. | T | 0,992 | 0,007** |
| Eur. | T | 0,978 | 0,021* |

| | | | |
|---|---|---|---|
| Eur. | Ch | - 0,965 | 0,035* |
| Eur. | Ph | - 0,984 | 0,015* |
| Eur. | G | 0,958 | 0,041* |
| Euras. | U | 0,976 | 0,023* |
| End. carp. | Ht | 0,969 | 0,030* |
| H | N | 0,998 | 0,001** |
| Ch | T | - 0,974 | 0,025* |
| Ch | R | - 0,963 | 0,036* |
| Ch | N | - 0,963 | 0,036* |
| Ph | T | - 0,993 | 0,006** |
| G | R | 0,973 | 0,026* |

R - Pearson correlation coefficient; Significance level: *≤0,05 – 0,01; **≤0,01 – 0,001; ***< 0,001

Correlation analysis (Table 2) conducted among species diversity, chorotypes, ecological preferences of the plants species from the composition of vegetal communities framed in *Juncetea trifidi* and some environmental variables specific to each vegetal community revealed strong positive correlation between altitude and the alpine elements, between the species richness, eveness and the geophyte species, between the European elements and species exigencies for temperature; strong negative correlation have been registered between altitude and species exigencies for temperature and nitrogen contents of the soils, between the alpine species and species preferences for temperature, between the circumpolar elements and species exigencies for soils humidity etc.

## Conclusions

The article presents four alpine and subalpine (montane) vegetal communities (Juncetum trifidi, Potentillo chrysocraspedae-Festucetum airoidis, Scorzonero roseae-Festucetum nigricantis and Violo declinatae-Nardetum) from Juncetea trifidi Hadač 1946 identified in Neagra Broştenilor hydrographic basin. These communities (included in two orders and three alliances) corresponds to 2 habitats types (according to Habitats Directive), one of them, 6230* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) considered as a priority for conservation. They are characterized by the dominance of hemicryptophyte, circumpolar and Eurasian elements and include species preferring cold boreal, arctic or alpine areas with moderate humid, acid and poor in nitrogen soils. Correlation analysis revealed both strong positive correlations (as altitude and the alpine elements) and strong negative correlations (as alpine species and species preferences for temperature etc).

Table 3

**Vegetal communities from Caricetalia curvulae Br.-Bl. in Br.-Bl. et Jenny 1926**

| *Floristic element* | *Life form* | *Association* | *Juncetum trifidi* | | | | | | | *Potentillo chrysocraspedae - Festucetum airoidis* | | | | | | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Altitude (m. a. s. l.) | 1880 | 1940 | 2020 | 1950 | 1890 | 1930 | 2000 | 1880 | 1850 | 1980 | 2005 | 1850 | 1890 | |
| | | Aspect | SE | NE | V | - | - | E | NE | SE | SV | E | - | SE | E | |
| | | Slope (°) | 15 | 15 | 20 | - | - | 5 | 5 | 5 | 15 | 10 | - | 35 | 20 | |
| | | Coverage (%) | 85 | 90 | 75 | 90 | 80 | 95 | 90 | 95 | 90 | 85 | 90 | 95 | 95 | |
| | | Relevé area ($m^2$) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | |
| | | Number of relevé | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| *Carr. ass.* | | | | | | | | | | | | | | | | |
| Circ.-arct.-alp. | H | Juncus trifidus | 4 | 4 | 3 | 5 | 4 | 4 | 4 | 1 | + | 1 | + | 1 | + | V |
| Euras.-arct.-alp. | H | Festuca supina | 1 | 1 | + | + | + | + | + | 4 | 4 | 4 | 4 | 4 | 3 | V |
| Alp. eur. | H | Potentilla aurea subsp. chrysocraspeda | + | - | + | - | + | - | - | + | - | + | + | + | + | IV |
| *Juncion trifidi* | | | | | | | | | | | | | | | | |
| Circ.-arct.-alp. | H | Hieracium alpinum | + | + | + | + | - | + | + | - | - | + | + | + | - | IV |
| *Caricetalia curvulae* | | | | | | | | | | | | | | | | |
| Alp.-carp. | H | Pulsatilla alba | 1 | + | + | + | - | + | + | 1 | + | + | + | + | 1 | V |
| Alp. eur. | H | Agrostis rupestris | + | - | + | r | - | - | + | - | - | + | + | - | - | III |
| Alp. eur. | H | Primula minima | + | - | + | + | - | r | - | - | - | + | + | r | - | III |
| Carp.-balc. | H | Potentilla ternata | - | + | + | - | - | - | + | - | - | - | + | + | - | II |
| *Festucetalia spadiceae* | | | | | | | | | | | | | | | | |
| Eur. centr. | H | Festuca nigrescens | - | - | - | - | + | - | - | - | - | - | - | - | - | I |
| Euras. | Ch | Antennaria dioica | + | + | + | - | - | - | + | + | + | - | + | + | + | IV |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Euras. | H | Hieracium aurantiacum | - | - | - | - | - | - | - | - | - | - | - | - | r | I |
| Euras. | T | Euphrasia minima | - | - | - | - | - | - | - | - | - | - | - | - | + | I |
| | | *Juncetea trifidi* | | | | | | | | | | | | | | |
| Circ.-arct.-alp. | H | Carex atrata | + | + | 1 | + | - | + | + | + | + | + | + | + | - | V |
| Alp.-carp. | H | Hypochoeris uniflora | - | + | - | - | - | - | + | - | - | - | - | - | + | II |
| Alp.-carp. | H | Campanula alpina | - | - | + | + | - | - | + | - | + | + | + | - | - | III |
| Alp. eur. | H | Gentiana punctata | - | - | + | + | - | - | + | - | - | - | - | - | - | II |
| Circ.-alp. | H | Phleum alpinum | - | - | - | - | - | - | + | - | - | + | + | - | - | II |
| Eur. | H | Arnica montana | - | - | - | - | - | - | - | - | - | - | - | r | - | I |
| | | *Loiseleurio – Vaccinietea* | | | | | | | | | | | | | | |
| Arct.-alp. | Ph | Juniperus sibirica | + | - | - | - | - | + | - | + | - | + | - | - | - | II |
| Circ. | Ch | Vaccinium vitis-idaea | + | - | - | - | + | - | - | + | - | - | - | + | + | II |
| Circ.-arct.-alp. | Ch | Vaccinium gaultherioides | + | + | + | 1 | + | + | - | + | + | + | + | + | - | V |
| Carp.-balc. | Ph | Rhododendron myrtifolium | - | + | + | - | + | - | - | + | - | + | - | - | - | II |
| Circ. | Ch | Vaccinium myrtillus | - | + | - | - | - | - | + | - | + | - | - | - | + | II |
| | | *Vaccinio – Piceetea* | | | | | | | | | | | | | | |
| Eur. centr. | Ph | Pinus mugo | + | - | - | - | + | - | - | + | - | + | - | - | - | II |
| Circ. | H | Deschampsia flexuosa | + | + | - | - | - | 1 | 1 | + | + | - | - | + | 1 | IV |
| Alp.-eur. | H | Homogyne alpina | - | + | + | - | - | + | + | - | - | + | - | - | - | II |
| Cosm. | Ch | Lycopodium selago | - | + | - | - | - | - | + | - | + | + | + | - | - | II |
| Eur. centr. | H | Luzula luzuloides | - | - | - | - | + | - | + | - | - | - | - | - | - | I |
| Carp.-balc. | H | Campanula abietina | - | - | - | - | - | - | - | r | - | - | - | - | - | I |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Molinio – Arrhenatheretea* | | | | | | | | | | | | | | | | |
| Euras. | H | Anthoxanthum odoratum | + | + | + | + | - | - | + | + | - | + | + | - | + | IV |
| Eur. | Ch | Thymus pulegioides | - | - | - | - | + | - | - | - | - | - | - | - | - | I |
| Cosm. | H | Deschampsia caespitosa | - | - | - | - | - | - | - | - | - | - | - | + | - | I |
| Euras. | Ch | Cerastium fontanum | - | - | - | - | + | - | - | - | - | - | - | - | - | I |
| Eur. | H | Alchemilla xanthochlora | - | - | - | - | - | - | - | - | - | - | - | - | 1 | I |
| Circ. | H | Agrostis capillaris | - | - | - | - | - | - | - | - | - | - | - | - | + | I |
| *Variae syntaxa* | | | | | | | | | | | | | | | | |
| Euras. | H | Hieracium pilosella | - | - | - | - | - | - | - | - | - | - | - | - | + | I |
| Euras. | H | Nardus stricta | + | + | + | - | - | - | + | + | - | - | - | + | 1 | III |
| Alp.-eur. | H | Ligusticum mutellina | + | + | + | + | - | + | + | + | + | - | + | + | - | IV |
| Eur. centr. | Ch | Thymus alpestris | + | + | - | + | - | + | - | + | - | - | + | - | - | III |
| Arct.-alp.-euras. | H | Luzula sudetica | + | + | - | + | - | + | + | + | + | + | + | - | - | IV |
| Euras. | H | Veratrum album | - | - | + | - | - | - | + | + | - | + | - | - | - | II |
| Carp.-balc. | H | Soldanella hungarica | - | - | + | - | - | - | - | - | - | - | - | - | - | I |
| Carp.-balc. | H | Viola declinata | - | - | - | - | - | + | - | - | - | - | - | - | + | I |
| End. carp. | H | Campanula serrata | - | - | - | - | - | - | - | - | - | - | - | - | + | I |
| Carp. | H | Veronica baumgartenii | - | - | - | - | - | - | - | - | - | - | + | + | - | I |
| Alp.-eur. | Ch | Galium anysophyllon | - | - | - | - | - | - | - | - | - | - | - | - | + | I |

Place and date of relevés: Căliman Izvor: 15.07.2007 (rel. 1, 2, 3, 8, 9, 10), 20.08.2008 (rel. 4, 11); Căliman Cerbuc: 15.07.2007 (rel. 5, 6), 20.08.2008 (rel. 7, 12); Budacu: 9.07.2007 (rel. 13).

Table 4

**Vegetal communities from Festucetalia spadiceae Barbero 1970 em. Grabherr in Grabherr et Mucina 1993**

| *Floristic element* | *Life form* | *Association* | *Scorzonero roseae – Festucetum nigricantis* | | | | | | | *Violo declinatae - Nardetum* | | | | | | | *K* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Altitude (m.a.s.l.) | 1615 | 1452 | 1375 | 1651 | 1510 | 1550 | 1596 | 1650 | 1710 | 1225 | 1050 | 1520 | 1753 | 1424 | |
| | | Aspect | SE | V | NE | NV | SE | E | SV | SE | NE | V | N | SE | SE | SV | |
| | | Slope (°) | 10 | 10 | 15 | 10 | 5 | 20 | 25 | 35 | 20 | 20 | 15 | 30 | 35 | 10 | |
| | | Coverage (%) | 100 | 90 | 90 | 100 | 95 | 90 | 95 | 100 | 95 | 100 | 90 | 100 | 100 | 95 | |
| | | Relevé area ($m^2$) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | |
| | | Number of relevé | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
| *Carr. ass.* | | | | | | | | | | | | | | | | | |
| Alp.-carp.-balc. | G | Scorzonera rosea | + | + | - | + | + | + | + | - | - | + | - | + | - | - | III |
| Carp.-balc. | H | Viola declinata | - | - | - | + | + | - | - | + | + | + | - | + | - | + | III |
| Eur. centr. | H | Festuca nigrescens | 4 | 3 | 3 | 4 | 3 | 4 | 4 | - | + | - | - | + | - | + | IV |
| Euras. | H | Nardus stricta | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 5 | 4 | 4 | 4 | 4 | 5 | 4 | V |
| *Potentillo ternatae - Nardion* | | | | | | | | | | | | | | | | | |
| End. carp. | H | Campanula serrata | + | - | + | - | - | + | + | + | + | - | + | + | - | + | IV |
| Eur. | H | Hieracium lactucella | - | + | + | - | + | - | + | - | - | - | - | - | - | - | II |
| Alp. eur. | H | Gentiana acaulis | - | + | - | - | + | + | - | - | - | - | - | - | - | - | II |
| Eur. | H | Thesium alpinum | - | - | - | + | - | + | - | - | + | - | - | - | - | - | II |
| Carp.-balc. | | Potentilla ternata | - | - | - | + | - | - | + | - | - | - | - | + | - | - | II |
| End. carp. | H | Campanula rotundifolia subsp. polymorpha | - | - | - | - | - | - | - | + | + | - | - | - | - | - | I |
| *Nardion strictae* | | | | | | | | | | | | | | | | | |
| Circ. | H | Carex pallescens | + | + | - | + | - | - | + | + | + | - | - | - | - | + | III |
| Alp.-carp. | H | Hypochoeris uniflora | + | - | + | + | - | - | + | - | + | - | - | - | + | - | III |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Euras. | H | Hypericum maculatum | + | + | 1 | - | + | + | + | + | + | + | + | + | - | - | IV |
| Alp.-carp.-balc. | Ht | Gentianella austriaca | - | - | - | + | - | - | - | - | - | + | + | - | - | + | II |
| Circ. | H | Luzula campestris | - | - | - | + | - | + | + | + | + | - | - | + | + | - | III |
| *Festucetalia spadiceae* | | | | | | | | | | | | | | | | | |
| Euras.-arct.-alp.-eur. | H | Hieracium aurantiacum | + | - | + | + | + | - | + | + | + | + | - | - | - | + | IV |
| Eur. centr. | H | Carlina acaulis | + | + | - | + | + | - | - | - | - | - | + | - | - | + | III |
| Euras. | Ch | Antennaria dioica | - | - | + | - | 1 | + | - | - | + | + | - | + | + | - | III |
| *Juncetea trifidi* | | | | | | | | | | | | | | | | | |
| Eur. | H | Arnica montana | + | + | + | - | - | + | + | - | - | + | - | + | + | + | IV |
| Circ.-alp. | H | Phleum alpinum | - | - | - | + | - | - | - | + | + | - | - | - | + | - | II |
| Alp. eur. | H | Potentilla aurea | - | - | - | - | - | + | - | + | + | - | - | - | + | - | II |
| Circ.-arct.-alp. | H | Juncus trifidus | - | - | - | - | - | - | - | - | + | - | - | - | + | - | I |
| Euras.-arct.-alp. | H | Festuca supina | - | - | - | - | - | - | - | - | + | - | - | + | + | - | II |
| *Molinio - Arrhenatheretea* | | | | | | | | | | | | | | | | | |
| Circ. | H | Festuca rubra | 1 | 1 | + | + | + | 1 | + | + | + | + | + | - | - | + | V |
| Eur. | H | Polygala vulgaris | + | + | - | + | - | + | - | - | - | - | - | - | - | + | II |
| Circ. | H | Agrostis capillaris | 1 | + | 1 | 1 | + | + | 1 | - | - | + | + | - | - | + | IV |
| Eur. | H | Cynosurus cristatus | + | + | + | - | + | + | + | - | - | + | - | + | - | + | IV |
| Euras. | H | Trifolium pratense | + | - | + | - | - | - | - | - | - | + | + | - | - | + | II |
| Euras. | H | Anthoxanthum odoratum | + | - | + | + | + | + | + | - | + | + | + | + | + | - | IV |
| Eur. | Ch | Thymus pulegioides | 1 | + | + | - | + | + | + | + | + | + | - | - | - | + | IV |
| Euras. | H | Lotus corniculatus | + | - | - | + | - | - | - | - | - | - | - | - | - | - | I |
| Euras. | H | Achillea millefolium | - | r | - | - | - | - | - | - | - | - | - | - | - | - | I |
| Euras. | H | Briza media | - | + | - | + | + | - | + | + | - | + | + | - | + | - | III |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Euras. | H | Trifolium repens | - | + | + | - | - | + | - | + | + | + | - | - | - | + | III |
| Euras. | T | Rhinanthus angustifolius | - | + | + | + | - | - | - | - | - | - | - | - | - | - | II |
| Euras. | H | Alchemilla monticola | - | - | + | + | - | - | - | - | - | - | - | - | - | - | I |
| Euras. | H | Leucanthemum vulgare | - | - | + | - | - | - | - | - | - | - | - | - | - | - | I |
| Euras. | H | Taraxacum officinale | - | - | r | - | - | - | - | - | - | - | - | - | - | - | I |
| Euras. | H | Stellaria graminea | - | - | + | - | + | + | + | - | - | - | + | - | - | - | II |
| Eur. | H | Bellis perennis | - | - | + | - | + | - | - | - | - | - | + | - | - | - | II |
| Cosm. | H | Prunella vulgaris | - | - | - | + | - | + | - | + | + | + | - | - | - | + | III |
| Euras. | H | Campanula glomerata | - | - | - | - | + | - | - | - | - | - | - | - | - | - | I |
| Eur. | H | Hypochoeris radicata | - | - | - | - | + | - | - | - | - | - | - | - | - | - | I |
| Euras. | H | Leontodon autumnalis | - | - | - | - | + | - | + | - | - | - | + | - | - | - | II |
| Cosm. | H | Deschampsia caespitosa | + | - | - | - | - | - | - | - | + | + | - | - | - | - | II |
| Eur. | H | Alchemilla vulgaris | - | - | - | - | - | - | - | + | 1 | + | + | - | - | + | II |
| Eur. | H | Centaurea phrygia | - | - | - | - | - | - | - | - | - | - | + | - | - | - | I |
| Euras. | H | Succisa pratensis | - | - | - | - | - | - | - | - | - | - | - | - | - | + | I |
| | | *Vaccinio - Piceetea* | | | | | | | | | | | | | | | |
| Carp.-balc. | H | Campanula abietina | - | - | + | - | + | - | - | - | - | + | + | - | - | - | II |
| Eur. centr.&N | Ph | Picea abies (juv.) | - | + | - | - | - | - | - | - | - | - | - | - | - | - | I |
| Circ. | H | Deschampsia flexuosa | - | + | - | + | + | - | + | - | - | - | - | - | + | - | II |
| Circ. | Ch | Vaccinium vitis-idaea | - | - | + | + | - | - | - | - | - | - | + | - | - | + | II |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Circ. | Ch | Vaccinium myrtillus | - | - | - | 1 | + | - | + | - | - | + | - | - | - | + | III |
| Alp. eur. | H | Homogyne alpina | - | + | + | - | + | - | - | - | - | - | - | + | + | - | III |
| Cosm. | Ch | Lycopodium clavatum | - | - | - | - | - | - | - | - | - | - | + | - | - | - | I |
| *Variae syntaxa* | | | | | | | | | | | | | | | | | |
| Euras. | H | Hieracium pilosella | + | 1 | + | 1 | + | + | + | - | - | 1 | - | + | + | + | IV |
| Euras. | H | Potentilla erecta | + | - | - | + | + | + | - | - | - | + | - | - | - | - | II |
| Euras. | T-Ht | Viola tricolor | + | - | - | - | - | + | - | - | - | - | - | - | - | - | I |
| Euras. | H | Veratrum album | + | + | - | + | - | + | - | + | + | - | - | - | + | - | III |
| Eur. | T | Euphrasia stricta | - | r | - | - | + | r | - | + | - | - | - | - | - | - | II |
| Euras. | Ch | Cerastium fontanum | - | + | - | + | + | - | + | - | + | - | - | - | + | - | III |
| Euras. | H | Veronica chamaedrys | - | - | + | - | - | - | + | - | - | - | - | - | - | - | I |
| Euras. | H | Cruciata glabra | - | - | + | + | - | + | + | + | - | + | + | - | - | + | III |
| Alp.-carp.-balc. | Ch | Dianthus barbatus subsp. compactus | - | - | + | - | - | - | - | - | - | + | - | - | - | - | I |
| Eur. | H | Anthyllis vulneraria | - | - | + | - | - | + | + | - | - | - | - | - | - | - | II |
| Eur. centr. | H | Phyteuma orbiculare | - | - | + | - | - | - | - | - | - | - | - | - | - | - | I |
| Eur. centr. | G | Traunsteinera globosa | - | - | - | r | - | - | - | - | - | - | - | - | - | - | I |
| Cosm. | G | Pteridium aquilinum | - | - | + | - | - | - | - | - | - | + | - | - | - | - | I |
| Eur. centr. | H | Astrantia major | - | - | - | + | - | - | + | - | - | - | - | - | - | - | I |
| Euras. | H | Trisetum flavescens | - | - | - | + | - | - | - | - | - | - | - | - | - | - | I |
| Eur. centr. | H | Rumex acetosella | - | - | - | + | + | + | + | - | - | - | - | + | - | - | II |
| Eur. centr. | H | Luzula luzuloides | - | - | - | + | - | - | - | + | - | - | - | - | - | - | I |
| Euras. | Ch | Veronica officinalis | - | - | - | - | + | - | + | + | + | + | - | - | - | + | III |
| Circ. | H | Hieracium umbellatum | - | - | - | - | - | + | - | - | - | - | - | + | - | - | I |
| Arct.-alp.-euras. | H | Luzula sudetica | - | - | - | - | - | - | - | - | - | - | - | - | + | - | I |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cosm. | H | Rumex acetosa | - | - | - | - | - | - | - | + | + | - | - | + | + | + | II |
| Arct.-alp. | Ph | Juniperus sibirica | - | - | - | - | - | - | - | - | - | - | - | - | + | - | I |
| Circ. | Ph | Rubus idaeus | - | - | - | - | - | - | - | - | + | - | - | - | - | - | I |
| Alp. eur. | Ch | Galium anysophyllon | - | - | - | - | - | - | - | - | + | - | - | - | - | - | I |
| Euras. | H | Fragaria vesca | - | - | - | - | - | r | - | r | - | - | - | - | - | - | I |
| Eur. | H | Laserpitium latifolium | - | - | - | - | - | - | + | - | - | - | - | - | - | - | I |

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# CARACTERISTICA TAXONOMICĂ ŞI SAPROBIOLOGICĂ ALGOFLOREI BAZINELOR STAȚIEI DE EPURARE BIOLOGICĂ (SEB) A MUN. CHIŞINĂU

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**Summary:** *During the years 2009 – 2010 in the biological station basins and in the Bâc river were identified 227 species and intraspecific varieties of algae, which are assigned to 5 phyla, 10 classes, 15 orders, 36 families and 65 genders. A main role in the formation of algae communities plays representatives of Chlorophyta phylum (84 species) and Bacillariophyta (53 species). The secondary role it plays by Euglenophyta phylum (28), and Xanthophyta (5 species). The saprobiological spectrum of the species indicating of the saprobity due to high spreading coefficient shows increased organic pollution of these waters.*

## Introducere

În ultimele decenii se observă o schimbare în compoziția apelor menajere orăşeneşti datorită creşterii cantității de azot şi fosfor din urma activității tehnologice. Gestiunea acestor ape reziduale este o problemă de mediu, în special pentru țările în curs de dezvoltare, iar tratarea biologică a apelor uzate cu ajutorul algelor pare a fi o alternativă pentru aceste țări, datorită costurilor sale reduse [1, 2]. Un rol mare în purificarea apelor reziduale îl joacă algoflora spontană, care contribuie la distrucția substanțelor organice din bazinul de epurare şi în final determină productivitatea biologică şi calitatea acestei ape [3, 4]. De aceea scopul lucrării noastre a fost de a studia structura taxonomică şi saprobiologică a speciilor ce vegetează în bazinele de epurare ale SEB Chişinău şi în râul Bâc.

## Materiale şi metode

A fost studiată algoflora bazinelor Sistemei de epurare a apelor reziduale a municipiului Chişinău. Probele au fost prelevate lunar în perioada anilor 2009 – 2010 din 7 puncte (deznisipătorul, decantorul primar, bazinul de aerare, nămolul activ utilizat în procesul de epurare, decantorul secundar şi sectorul râului Bâc în punctul de deversare a apelor reziduale deja epurate) şi prelucrate după metodele algologiei moderne. Analiza probelor sub formă fixată şi vie s-a efectuat în Laboratorul de Cercetări Ştiințifice „Algologia", U.S.M. Pentru studierea probelor au fost utilizate microscoapele de marca Optika şi Kruss, identificarea speciilor a fost efectuată cu ajutorul determinatoarelor [5,6,7,8,9,10,11,12]. A fost calculat coeficientul de răspândire a speciilor pe parcursul perioadei de cercetare.

Indicile saprobității a fost apreciat după Pantle – Buck cu modificarea efectuată de Sladecek [13].

**Rezultate şi discuții**

Algoflora bazinelor investigate reprezintă un complex variat de specii cu proveniență diferită. Structura taxonomică a algoflorei se modifică de la un bazin la altul. Pe parcursul perioadei de investigații în bazinele Stației şi în râul Bâc au fost identificate 227 specii şi varietăți intraspecifice de alge, care se atribuie la 5 filumuri, 10 clase, 15 ordine, 36 familii şi 65 genuri. Un rol principal la formarea comunităților algale îl joacă reprezentanții filumurilor *Chlorophyta*, *Cyanophyta* şi *Bacillariophyta.* Iar rolul secundar le revine speciilor din încrengăturile *Euglenophyta* şi *Xanthophyta.*

După cum vedem din figura 1 o preponderență numerică o dețin algele verzi – 84 de specii şi variații intraspecifice, ceea ce constituie 37% din numărul total de specii, urmate de cele cianofite şi diatomee cu 25 şi respectiv 24%. Speciilor de euglenine le revine 13%, iar celor xantofite - doar 2%.

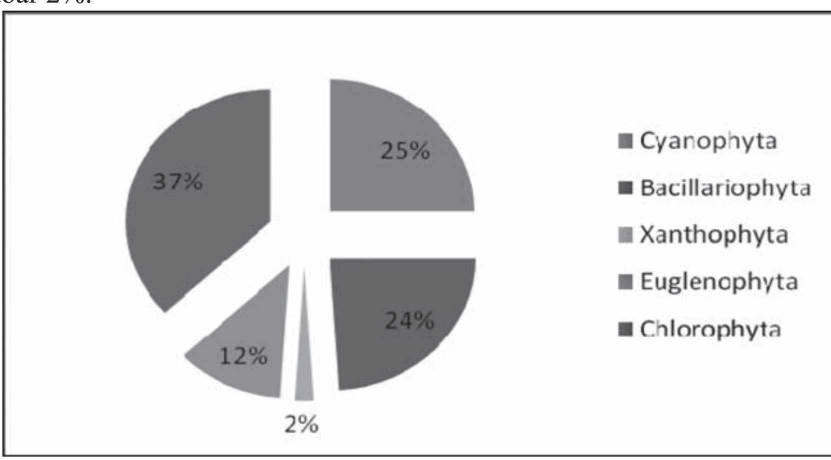


Figura 1. Diversitatea taxonomică a algoflorei bazinelor SEB mun. Chişinău în an. 2009 – 2010

Algele cianofite în perioada anilor 2009 – 2010 au fost în număr de 57 specii, care se atribuie la 2 clase (*Chroococcophyceae* şi *Hormogoniophyceae*), 3 ordine (*Chroococcales, Nostocales* şi *Oscillatoriales*), 7 familii – *Oscillatoriaceae* cu 40 specii, *Coccobactreaceae* - 6, *Gloeocapsaceae* – 3, *Merismopediaceae*, *Mycrocystidaceae*, *Nostocaceae, Anabaenaceae* cu câte 2 specii fiecare (figura 2) şi respectiv 11 genuri. În anul 2009 cianofitele au fost în număr de 37 de specii (2 clase, 3 ordine, 6 familii, 9 genuri), iar în următorul an – 57 de specii şi variații intraspecifice, care fac parte din 2 clase, 3 ordine, 7 familii, şi 11 genuri.

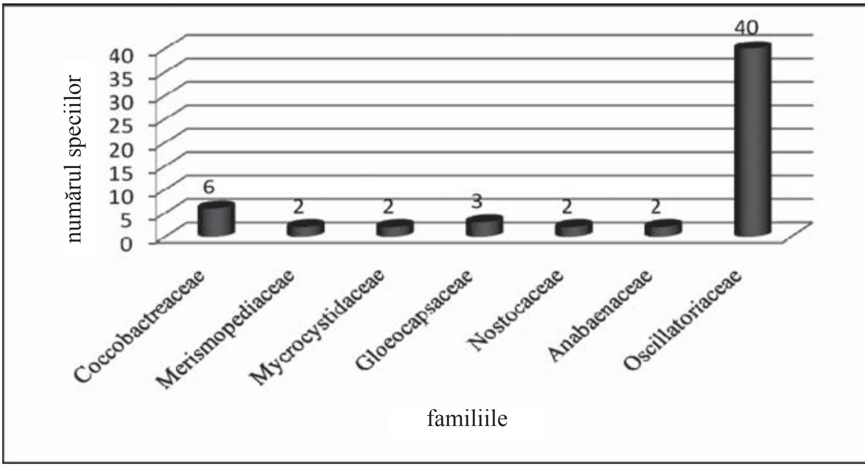


Figura 2. Repartizarea algelor cianofite pe familii

Cele mai larg răspândite specii cianofite în această perioadă de cercetare au fost *Phormidium tenue* (Menegh.) Gom. cu un coeficient de răspândire 82%, *Synechocystis salina* Wisl. – 70,5%, urmate de speciile *Oscillatoria amphibia* Ag., *O. rupicola* Hansg., *Gloeocapsa magma* (Bréb) Kütz emend Hollerb., *Mycrocystis aeruginosa* Kütz. emend Elenk. etc. Un rol secundar în formarea comunităților algale le-a revenit speciilor *Merismopedia glauca* (Echr.) Näg., *Mycrocystis pulverea* Wood., *Anabaenopsis elenkinii* V. Miller, *Lyngbya stagnina* Kütz. ş.a.

În apele bazinului de deznisipare au fost identificate 33 de specii şi variații de alge cianofite, dintre care *Phormidium tenue* (Menegh.) Gom. a fost întâlnită în toate probele prelevate cu coeficientul de răspândire 100%. Pe lângă această specie frecvent au fost detectate *Synechocystis salina* Wisl., *Gloeocapsa magma* (Bréb) Kütz emend Hollerb., *Ph. frigidum* F.E. Fritsch., *Oscillatoria amphibia* Ag., *Ph. fragile* (Menegh.) Gom. În decantorul primar au fost determinate 32 specii şi variații algale şi de această dată au predominat aceleaşi specii doar că diferă coeficientul de răspândire. În bazinul de aerare numărul cianofitelor detectate a fost 36, cu predominarea speciilor *Phormidium tenue* (Menegh.) Gom. şi *Synechocystis salina* Wisl. În nămolul activ utilizat în procesul de epurare au fost identificate 28 specii şi deoarece nămolul este introdus în bazinele de aerare au predominat aceleaşi specii cianofite. În algoflora apelor decantorului secundar au fost detectate 32 specii. În bioderma decantorului s-au dezvoltat 49 de specii, ceea ce constituie numărul maximal detectat pe parcursul perioadei de studiu. Cel mai intens s-au dezvoltat speciile *Synechocystis salina* Wisl., *Mycrocystis aeruginosa* Kütz. emend Elenk., *Phormidium tenue* (Menegh.) Gom., *Lyngbya limnetica* Lemm., *Ph. fragile* (Menegh.) Gom., *Ph. angustissimum* W. et G.S. West., *Oscillatoria amphibia* Ag., *O. chalybea* (Mert.) Gom. ş.a. În sectorul râului Bâc pe parcursul anilor 2009 – 2010 au fost identificate 38 de specii şi varietăţi de alge cianofite, însă coeficientul de răspândire a fost mai mic.

După indicile saprobiologic o pondere majoră le revine speciilor cianofite din intervalul β, α, β-α mezosaprobe şi polisaprobe – 50%. Plasarea celui mai mare număr de specii indicatoare spre acest interval denotă prezenţa unui grad înalt de poluare organică a apei bazinelor cercetate. Doar 15% din speciile filumului *Cyanophyta* se referă la categoriile x şi oligosaprobe, dar şi acestea sunt solitare.

Speciile de diatomee în această perioadă de cercetare au fost în număr de 53, din 2 clase, 3 ordine, 6 familii şi 14 genuri. O parte considerabilă a diatomeelor se referă la familiile *Naviculaceae* şi *Nitzschiaceae* (figura 3), care au 24 şi respectiv 10 specii. Pe locul 3 se situează familia *Fragilariaceae* – 8 specii. Cel mai intensiv se dezvoltă speciile *Navicula cryptocephala* Kütz. – 54,49%, *N. vulpina* Kütz. – 15,38%, *Gomphonema parvulum* (Kütz.) Grun. – 14,74%, *Pinnularia viridis* (Nitzsch.) Ehr. – 8,975, *Nitzschia hungarica* Grun., *N. tryblionella* Hantzsch., *N. sigmoidea* (Ehr.) W. Sm., *Hantzschia amphioxis* (Ehr.) Grun., *Cyclotella meneghiniana* Kütz., *C. stelligera* Cl. et Grun., *Synedra acus* Kütz., *S. ulna* (Nitzsch.) Ehr.

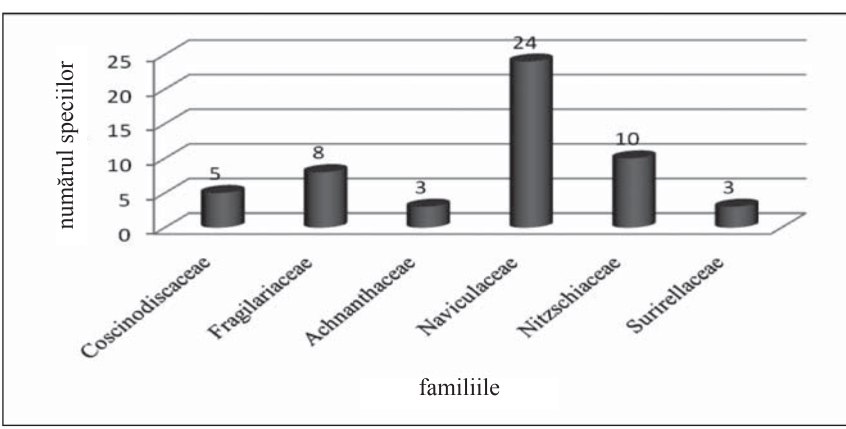


Figura 3. Repartizarea algelor diatomee pe familii

Mai slab vegetează speciile *Nitzschia kuetzingiana* Hilse, *N. linearis* W. Sm., *N. angustata* (W. Sm.)., *Melosira distans* (Ehr.) Kütz. v. *lirata* (Ehr.) Bethge, *Fragilaria intermedia* Grun., *Cocconeis pediculus* Ehr. ş.a.

În trepta de epurare mecanică a sistemei de epurare (deznisipătorul şi decantorul primar) au fost identificate 17 şi respectiv 16 specii bacilariofite cu predominarea speciilor *Navicula cryptocephala* Kütz., *Hantzschia amphioxis* (Ehr.) Grun., *Nitzschia hungarica* Grun., *N. tryblionella* Hantzsch., *N. rynchocephala* Kütz., *Cyclotella meneghiniana* Kütz. În treapta de epurare biologică (bazinul de aerare şi în nămolul activ) speciile diatomee detectate au fost în număr mai mic (bazinul de aerare – 9, în proba de nămol activ – 8 specii şi varietăți). Cu un coeficient mai înalt de răspândire s-au întâlnit speciile *Hantzschia amphioxis* (Ehr.) Grun., *Navicula cryptocephala* Kütz., *Nitzschia hungarica* Grun., *N. tryblionella* Hantzsch. etc. În decantorul secundar, numărul speciilor diatomee a crescut de circa 3 – 4 ori față de bazinele anterioare, în grosul apei au fost depistate 41, iar în biodermă – 38 specii. Pe lângă speciile care predomină în bazinele din treptele precedente de epurare activ în acest bazin au vegetat şi speciile *Cyclotella meneghiniana* Kütz., *Synedra acus* Kütz., *S. ulna* (Nitzsch.) Ehr., *Navicula pupula* Kütz., *N. vulpina* Kütz., *Pinnularia interrupta* W. Sm., *Gomphonema parvulum* (Kütz.) Grun., *Surirella linearis* W. Sm., *Melosira varians* Ag., *Rhoicosphenia curvata* (Kütz.) Grun. ş.a. În apele râului Bâc în punctul de deversare a apelor de la SEB au fost determinate 39 specii şi varietăți de alge bacilariofite. Intens s-au dezvoltat aici *Navicula cryptocephala* Kütz., *N. cryptocephala* Kütz. var. *intermedia* Grun., *N. vulpina* Kütz., *N. pupula* Kütz., *Pinnularia viridis* (Nitzsch.) Ehr., *Gomphonema parvulum* (Kütz.) Grun., *Synedra acus* Kütz., *Cyclotella stelligera* Cl. et Grun., *Surirella linearis* W. Sm., *Nitzschia hungarica* Grun. etc.

O mare parte din numărul speciilor diatomee depistate aici indică zona β – mezosaprobă (40%). Au fost detectate doar trei specii indicatoare a purității apei (grupa de saprobitate x) *Cyclotella stelligera* Cl. et Grun., *Pinnularia appendiculata* (Ag.) Cl. şi *Nitzschia linearis* W. Sm. toate într-un număr mic de exemplare.

Speciile de alge xantofite joacă un rol secundar în formarea comunităților de alge din bazinele cercetate. Pe parcursul perioadei de studiu au fost identificate doar 5 specii de alge xantofite, care fac parte din 2 clase (*Heterococcophyceae* şi *Heterotrichophyceae)*, 2 ordine (*Heterococcales* şi *Tribonematales*), 3 familii (*Pleurochloridaceae, Heterotrichaceae* şi *Tribonemataceae*) şi 3 genuri (*Chloridella, Heterothrix* şi *Tribonema*). Cel mai intens s-a dezvoltat specia *Tribonema viride* Pasch., urmată de

*Chloridella neglecta* Pasch. Mai rar s-au întâlnit speciile *Tribonema* sp. şi *Heterothrix debilis* Visch. Algele xantofite s-au întâlnit câte 1 – 3 specii în toate bazinele, cu excepția aerotancului.

Din algele euglenofite au fost întâlnite doar 28 de specii, dintre care 27 aparțin familiei *Euglenaceae*, iar specia *Astasia sagittefera Skuja.* face parte din familia *Astasiaceae*. Aceste 27 de specii se atribuie la 4 genuri, dintre care cel mai bogat în taxoni este genul *Trachelomonas* cu 10 specii, urmat de genul *Phacus* – 8, *Euglena* – 6 şi *Lepocinclis* – 3.

Cele mai larg răspândite specii de euglenofite în 2009 au fost *Trachelomonas volvocina* Ehr., *T. hispida* (Perty) Stein emend Defl., *Euglena polymorpha* Dang., *E. viridis* Ehr., iar în anul 2010 – *Phacus curvicauda* Swir., *Trachelomonas oblonga* Lemm., *Euglena polymorpha* Dang. Cu o frecvență mai mică de răspândire au fost speciile *Lepocinclis acicularis* France, *Euglena oxyuris* Schmarda, *Trachelomonas arnoldii* Roll.

În bazinul de desnisipare au fost detectate 14 specii de euglenofite dintre care în perioada rece a anului a predominat *Trachelomonas oblonga* Lemm., urmată de *Phacus curvicauda* Swir. cu coeficientul de răspândire de 16,67% şi respectiv 12,5%. În decantorul primar au fost evidențiate 17 specii şi variații de euglenofite, care s-au întâlnit sporadic în timpul perioadei reci a anului. În bazinul de aerare euglenofitele au fost în număr de 18 specii, un coeficient mai înalt de răspândire l-a avut specia *Trachelomonas volvocina* Ehr. (25%), urmată de *Phacus curvicauda* Swir. şi *Ph. arnoldii* Swir. var. *ovatus* Popova. În probele cu nămol activ au fost determinate 14 specii de euglenine. Cele mai răspândite specii au fost *Phacus curvicauda* Swir. şi *Trachelomonas verrucosa* Stokes. Apele decantorului secundar sunt sărace în specii de euglenofite, aici au fost depistate 11 specii şi varietăți de euglenine. Pe pereții decantoarelor secundare s-au dezvoltat un număr maximal de euglenofite – 27. Cele mai bogate taxonomic au fost genurile *Trachelomonas* cu 10 specii şi *Phacus* – 8. În punctul de deversare a apelor reziduale epurate în râul Bâc, au fost detectate doar 10 specii de euglenine, dintre care cea mai frecvent întâlnită a fost *Euglena polymorpha* Dang. cu un coeficient de răspândire 20,83%. Majoritatea speciilor euglenofite fac parte din grupele β - şi α - mezosaprobe, care sunt indicatoare ale poluării organice a apei.

Speciile filumului *Chlorophyta* în număr de 84 detectate în bazinele cercetate în perioada dată de studiu se atribuie la 4 clase (*Volvocophyceae, Chlorococcophyceae, Ulothricophyceae* şi *Conjugatophyceae*), 6 ordine, 18 familii şi 32 genuri. Familiile de alge verzi cele mai bogate în taxoni sunt *Scenedesmaceae* cu 30 de specii şi *Selenestraceae* – 15 (figura 4).

Pe când cele mai  sărace familii au fost *Treubariaceae, Golenkiniaceae, Micractinaceae, Botryococcaceae* şi  macrofitele (*Ulothrichaceae, Oedogoniaceae, Chladophoraceae*), care au fost prezente prin  1 – 2 reprezentanți, cu un coeficient de răspândire  1 – 5 %.

Cele mai răspândite specii clorofite din algoflora bazinelor de epurare şi a râului Bâc în perioada anilor 2009 – 2010 au fost *Chlamydomonas reinhardii* Dang., *Chlorella vulgaris* Beijer., *Dictyosphaerium pulhelum* Wood., *Oocystis solitaria* Wittrack., *Scenedesmus  acutus* Meyen., *S. ellipticus* Corda., *S.  obtusus* Meyen., *S. quadricauda* (Turp.) Brèbisson. ş.a.

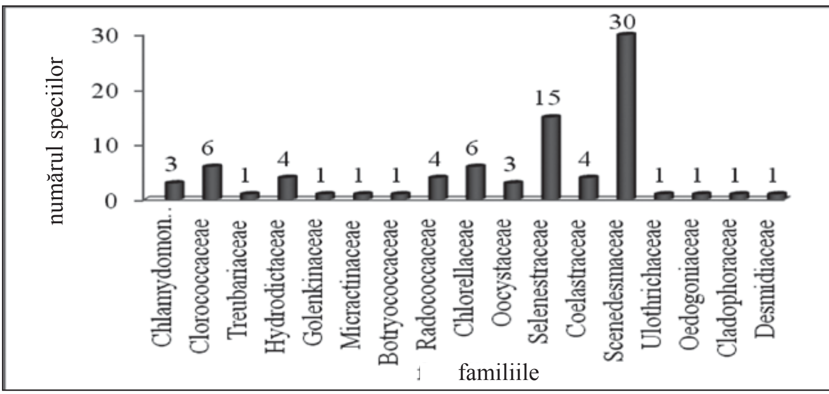


Figura 4. Repartizarea algelor clorofite pe familii

În apele deznisipătorului pe parcursul acestor doi ani de studiu au fost identificate 27 specii şi varietăți de alge verzi. În acest bazin activ au vegetat speciile *Chlamydomonas reinhardii* Dang., *Chlorella vulgaris* Beijer., *Dictyosphaerium pulhelum* Wood., *Scenedesmus obliquus* (Turp.) Kütz., *S. ellipticus Corda., S. obtusus* Meyen*., S. quadricauda* (Turp.) Brèbisson. În apele decantorului primar în această perioadă de cercetare s-au dezvoltat 32 specii şi varietăți de alge verzi. Pe lângă speciile dominante din bazinul precedent cu un coeficient mai înalt de răspândire s-au întâlnit *Coeconoccus planctonicus* Korschikoff*, Oocystis solitaria* Wittrack., *Kirchneriella obesa* (W. West.) Scmidle*, Hyaloraphidium contortum* Pascher et Korscikoff var. *tenuissimum* Korschik. În bazinul de aerare au fost depistate 22 speci şi varietăți de alge clorofite cu predominarea speciilor *Chlamydomonas reinhardii* Dang., *Chlorella vulgaris* Beijer., *Scenedesmus obliquus* (Turp.) Kütz., iar în probele de nămol activ din acest bazin s-au dezvoltat doar 14 specii de clorofite. În treapta finală de epurare – bazinul de decantare secundară varietatea algelor clorofite a crescut până la 50 specii în grosul apei, iar în biodermă – 21, cu predominarea aceloraşi specii care au dominat şi în bazinele anterioare, doar cu un coeficient de răspândire diferit. În algoflora râului Bâc pe parcursul anilor 2009 – 2010 au fost identificate 66 specii de alge verzi, care s-au întâlnit pe tot parcursul anilor cu o abundență înaltă în perioada estivală a anului.

Din numărul total de specii clorofite 62% sunt indicatoare a saprobității, dintre care predomină reprezentanții grupelor β, β – α, α – mezosaprobe (58%). Cele mai larg răspândite specii din acest interval au fost *Chlamydomonas reinhardii* Dang., *Chlorella vulgaris* Beijer., *Dictyosphaerium pulhelum* Wood., *Monoraphidium tortile* (W. et G.S. West.) Komàrkova – Legnerova, *Kirchneriella obesa* (W.West.) Scmidle, *Coelastrum microporum* Nägeli., *Scenedesmus obtusus* Meyen., *S. quadricauda* (Turp.) Brèbisson.

## Concluzii

Pe parcursul anilor 2009 – 2010 în bazinele SEB Chişinău şi în râul Bâc au fost identificate 227 de specii şi varietăți intraspecifice de alge dintre care *Chlorophyta* – 84 specii şi varietăți de alge sau 37% din numărul total, C*yanophyta* – 57 (25%), şi *Bacillariophyta* – 53 (24%), *Euglenophyta* – 28 (12%) şi *Xanthophyta* – 5 (2%).

Cele mai larg răspândite specii în această perioadă de cercetare au fost: *Phormidium tenue* (Menegh.) Gom., *Synechocystis salina* Wisl., *Navicula cryptocephala* Kütz., *Hantzschia amphioxis* (Ehr.) Grun., *N. vulpina* Kütz., *Nitzschia hungarica* Grun., *N. tryblionella* Hantzsch., *Euglena polymorpha* Dang., *E. viridis* Ehr., *Phacus curvicauda* Swir., *Trachelomonas oblonga* Lemm, *Chlamydomonas reinhardii* Dang., *Chlorella vulgaris* Beijer., *Dictyosphaerium pulhelum* Wood, *S. ellipticus* Corda., *S. obtusus* Meyen., *S. quadricauda* (Turp.) Brèbisson etc.

Speciile indicatoare ale saprobității datorită coeficientului de răspândire înalt demonstrează poluarea organică mărită a acestor ape reziduale.

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# FOREST STANDS IN THE NATURAL PROTECTED AREA "FOREST HINCESTI"

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**Summary.** *This article presents the stands diversity of protected area "Forest Hincesti". In this protected area exists three categories of forest stands: natural fundamental, derived and artificial.*

## Introduction

The natural protected area „Forest Hincesti" is located in the proximity of Lapusna and Mereseni village (district Hincesti, Hincesti forest agency) and has next geographical coordinates:

1. East longitude: 28°34´09″, latitude: 46°49´24″, altitude: 245m; 2. East longitude: 28°33´12″, latitude: 46°48´33″, altitude: 178m; 3. East longitude: 28°30´33″, latitude: 46°49´24″, altitude: 171m;

4. East longitude: 28°27´59″, latitude: 46°49´23″ altitude: 290m; 5. East longitude: 28°26´51″, latitude: 46°51´08″; 6. East longitude: 28°28´39″, latitude: 46°52´13″. Mereseni forestry department includes plots 10-14, 17-22, 25; subplots A,B,C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, Y; 26-32; 35-40; 42-47; 48, subplots A,B,C, D, E, F, G, H, I, J, K, L, F2, R1; 50-54. Loganesti forestry department plots 47, subplots A,B,C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, X, Y1; 55; 56. The studied natural protected area covers an area of 4499 ha. According to the law of the State Natural Protected Areas Fund (1998), natural protected area „Hincesti forest" is assigned to the landscape reserves category [2]. The research was conducted with the aim to make an assessment of the „Forest Hincesti" natural protected area.

## Materials and methods

Forest stands analysis was performed based on the management data from Mereseni and Loganesti forestry department [3, 4]. The assessment of forest protected area has been carried out according to the methodology described by Gh. Postolache [1]. Three categories of forest stands have been assessed: fundamental, natural and artificial derived.

## Results and discussions

The undertaken analysis has revealed the predominance of fundamental natural stands (60%) with small proportion (16%) of derived stands and artificial stands (24%), compound mostly of acacia (Image 1).

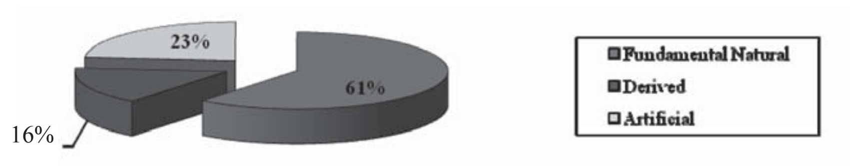


Image 1. Tree stands in natural protected area “Forest Hincesti”

***Fundamental natural stands*** are found in 145 subplots, with a total area of 2510.3 ha. According to productivity level: 57 of subplots are fundamental natural stands of medium productivity; 79 subplots are fundamental and natural stands of lower productivity and 8 subplots are underproductive fundamental natural stands.

***Forest fundamental natural stands*** of pubescent oak *(Quercus pubescens)* are present in 25 subplots with total area of 279 ha (10F; 21G; 51A; 53E; 42B; 11H; 45B; 50F; 31C; 37G; 44A; 21T; 31G; 31L; 31Q; 31B; 22M; 32A; 35D; 31A; 29C; 52D; 38B; 38M; 55G), of which 147,1 ha (53%) are fundamental natural stands of medium productivity; 100 ha (36%) are fundamental and natural stands of lower productivity and 31,5 ha (11%) are underproductive fundamental natural stands. In subplots 46B, 21B, 43J, 32P, 36D, 47D, 56D the pubescent oak is more than 50%. Besides pubescent oak other species like pedunculate oak *(Quercus robur),* sessile oak *(Quercus petraea),* linden *(Tilia cordata, T. tomentosa),* ash *(Fraxinus excelsior)* could be found. Forest stands are 35-75 years old.

***Forest fundamental natural stands of pedunculate oak (Quercus robur)*** are of medium and lower productivity. The pure fundamental natural stands (10ST) are of lower productivity and have been recorded in 26 subplots (26E; 22W; 44F; 43S; 47N; 47P; 21R; 26O; 51L; 53O; 53V; 52B; 52M; 10C; 38E; 27A; 17E; 19C; 19D; 25I; 27E; 27O; 28H; 13F; 11B; 36B) with an area of 264,3 ha. and in 916 ha of trees have in composition species as oak, maple, linden, walnut, maple, cherry, ash but the participation of these species is very small. Stand age is between 35-90 years.

***Forest fundamental natural stands*** of sessile oak *(Quercus petraea)* are of medium, lower and underproductive productivity and are present in subplots 48A, 14F, 38H, 14A, 14S, 50C, 12B, 35A, 22A, 26J, 40N, 43M, 28P, 47C, 47S. Pure fundamental natural stands of sessile oak (10GO) occupies an area of 175.5 ha and 750.1 ha include sessile oak trees that have in composition species as oaks, ash, cherry, maple and other diversity, but the participation of these species is insignificant (13B; 54S; 54V; 28L; 42A; 40C; 40G; 39E; 40A; 46E; 13C; 45T; 37O; 28C; 46J; 47C; 39A; 13D; 32F; 32B; 43F; 13H; 13A; 56C; 55K; 55B; 56E; 56F). Stand age is between 30-80 years.

***Forest derived stands*** were registered next species like oak, ash, maple, oak and elm. Derived stands have a total area of 652.4 ha which is 16% of the forest trees.

***Forest total derived stands*** are present next forest tree species like ash, maple, oak, elm and cover a total area of 269.9 ha in next 41 subplots ((27Q; 29B; 51G; 22U; 22V; 51D; 51E; 45E; 21J; 29H; 37J; 37F; 10K; 40B; 17L; 32Q; 18K; 27S; 31I; 18C; 18M; 19A; 21D; 28J; 28K; 35C; 43A; 28M; 21S; 17A; 28S; 21J; 31D; 21C; 32C; 39J; 22T; 29O; 45V; 22S; 47M).

***Forests partially derived*** have been registered in 27 subplots with a total area of 383.2 ha. Partial derivatives forest stands are consist of evergreen oak, oak, ash, lime.

***Forest artificial stands*** in protected area “Forest Hincesti” were planted on an area of 975,8 ha, (24%). Productivity of these forests is middle and lower. Artificial forest stands have been established both from autochthonous forest tree species (oak, sessile oak, ash, willow, cherry) and allochthonous forest species (pine, walnut, locust, maple, spruce, chestnut, elm). Pure artificial forest stands were planted in 216 subplots on an area of 519.4 ha (Table 1).

***Forest artificial stands of Pedunculate oak*** *(Quercus robur).* Pedunculate oak stands were planted on an area of 201,9 ha. Pure Pedunculate oak forest stands have a small area of 25,5 ha, but mixed stands with maple, walnut, ash, elm, maple, acacia, glade, pine cover an area of 176,4 ha. Pure Pedunculate oak forest stands were created with different participation, of sycamore maple in composition (8ST2PA; 5ST5PA; 3ST7PA; 6ST4PA; 6ST3PA1DT; 4ST6PA; 5ST3PA2ULC; 3ST6PA1NU, 7ST3PA; 3ST4PA3SC, 5ST1PA2ULC2FR; 4ST2FR4PA; 7ST2PA1AR; 6ST2PA2FR), with ash participation (7ST3FR; 7ST2FR1PA, 6ST4FR, 9ST1FR; 8ST2FR; 4ST2FR3NU1PA), with walnut participation (5ST2NU3FR; 8ST2NU; 9ST1NU; 5ST4NU1FR; 5ST3NU1FR1TE). Have been also created forest stands with participation of maple (8ST2AR; 9ST1AR), pine (6ST3PI1SC) and elm (6ST4ULC).

Table 1

**Total area of planted stands in natural area " Hincesti forest"**

| *Species* | *Type of stands* | | | | | |
|---|---|---|---|---|---|---|
| | *Pure* | | *Mixed* | | *Total* | |
| | *Nr.of subplots* | *Area, ha* | *Nr.of subplots* | *Area, ha* | *Nr.of subplots* | *Area, ha* |
| Pedunculate oak | 17 | 25,5 | 83 | 176,4 | 100 | 201,9 |
| Sessile oak | 5 | 4,7 | 10 | 69,8 | 15 | 74,5 |
| Ash | 81 | 116,7 | 35 | 76 | 116 | 192,7 |
| Willow | 1 | 0,9 | - | - | 1 | - |
| Cherry | - | - | 1 | 3,1 | 1 | 3,1 |
| Pine | 7 | 25,2 | 2 | 1,9 | 9 | 27,1 |
| Walnut | 9 | 28,8 | 4 | 9,3 | 13 | 38,1 |
| Acacia | 82 | 304,8 | 35 | 92,8 | 117 | 397,6 |
| Maple | 3 | 1,1 | 6 | 16,4 | 9 | 17,5 |
| Chestnut | 1 | 3,1 | - | - | 1 | 3,1 |
| Glade | 6 | 4,8 | 6 | 5,4 | 12 | 10,2 |
| Elm | 1 | 1,2 | 2 | 3 | 3 | 4,2 |
| Spruce | 3 | 2,6 | 1 | 2,3 | 4 | 4,9 |
| Total | 216 | 519,4 | 185 | 456,4 | 401 | 975,8 |

***Artificial stands of ash*** *(Fraxinus excelsior)* from the protected area „Hincesti forest" have been created on an area of 192,7 ha in 116 subplots. Hence 116,7 ha of pure ash stands (10FR) and 75 mixed stands have been created. We recorded stands with oak participation (9FR1ST; 8FR2ST), acacia (9FR1SC; 6FR4SC; 7FR3SC). In some subplots were created ash stands with Honey locust and sycamore maple.

***Artificial stands of acacia*** *(Robinia pseudoacacia)* were created on an area of 397,6 ha. It is worth to mention that the planted forest stands with acacia are of less productivity. One of the explanations of this situation could be that acacia forest stands have not been planted in suitable forest station being planted in areas suitable for pedunculate oaks and sessile oak. Pure acacia stands were planted on an area of 304,4 ha in 82 subplots and have in composition oak (9SC1ST; 7SC2ST1FR), ash (8SC2FR; 9SC1FR; 7SC3FR; 5SC5FR), elm (7SC3ULC), walnut (7SC3NU) and Honey locust (6SC4GL; 9SC1GL; 3SC2GL3PA2AR; 8SC1GL1ST) .

***Artificial stands of sessile oak*** *(Quercus petrea)* have been planted on an area of 74,5 ha. The area of pure sessile oak plantation is just 4,7 ha, in 5 subplots and mix sessile oak was planted with sycamore maple on an area of 20,9 ha (6GO4PA; 8GO2PA; 4GO6PA; 3GO7PA), with pedunculate oak on an area of 44,3 ha (4GO5ST1DT).

***Artificial plantation of walnut*** *(Junglans regia)* have been planted on an area of 38,1 ha. The pure stands (10NU) constitute 28,8 ha, in mix with ash 0,6 ha (6NU4FR), with hornbeam and sycamore maple 8,7 ha (4NU3CA3PA; 7NU2PA1AR; 4NU4PA2AR).

***Artificial plantation of pine*** *(Pinus nigra)* was planted on area of 27,1 ha, of which pure pine plantation represents 25,2 ha and the mix with sycamore maple 1,9 ha (8PI2PA; 5PI5PA).

***Artificial plantation of sycamore maple*** *(Acer platanoides)* were planted on area of 17,5 ha, from which pure stands is 1,1 ha and mix stands with walnut (7PA3NU; 6PA3NU1DT; 5PA4NU1FR), oak and acacia (8PA1ST1SC; 7PA3SC) are 16,4 ha.

***Artificial plantation of spruce*** *(Picea abies)* have been planted on an area of 4,9 ha. In one subplot is spruce mixed with sycamore maple (5MO5PA) covering 2,3 ha and in 3 subplots is pure spruce plantation (10MO), 2,6 ha.

***Artificial plantation of Honey locust*** *(Gledicia triacantus)* covers an area of 10,2 ha. Pure stands (10GL) covers 4,8 ha. Mix stands of honey locus with acacia (9GL1SC; 7GL2SC1FR; 8GL2SC; 7GL3SC) and sycamore maple (8GL2PA) are covering an area of 5,4 ha.

Also plantations of pure acacia (10SA) (0,9 ha) and chestnut (10CA) (3,1 ha) have been created. Mixed plantation of cherry (3,1 ha) (3CI3SC2FR1NU1AR) and elm (4,2 ha) (7ULC2ST1FR; 10ULC; 7ULC3SC) have been created.

From total area around 155.8 hectares serve as for the administrative needs.

## Conclusions

In the protected area “Hincesti Forest” exists three categories of forest stands: natural fundamental, derived and artificial. The fundamental natural stands were highlighted in 145 subplots with a total area of 2510,3 ha which is 60% of protected area stands. Derived stands are present in 68 subplots with a total area of 652,4 ha which is 16% of area. Artificial stands were planted on an area of 519,4 ha in 216 subplots.

Condition of many stands from protected area “Forest Hincesti” is unsatisfactory, especially those trees that were created in improper area.

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# GENUL *RANUNCULUS* L. (*RANUNCULACEAE ADAN*S.) ÎN FLORA BASARABIEI

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*Grădina Botanică (I) a AŞ M*

**Summary.** *The paper presents the critical processing's results concerning the Ranunculus L. (Ranunculaceae Adans.) genus for Bessarabia's flora which includes 20 species. The key date for determining the species, a brief taxonomical, bioecological and chorological characteristics of the species were given.*

## Introducere

Genul *Ranunculus L. – Boglar* include circa 600 specii, răspândite vast în flora Globului, începând cu tundra arctică până în pustiu, cu excepția regiunilor tropicale. Cuprinde plante erbacee anuale sau perene, decorative, unele medicinale, iar o mare parte – toxice. Se întâlnesc în cele mai diverse condiții ecotopologice palustre, acvatice, silvice, praticole stepice şi a. Totodată majoritatea reprezentanților genului îşi păstrează caracterul mezofil, chear dacă se întâlnesc în regiunile de pustiu.

## Materiale şi metode

Material pentru cercetare, privitor la genul *Ranunculus*, au servit atât exsicatele de plante existente în Herbarele Grădinii Botanice (I) şi a Universității de Stat din Moldova, cât şi literatura de specialitate. Prelucrarea critică a taxonilor specifici a fost efectuată conform metodei comparativ-morfologice [9]. Nomenclatura ştiințifică latină şi în limba maternă a taxonilor a fost revizuită şi selectată conform lucrărilor recent publicate [11, 5, 2]. Particularitățile bioecologice ale speciilor evidențiate au fost întocmite pe baza literaturii [4]. Districtele geobotanice ale Basarabiei şi teritoriilor adiacente sunt indicate conform monografiei „Flora Basarabiei”[3].

## Rezultate şi discuții

Printre primii cercetători ai florei Basarabiei, care au adus date cu privire la genul *Ranunculus* L., au fost Липский В., indică 14 specii de boglari [7], Окиншевич Н., prezintă 8 specii [10] şi Săvulescu Tr., Rayss T., indică 15 specii de boglari [6].

În cadrul cercetărilor de verificare şi prelucrare critică a taxonilor floristici pentru elaborarea monografiei „Flora Basarabiei" în 6 volume, au fost studiate materialele herbarizate, privitor la genul *Ranunculus* L., existente în Herbarele Grădinii Botanice (I) şi a USM. La etapa actuală, pe baza analizei critice atât a specimenelor existente în colecțiile herbarizate indicate, cât şi a izvoarelor de literatură publicate, a fost precizată şi evidențiată componența taxonomică a genului *Ranunculus* L., ce include 20 specii. Din totalitatea taxonilor specifici evidențiați prezența speciei *R. reptans* L. este discutabilă, deoarece nu poate fi confirmată prin material herbarizat colectat. Specia *R. pseudobulbosus* Schur, în lucrările floristice europene, este sinonimizată cu specia *R. sardous* Crantz.

Pentru speciile *R. auricomus* L., *R. cassubicus* L., *R. falax* (Wimm. et Crab.) Sloboda, având în vedere polimorfismul lor înalt, considerăm adecvată tratarea volumului acestor taxoni „*sensu lato*".

Autorii lucrărilor de specialitate publicate la sfârşitul sec. 18, cu privire la flora în studiu, indică prezența speciilor *R. bulbosus* L. – în parchetul de tăiat din Hotin [10], *R. lanuginosus* L. – localitățile Akkerman, Căuşani [7]. Colectări ulterioare, care ar confirma prezența acestor specii, nu avem, sunt necesare cercetări de teren suplimentare.

În continuare este prezentată cheia pentru determinarea speciilor, sinonimia, particularitățile lor bioecologice şi corologice.

Cheia pentru determinarea speciilor

| | | |
|---|---|---|
| 1a. | Rădăcini (toate sau unele) tuberizat-îngroşate .................................................. | 2 |
| 1b. | Rădăcini (toate) neîngroşate .................... | 4 |
| 2a. | Flori cu sepale patente sau alipite de petale........................................................ | R. pedatus Waldst. et Kit. |
| 2b. | Flori cu sepale reflecte ............................ | 3 |
| 3a. | Achene cu rostru mai lung decât însăşi achena.................................................... | R. oxyspermus Willd. |
| 3b. | Achene cu rostru mai scurt decât achena | R. illyricus L. |
| 4a. | Frunze întregi sau cu inciziuni mici ........ | 5 |
| 4b. | Frunze (cel puțin tulpinale) cu inciziuni profunde ................................................ | 8 |

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Plantă perenă, înfloreşte în lunile mai-august, hemicriptofit, praticolă; element eurasiatic (mediteranean); specie mezofită, amfitolerantă față de temperatură şi reacția solului. Vegetează în luncile râurilor, poiene; comună pe întreg teritoriul „Florei".

**R. stevenii** Andrz. 1814, Bess. Suppl. 3 ad Cat. Pl. Gymn. Volh.: 19; A. Nyar. 1953, Fl. RPR, 2: 615; Добр.1999, Опред. высш. раст. Укр.: 52; Цвел. 2001, Фл. Вост. Евр., 10: 125; Negru, 2007, Determ. de pl. din fl. R. Mold.: 43. – *R. strigulosus* Schur, 1866, Enum. Pl. Transsilv.: 17; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 274. – ***B. Steven***

Plantă perenă, înfloreşte în lunile iunie-iulie; hemicriptofit-geofit; silvicolă; element european (mediteranean); specie mezofilă, microtermă, acido-neutrofilă. Vegetează prin poiene, liziera pădurilor. Răspândită în districtele geobotanice cu vegetație silvică.

**R. polyanthemos** L. 1753, Sp. Pl., ed. I: 554; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 273 p. p.; Добр.1999, Опред. высш. раст. Укр.: 52; Цвел. 2001, Фл. Вост. Евр., 10: 126; Negru, 2007, Determ. de pl. din fl. R. Mold.: 43; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 172 pp. – *R. polyanthemos* L. var. *latifolius* Rupr. 1869, Fl. Cauc. I: 16. – *B.* ***pluriflor***

Plantă perenă, înfloreşte în lunile mai-iulie, hemicriptofit; praticolă; element eurasiatic (cont.); specie mezofită, mezotermă, preferă soluri acido-neutre. Vegetează în poiene, liziera pădurilor, lunci; răspândită aproape pe întreg teritoriul „Florei".

**R. meyerianus** Rupr. 1869, Fl. Cauc., I: 25; Цвел. 2001, Фл. Вост. Евр., 10: 126; Negru, 2007, Determ. de pl. din fl. R. Mold.: 43. – *R. polyanthemos* L. subsp. *meyerianus* (Rupr.) Jelen. et Derv.-Sok. 1984, Изв. высш. школы, Биол. науки, 10: 75. - *R. polyanthemos* auct., non L.: Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, 1: 273, pp. – ***B. Meier***

Plantă perenă, înfloreşte în lunile mai-iulie; hemicriptofit; praticolă; element eurasiatic (continental); specie xerofită, mezotermă, acido-neutrofilă. Vegetează prin poiene, lizieră de pădure, lunci stepizate, răspândită sporadic, aproape pe întreg teritoriul „Florei".

**R. nemorosus** DC. 1818, Reg. Veg. Sist. Nat., I: 280; Цвел. 2001, Фл. Вост. Евр., 10: 128; Negru, 2007, Determ. de pl. din fl. R. Mold.: 43; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 172. – *R. polyanthemos* L. subsp. *nemorosus* (DC.) Schmalh. 1895, Фл. Ср. Южн. Росс. I: 22. – *R.* serpens Schrank subsp. *nemorosus* (DC.) Lopez Gonz. 1985, Anal. Jard. Bot. Madrid, 41, 2: 470; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 273. - ***B. silvatic***

Hemicriptofit, înfloreşte în lunile iunie-august; silvicolă; element european (mediteranean); specie mezofită, amfitolerantă față de temperatură, acido-neutră față de reacția solului; vegetează în păduri luminoase, poiene, lizieră de pădure. Pe teritoriul florei răspândită în toate districtele geobotanice cu vegetație silvică.

**R. repens** L. 1753, Sp. Pl., ed. I: 549; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 274; Добр.1999, Опред. высш. раст. Укр.: 51; Цвел. 2001, Фл. Вост. Евр., 10: 131; Negru, 2007, Determ. de pl. din fl. R. Mold.: 43; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 172. – ***B. repent***

Plantă perenă, stoloniferă, înfloreşte în lunile mai-august, hemicriptofită, mezohigrofilă, amfitolerantă față de temperatură şi reacția solului, element eurasiatic (mediteranean). Vegetează în luncile râurilor, se întâlneşte pe întreg teritoriul „Florei”.

**R. sardous** Crantz. 1763, Stirp. Austr., I: 84; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 277; Добр. 1999, Опред. высш. раст. Укр.: 52; Цвел. 2001, Фл. Вост. Евр., 10: 132; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 172. – *R. pseudobulbosus* Schur, 1853, Verh. Siebenb. Ver. Naturw. 10: 84; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3: 215. - ***B. sardinian***

Plantă anuală-bianuală, perenă, înfloreşte în mai-august, terofit anual-bianual, hemicriptofit, praticolă; element european (mediteranean); specie mezofită, mezotermă, slab acid-neutrofilă. Vegetează în luncile râurilor, livezi, pante ierboase, păduri cu stejar, liziera pădurilor. Răspândită pe teritoriul florei la Nord (II-Ht, IIIb-Rş, IIIc-Rz), în Codri, la Sud (VI).

**R. muricatus** L. 1753, Sp. Pl., ed. I: 555; Добр.1999, Опред. высш. раст. Укр.: 51; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 277; Цвел. 2001, Фл. Вост. Евр., 10: 133; Negru, 2007, Determ. de pl. din fl. R. Mold.: 43; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 171. – ***B. muricat***

Plantă anuală, înfloreşte în luna mai; terofit anual; adventivă; element mediteranean; specie mezofită, mezotermă, amfitolerantă față de reacția solului. Vegetează pe locuri cu vegetație degradată, în apropierea c. Bahmut, raionul Călăraşi; foarte rară. Arealul speciei cuprinde Europa Atlantică, regiunea Mediteraneană, Balcani, Asia Mică.

**R. arvensis** L. 1753, Sp. Pl., ed. I: 555; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 277; Добр. 1999, Опред. высш. раст. Укр.: 51; Цвел. 2001, Фл. Вост. Евр., 10: 134; Negru, 2007, Determ. de pl. din fl. R. Mold.: 43; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 171. – *R. tuberculatus* DC. 1817, Reg. Veg. Sist. Nat.: 297. – *R. arvensis* var. *tuberculatus* (DC.) Koch, 1835, Syn. Fl. Germ.: 18. – ***B. campestru***

Plantă anuală, înfloreşte în lunile mai-iulie; terofit anual; segetală; element eurasiatic (mediteranean); specie mezofită, mezotermă, amfitolerantă față de reacția solului. Vegetează pe câmpuri de cereale, în luncă; răspândită foarte rar pe teritoriul „Florei”(Corneşti, r-nul Ungheni). Arealul speciei cuprinde Eurasia, Africa de Nord.

**R. pedatus** Waldst. et Kit. 1805, Descr. et icon. Pl. rar. Hung. 2: 112; A. Nyar. 1953, Fl. RPR, 2: 625; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 278; Добр. 1999, Опред. высш. раст. Укр.: 51; Цвел. 2001, Фл. Вост. Евр., 10: 135; Negru, 2007, Determ. de pl. din fl. R. Mold.: 43; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 169. – ***B. pedat***

Plantă perenă, înfloreşte în lunile aprilie-mai; hemicriptofit(geofit); prato-stepică sau stepică; element eurasiatic (continental); specie xerofită, mezotermă, preferă soluri slab acid-neutre; Vegetează în poiene, liziera pădurilor, pante ierboase, lunci stepizate. Răspândită predominant în partea centrală şi de sud a teritoriului „Florei”.

**R. illyricus L.** 1753, Sp. Pl.: 552; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 278; Добр. 1999, Опред. высш. раст. Укр.: 51; Цвел. 2001, Фл. Вост. Евр., 10: 136; Negru, 2007, Determ. de pl. din fl. R. Mold.: 42; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 168. – *R. scythicus* Klok. ex Grossh. Grossh. 1948, Бот. журн. 33, 3: 311, descr. ross. – ***B. ilirian*** *(Trânjoaică)*

Plantă perenă, înfloreşte în luna mai; hemicriptofit (geofit); stepică; element ponto-mediteranean; specie xeromezofită, moderat termofilă, preferă soluri slab acid-neutre; Vegetează pe pante stepice, poieni şi liziere de pădure, pe nisipuri; răspândită sporadic în districtele geobotanice VIII-BgS(v. Nistr.), VI-Tn(v. Nistr.), VI-Tgh, Va-Cd, IIIb-Rş, IIIa-Br, II-Ht.

**R. oxispermus** Willd. 1800, Sp. Pl., ed. 2: 1328; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 277; Добр.1999, Цвел. 2001, Фл. Вост. Евр., 10: 136; Negru, 2007, Determ. de pl. din fl. R. Mold.: 42; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 168. – ***B. oxisperm***

Plantă perenă, înfloreşte în mai, hemicriptofit; stepică; element balcano-caucazian; specie xeromezofită, mezotermă, preferă soluri acido-neutre; vegetează pe pante ierboase, în lunci stepizate, dezgoliri calcaroase, rarişti de pădure. Vegetează la nordul teritoriului (IIIb-Rş), partea centrală (IIIc-Cd) şi în partea de sud (VI, VII, VIII - Tn, Ml, BgN, BgS).

**R. auricomus** L. 1753, Sp. Pl., ed. I: 551; Pacz. 1912, Mat. Fl. Basarab., 3: 25; Овч. 1937, Фл. СССР, 7: 377; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 280; Добр. 1999, Опред. высш. раст. Укр.: 52; Цвел. 2001, Фл. Вост. Евр., 10: 140; Negru, 2007, Determ. de pl. din fl. R. Mold.: 43; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 175. – *B. auripilos*

Plantă perenă, înfloreşte în lunile aprilie-mai, hemicriptofit; silvicolă; element eurasiatic, specie mezofită, mezotermă, preferă soluri acido-neutre. Vegetează în păduri, zăvoaie. Răspândită pe teritoriul „Florei” în districtele geobotanice cu vegetație silvică.

**R. fallax (**Wimm. et Grab.) Sloboda, 1852, Rostlinnistvi: 679; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 277; Изверская, 1992, Bul. AŞ RM, Ser. şt. biol. şi chim., I: 3; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 175.- *R. auricomus* e *fallax* Wimmer et Grab. 1829, Fl. Siles. 1, 2: 128. - *R. megacarpus* Walo Koch pp., 1934, Ber. Schweiz. Bot. Ges. 43: 126; Овч. 1937, Фл. СССР, 7: 380. – ***B. nesigur***

Plantă perenă, înfloreşte în lunile aprilie-mai, hemicriptofit, element eurasiatic (continental), specie mezofită, mezotermă, preferă soluri acido-neutre. Vegetează în lunci şi zăvoaie. Rară în partea de nord a teritoriului, în pădurile de stejar cu cireş şi stejar cu mesteacăn.

**R. cassubicus L.** 1753, Sp. Pl.: 551; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, 1: 280; Добр.1999, Опред. высш. раст. Укр.: 52; Цвел. 2001, Фл. Вост. Евр., 10: 150; Negru, 2007, Determ. de pl. din fl. R. Mold.: 42; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 175. – *B. golaş*

Plantă perenă, înfloreşte în mai-iunie, hemicriptofit, silvicolă; eurasiatic (continental); specie mezofită, mezotermă, amfitolerantă faţă de reacţia solului; vegetează prin poieni, păduri; răspândită foarte rar pe teritoriul florei în districtul Hotin Corneşti (indicată de Tr. Săvulescu et T. Rayss), Rezervaţia ştiinţifică „Codrii” şi (colectări P. Pânzaru).

**R. flammula** L. 1753, Sp. Pl., ed. I: 548; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 283, excl. subsp.; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3: 213; Добр.1999, Опред. высш. раст. Укр.: 50; Цвел. 2001, Фл. Вост. Евр., 10: 154; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 171. – ***B. roşu***

Plantă perenă, înfloreşte în lunile iunie-iulie; hemicriptofit; praticolă; element eurasiatic; mezohidrofilă, mezotermă, amfitolerantă faţă de reacţia solului. Vegetează pe locuri mlăştinoase, răspândită foarte rar; atestată dintr-o singură localitate c. Voinovo, r-nul Străşeni (8). Arealul speciei cuprinde Eurasia.

**R. reptans** L. 1753, Sp. Pl., ed. I: 549; Гейдеман, 1986, Опред. высш. раст. МССР, изд. 3: 213; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 283; Добр. 1999, Опред. высш. раст. Укр.: 50; Цвел. 2001, Фл. Вост. Евр., 10: 155; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 171. – *R. flammula* subsp. *reptans* (L.) Schnz. et Kell. 1905, Fl. Schw., 2: 77. – ***B. decumbent***

Plantă perenă, înfloreşte în lunile mai-septembrie; hemicriptofit; praticolă; element european, mezohidrofilă, mezotermă, amfitolerantă faţă de reacţia solului. Vegetează pe lunci umede. Rară în rezervaţia ştiinţifică Codrii (Colectări P. Pânzaru).

**R. lingua** L. 1753, Sp. Pl., ed. I: 549; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 283; Добр. 1999, Опред. высш. раст. Укр.: 51; Цвел. 2001, Фл.

Вост. Евр., 10: 155; Negru, 2007, Determ. de pl. din fl. R. Mold.: 42; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 169. – ***B. lingulat***

Plantă perenă, înfloreşte în lunile iunie-iulie, helohidatofit; palustră; element eurasiatic; specie ultrahidrofită, mezotermă, slab acid-neutrofilă. Vegetează prin mlaştini, bălți, plauri în lacul Manta; foarte rară pe teritoriul „Florei", la Crihana Veche şi în districtele Chilia şi Hotin.

**R. polyphylus** Waldst. et Kit. ex Willd. 1799, Sp. Pl. 2, 2: 1331; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 284; Цвел. 2001, Фл. Вост. Евр., 10: 157; Добр. 1999, Опред. высш. раст. Укр.: 50; Negru, 2007, Determ. de pl. din fl. R. Mold.: 42; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 169. – ***B. plurifil***

Plantă perenă, polimorfă; helohidatofit-hemicriptofit; acvatică; element eurasiatic (continental); specie ultrahidrofită, moderat termofilă, neutro-bazifilă. Vegetează în bazine cu ape mici (rar se întâlnesc şi exemplare terestre mici). Atestată numai în lunca râului Bâc, spre nord de localitatea Ghidighici. Inclusă în Cartea Roşie a plantelor vasculare din România [1]

**R. sceleratus** L. 1753, Sp. Pl., ed. I: 551; Pacz. 1912, Mat. Fl. Basarab., 3: 25; Tutin a. Akeroyd, 1993, Fl. Europ., ed. 2, I: 280; Добр. 1999, Опред. высш. раст. Укр.: 52; Цвел. 2001, Фл. Вост. Евр., 10: 158; Negru, 2007, Determ. de pl. din fl. R. Mold.: 42; Ciocârlan, 2009, Fl. Ilustr. a Rom.: 171. – ***B. toxic***

Plantă anuală, înfloreşte în lunile mai-august; terofit anual; palustră; element circumpolar; mezohidrofilă, mezotermă, preferă soluri slab acid-neutre; vegetează pe sărături în lunci, pe malul râurilor. Răspândită pe întreg teritoriul „Florei".

## Concluzii

Pe baza prelucrării critice a materialului herbarizat şi analiza publicațiilor de domeniu, privitor la genul *Ranunculus* L. au fost evidențiate următoarele:

1. În flora Basarabiei genul *Ranunculus* L. este reprezentat prin 20 de specii de boglari.
2. Considerăm adecvată tratarea volumului „*sensu lato*" pentru speciile *R. auricomus* L. s.l., *R. cassubicus* L. s. l., *R. falax* (Wimm. et Crab.) Sloboda s. l.
3. Din punct de vedere al rarității *R. lingua* L., *R. polyphyllus* Waldst. et Kit. ex Willd., *R. muricatus* L., *R. flammula* L., *R. falax* (Wimm. et Grab.) Sloboda, *R. arvensis* L. sunt specii foarte rare pentru flora R. Moldova.

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# RARE VASCULAR PLANTS OF EUROPEAN IMPORTANCE IN THE FLORA OF REPUBLIC OF MOLDOVA

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**Summary.** *The paper contains the list of rare vascular plants of European Importance from the flora of Republic of Moldova. The list comprises 41 species which are listed under European or global policy instruments such as the Habitats Directive (16 taxa), Bern Convention (18) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (20 species), 6 species listed under the European Union Wildlife Trade Regulation and 2 species have been identified as threatened with extinction and included in the European Red List of Vascular Plants.*

## Introduction

Intensified livestock farming, recreational activities, tourism and urban development, wild plant collection, invasive alien species, natural system modifications and pollution, as well as introduction of modern agricultural practices and lack of financial support for appropriate active protection management, resulted in changes in floristic composition. The conservation status of plants is one of most widely used indicators for assessing the condition of ecosystems and their biodiversity. It also provides an important tool in establishing priorities for species conservation.

The necessity of this study was to make a list of rare vascular plants of European Importance from the flora of Republic of Moldova [9, 10, 13] in order to provide key resources for decision-makers, policy-makers, resources managers, environmental planners and NGOs etc.

## Materials and methods

The present account includes all the taxa that are listed under: the Annexes of the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora); Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) (1979) [4], the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) [3] and European Union Wildlife Trade Regulation, and under the European Red List of Vascular plants [1, 5, 6, 7].

All selected plant species are native to local flora and the taxonomy followed by the recent taxonomical literature [2, 9, 12, 14].

## Results and discussions

The flora of the Republic of Moldova comprises over 1820 species [9, 13] inhabiting one of the most fragmented landscape in Eastern Europe with only a tiny fraction of its land surface that can be considered as wilderness. The plants in the present list are given in alphabetical order, each with the indication of the list (or lists) which it is included as follows: the Annexes of the Habitats Directive; Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention); the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and European Union Wildlife Trade Regulation, and in the European Red List of Vascular plants [1].

The Bern Convention is a binding international agreement that aims to conserve wild flora and fauna and their natural habitats and to promote European co-operation towards that objective. The Bern Convention was the basis for designing the Habitats Directive, a strong legal instrument that needs to be transported into national law by the European Union member states. There are three annexes of direct relevance to plant species:

Annex II, which is by far the most important in terms of conservation impact, requires the designation of Special Areas of Conservation for the species listed in there; Annex IV lists species for which it is prohibited to pick, collect, cut, uproot or dectruct plants in their natural range in the wild (Article 13.1(a)) and to keep, transport, sell or exchange those plants (Article 13.1(b)). Annex IV covers all plant species listed in Annex II plus additional ones. Plants listed under Annex V may require management measures for its collection from the wild and exploitation. Under Article 17 of the Habitats Directive, member states are required to report on the status of the species and on the conservation measures taken. Annexes II, IV and V of the Habitats Directive list seventeen and the Bern Convention includes 19 taxa from the Republic of Moldova and there is an overlap of 11 species between two instruments.

CITES regulates the international trade in endangered species. It provides a framework for countries to establish national legislation to implement the convention. The trade for all the species listed in Appendix II should be controlled in the form of export permits and re-export certificates being required [3]. For the Republic of Moldova there are 20 species listed under Appendix II. This includes all snowdrop species (genus *Galanthus*) with a total of three occurring in the republic, the *Sternbergia colchiciflora* and *Adonis vernalis*. Furthermore, the whole *Orchidaceae* family is included under Appendix II totaling 15 native Moldavian species. The European Union Wildlife Trade Regulation (338/97) lists additional species to CITES that need management at European level.

The European Red List of Vascular Plants represents a first attempt of assessment the European vascular flora (a summary of results for three selected groups of vascular plants, totaling 1826 species native to Europe or naturalized before AD 1500. They belong to one or more of three groups: plants listed under European or global policy instruments; Crop wild relatives of priority crops and Aquatic plant species) which is a part of a wider project aimed at comprehensively assessing several taxonomic groups [1]. The European Red List of Vascular plants provides key resources for decision-makers, policy-makers, resources managers, environmental planners and NGOs. Under this listing only two species occurring in our native flora: *Carlina onopordifolia* and *Genista tetragona* have been identified as threatened with extinction.

In total, there are 41 species in this group which will be from now on referred to as the European and International "policy species". Many of them are protected by the State [8, 11] and are listed in more than one international policy instrument (Table 1).

Table 1

**Policy species of vascular plants of European Importance in the native flora of Republic of Moldova**

| *Family* | *Species Latin name* | *Habitats Directive* | *Bern Convention* | *CITES* | *EU Trade Regulation* | *IUCN Red List Category (Europe)* |
|---|---|---|---|---|---|---|
| *Alismataceae* | *Caldesia parnassifolia* (Bassi) Parl. | II, IV | I | | | NT |
| *Amaryllidaceae* | *Galanthus elwesii* Hook.fil. var. *maximus* (Velen.) G. Beck | | | II | + | DD |
| *Amaryllidaceae* | *Galanthus nivalis* L. | V | | II | + | NT |
| *Amaryllidaceae* | *Galanthus plicatus* Bieb. | | | II | + | LC |
| *Amaryllidaceae* | *Sternbergia colchiciflora* Waldst. et Kit. | | | II | + | LC |
| *Apiaceae* | *Angelica palustris* (Boiss.) Hoffm. | II, IV | I | | | DD |
| *Asteraceae* | *Carlina onopordifolia* Bess. ex Szaf., Kulcz. et Pawl. | II, IV | I | | | VU B2ab(iii) |
| *Boraginaceae* | *Echium russicum* J.F.Gmel. | II, IV | | | | LC |
| *Brassicaceae* | *Crambe tataria* Sebeok | II, IV | I | | | LC |
| *Brassicaceae* | *Schivereckia podolica* (Bess.) Andrz. ex DC. | | I | | | LC |
| *Campanulaceae* | *Adenophora liliifolia* (L.) A. DC. | II, IV | | | | LC |
| *Cyperaceae* | *Carex secalina* Willd. ex Wahlenb. | | I | | | DD |
| *Cyperaceae* | *Eleocharis carniolica* Koch | II, IV | I | | | LC |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Droseraceae* | *Aldrovanda vesiculosa* L. | II, IV | I | | | DD |
| *Fabaceae* | *Genista tetragona* Bess. | | I | | | VU B1ab(iii) |
| *Iridaceae* | *Iris aphylla* L. | II, IV | | | | DD |
| *Liliaceae* | *Fritillaria montana* Hoppe | | I | | | DD |
| *Marsileaceae* | *Marsilea quadrifolia* L. | II, IV | I | | | NT |
| *Melanthiaceae* | *Colchicum fominii* Bordz. | II, IV | I | | | LC |
| *Orchidaceae* | *Cephalanthera damasonium* (Mill.) Druce | | | II | | LC |
| *Orchidaceae* | *Cephalanthera longifolia* (L.) Fritsch | | | II | | LC |
| *Orchidaceae* | *Cephalanthera rubra* (L.) Rich. | | | II | | LC |
| *Orchidaceae* | *Cypripedium calceolus* L. | II, IV | I | II | + | NT |
| *Orchidaceae* | *Dactylorhiza majalis* (Reichenb.) P.F.Hunt et Summerhayes | | | II | | LC |
| *Orchidaceae* | *Epipactis atrorubens* (Hoffm. ex Bernh.) Bess. | | | II | | LC |
| *Orchidaceae* | *Epipactis helleborine* (L.) Crantz | | | II | | LC |
| *Orchidaceae* | *Epipactis palustris* (L.) Crantz | | | II | | LC |
| *Orchidaceae* | *Epipactis purpurata* Smith | | | II | | LC |
| *Orchidaceae* | *Gymnadenia conopsea* (L.) R.Br. | | | II | | LC |
| *Orchidaceae* | *Neottia nidus-avis* (L.) Rich. | | | II | | LC |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Orchidaceae* | *Orchis militaris* L. | | | II | | LC |
| *Orchidaceae* | *Orchis purpurea* Huds. | | | II | | LC |
| *Orchidaceae* | *Orchis signifera* Vest | | | II | | LC |
| *Orchidaceae* | *Platanthera bifolia* (L.) Rich. | | | II | | LC |
| *Orchidaceae* | *Platanthera chlorantha* (Cust.) Reichenb. | | | II | | LC |
| *Ranunculaceae* | *Adonis vernalis* L. | | | II | + | LC |
| *Ranunculaceae* | *Pulsatilla grandis* Wend. | II, IV | I | | | LC |
| *Ranunculaceae* | *Pulsatilla patens* (L.) Mill. | II, IV | I | | | DD |
| *Rosaceae* | *Agrimonia pilosa* Ledeb. | II, IV | | | | LC |
| *Salviniaceae* | *Salvinia natans* (L.) All. | | I | | | LC |
| *Scrophulariaceae* | *Veronica euxina* Turrill | | I | | | DD |
| *Trapaceae* | *Trapa natans* L. | | I | | | NT |

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# DISTRIBUTIONAL PATTERN OF SOME RARE FEATHER-GRASSES (*STIPA*, *POACEAE*) IN THE REPUBLIC OF MOLDOVA

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**Summary.** *The paper represents the results of the distributional pattern of rare feather-grass species - Stipa ucrainica and Stipa dasyphylla. The distribution based on compilation of new records and the existing floristic literature reference, as well as habitat, phytosociology characteristics and some considerations on threats to steppe vegetation is given.*

## Introduction

The territory of Republic of Moldova is a region of meeting of most diverse floristic influences. In phytogeographical sense this area borders with the Central European forest region, Eastern European steppe province and from the south with the Mediterranean region. Such influences caused by long-term florogenetic and plant migration processes created the original flora of the republic with a diversity of habitat conditions.

The steppes and dry grasslands exhibit special habitat conditions, due to the various climatic effects and the unique biogeographical position. They offer many highly specialized plant species a valuable habitat and are characterized in general by a high biodiversity. In our country we have large responsibility for the preservation of the numerous species of plants belonging to the steppe vegetation. This is in large part because many of these species have their most important range of distribution here and dry grasslands is their only home.

The endangerment of the steppes and dry grasslands is a result of the change in traditional land use. This is especially evident in the decreasing number of grazing sheep, goats and cattle. The intensification of certain agricultural and forestry practices has also contributed to large scale losses.

An extreme hazard to the steppes and dry grasslands comes from the spread of invasive plant species, such as the black locust (*Robinia pseudoacacia*), tree-of-heaven (*Ailanthus altissima*), etc. especially in the areas formerly used for agriculture. From past experience we know that it is very difficult and costly to try to suppress these species. The only meaningful solution is to re-establish the traditional use of the land.

The southern part of the republic is characterized by a significant number of xerophilous habitat types, which generated conditions for the development and establishment of plant species which belong to the Mediterranean area type. The spread of these plants to the north is limited mainly by the influence of the continental climate that is becoming more present towards central and northern parts.

The aim of the present article is to examine the distribution pattern of a rare grass species – *Stipa ucrainica* and *Stipa dasyphylla.* The complete distribution of these plants in republic is based on a compilation of new records and the existing floristic reference literature data. Besides the new field records, some unpublished chorological data on the material deposited in the Herbarium of the State University of Moldova, Herbarium of National Museum of Ethnography and Natural History of Moldova and Herbarium of the Botanical Garden (Institute) of Academy of Sciences of Moldova.

## Materials and methods

This paper is a continuation of the intensive floristic and chorological studies of the vascular flora of Republic of Moldova undertaken recently by the authors of this article. Besides the field survey, checking and revision of herbarium material and numerous literature sources we used to supplement the distribution records.

The collected material of plant species is deposited in the Herbarium of the Botanical Garden (Institute) of ASM.

## Results and discussions

The genus *Stipa* comprises about 300 species [13, 14], widely distributed in both hemispheres, mostly in temperate and warm-temperate districts, in dry, open habitats, sometimes in mountainous regions. In the Republic of Moldova is represented by 7 species: ***Stipa capillata*** L., ***S. dasyphylla*** (Lindem.) Trautv. (=*C. pennata* L. γ. *dasyphylla* Czern. ex Lindem.), ***S.***

***lessingiana*** Trin. et Rupr., ***S. pennata*** L., ***S. pulcherrima*** C. Koch, ***S. tirsa*** Stev. (=*S. stenophylla* (Czern. ex Lindem.) Trautv., *S. longifolia* Borb.) and ***S. ucrainica*** P. Smirn. – inhabiting mainly species-rich steppes on south or southwest facing slopes on calcareous or loess soils, which developed mainly secondarily after the abandonment of extensively managed vineyards or orchards [7, 9, 15, 16]. They are considered to be forest steppe meadows in spite of their sandy, sometimes rocky soil and the dominance of *Stipa* species, since they contain many forest and forest-steppe species. Usually, one particular *Stipa* species dominates a stand. Different *Stipa* species rarely occur in the same stands, what is most probably explained by the different site condition preferences of different *Stipa* species.

An investigation of this phenomenon found that *Stipa tirsa* and *S. pennata* favors medium-deep or deep soils poor in chalk, while *S. dasyphylla* is characteristic for very shallow soils also poor in chalk. *S. pulcherrima* thrives mainly on calcareous soils. The pattern of the patches of different *Stipa* species faithfully reflects the geological and soil conditions as well as the land use history of a given location. Steppes dominated by *Stipa* species are usually two-layered [9]. The upper layer is formed by *Stipa*, and there are *Festuca valesiaca* or *Koeleria cristata* beneath. Other characteristic grasses of such stands are *Potentilla recta*, *Inula ensifolia*, *I. salicina*, *Scorsonera hispanica*, *Anthemis tinctoria*, *Polygala major*, *Campanula bononiensis* etc. are typical forbs of these steppes.

Fortunatelly, *Stipa* species are still common in loess steppes and slope steppes in the republic today. These are the most beautiful grass species of steppes. One of them is *S. capillata*, a disturbance-tolerant common species of dry steppes. *S. tirsa* is a dominant species of species rich forest steppe meadows, occurring mainly in the south. *Stipa. pennata* and *S. pulcherrima* and *S. lessingiana* are more widespread, they can be dominants in loess steppes and slope steppes as well. *Stipa dasyphylla* and *Stipa ucrainica* rarely occurs on calcareous and loess soils.

In the process of identification of important plant areas in Republic of Moldova, several fragments of steppe community with rare feather-grasses (*Stipa* spp.) were visited and studied.

## Distribution, habitats and phytosociology

***Stipa ucrainica*** is endemic to the Pontic floristic region [1, 4, 5]. It takes part in the existing steppe vegetation in East Romania, Moldova, South Ukraine (including Crimea), the southern part of European Russia (including the foothills of North Caucasus) [2, 5, 9]. In the Republic of Moldova its distribution covers mainly southern parts, although there are some localities in the central parts (district Orhei) and in northern steppe province (Belts steppe).

For the *Stipa ucrainica* were identified six new locations: near village Chizlear (dist. Leova), vill. Rascaiets (district Shtephan-Voda), vill. Lebedenco (district Cahul), villages Batar and Mihailovca (district Cimishlia) and vill. Chioc-Maidan (Gagauzia) (Figure 1) and documented


Figure 1. New locations of *Stipa ucrainica* - ● and *S. dasyphylla* - ■ in the Republic of Moldova

by herbarium specimens. These sites are characteristic by presence of somewhat rare plant associations with the dominance of *Botriochloa ischaemum*. The species richness represented by 72 species per 100 square meters with an average of 18 species (from 12 to 25) per 1 square meter. Overall projective cover is 90 – 95%. These plant communities contain a good number of rare steppe plants, such as: *Seseli tortuosum* L. *Goniolimon besserianum* (Schult.) Kusn. *Stipa lessingiana* Trin. et Rupr. *Otites parviflora* Grossh., *Otites exaltata* (Friv.) Holub, *Salvia* *nutans* L., *Otites moldavica* Klok., *Adonis vernalis L., Amygdalus nana* L., *Asparagus officinalis* L., *Astragalus dasyanthus* Pall., *Bellevalia sarmatica* (Georgi) Woronow, *Colchicum fominii* Bordz., *Crambe tataria* Sebeok, *Crocus reticulatus* Stev. ex Adams, *Helichrysum arenarium* (L.) Moench, *Ornithogalum oreoides* Zahar. etc.

The leaves of *S. ucrainica* may resemble those of *S. lessingiana* Trin. & Rupr. and *S. tirsa* Steven in the field, but both species differ by the very short, only 0.1–0.3 mm long ligules of the leaves of vegetative tillers, developed as a fimbriate collar, and in abaxial leaf surface covered by very short, up to 0.2 mm long, stiff, subappressed hairs. *Stipa tirsa* differs also by conspicuously long leaves with a setaceous apex [1].

According to the description of the species, the plants considered here clearly belong to the *S. dasyphylla* group, whose taxonomy is based mainly on the studies by Smirnov [10-12] and Martinovsky [3] both applying a rather splitting attitude. In Eastern and Central Europe, this species group includes *S. dasyphylla* (Lindem.) Trautv., *S. smirnovii* Martinovsky, *S. glabrata* P.A. Smirn., *S. zalesskii* Wilensky s. str. (syn. *S. rubentiformis* P. A. Smirn.), *S. pontica* P. A. Smirn., and *S. ucrainica* [3, 11]. Apart from *S. ucrainica*, they all have lemmas with ventral (or marginal) lines of hairs usually reaching the base of the awn, or ending 1(–2) mm below the base, and most of them also have thicker leaves and puberulent sheaths of the stem leaves. Despite the conflicting opinions about the taxonomy of the *S. dasyphylla* group [14], *S. ucrainica* is easily recognizable and therefore generally accepted on species level in all recent floras covering parts of its distribution range [6, 8, 13], while only Cvelev [14] preferred treating it as one of the five subspecies of *S. zalesskii*.

***Stipa dasyphylla*** is endemic to the Pontic floristic region [13]. Its area of distribution covers East Romania, Moldova, South Ukraine, the southern part of European Russia, Northern Caucasus [9, 13]. In the Republic of Moldova its distribution covers chiefly southern parts.

For the *Stipa dasyphylla* were identified two new locations: near village Copanca (district Shtephan-Voda) and vill. Baurchi Moldoveni (district Cahul) (figure 1) and documented by herbarium specimens. These sites are characteristic by presence of rather rare plant associations with the dominance of *Botriochloa ischaemum*. The species richness represented by 83 species per 100 square meters with an average of 27 species (from 23 to 33) per 1 square meter. Overall projective cover is 85 – 90%. These plant communities contain a number of rare steppe plants, such as: *Adonis vernalis* L., *Amygdalus nana* L., *Asparagus tenuifolius* Lam., *Crocus reticulatus* Stev. ex Adams, *Helichrysum arenarium* (L.) Moench., *Seseli* *tortuosum* L. *Goniolimon besserianum* (Schult.) Kusn. *Stipa lessingiana* Trin. et Rupr. *Otites parviflora* Grossh., *Otites exaltata* (Friv.) Holub, *Salvia nutans* L., *Otites moldavica* Klok. etc.

**Some considerations on threats to steppe vegetation**. The invasion of shrubs, trees and invasive weeds are the most serious threats to steppes. These factors emerge due to the cessation of the former land-use (grazing, mowing). In the past, herdsmen cleared out most of the shrubs from the pasture but some larger ones for the midday rest of the herd. The grazing pattern itself also altered. Previously, several small herds were grazing a broad area, while today one single herd graze a relatively small one, thus over-utilizing and overgrazing the habitat.

Invasion of shrubs endangers steppe meadows, although, this factor also threatens about the half of the slope steppes. In these grasslands, the rate of shrub invasion might be so high, that an impenetrable thicken of blackthorn, hawthorn and dog rose may develop in mere one or two decades. Beneath these thickets characteristic species of the grasslands may be suppressed and might die, and we do not know whether these scrubs would ever naturally open or not.

Nevertheless, according to our present knowledge, we presume that these characteristic species may disappear forever. The intense propagation of alien, invasive species can also be related to the cessation of the former land-use. The spread of these plants can only be restrained by regular mowing or grazing. Although they might turn up with low cover, even then trampling and grazing can prevent the forming of closed, vast patches of aliens. Unfortunately, our experience shows that once these species appeared, they are hard to repress, unless restoring or reliving the traditional management. The reason for the high cover of invasive weeds on loess steppes may be the fact that there were attempts to arrest erosion of these grounds near settlements by introducing black locust (*Robinia pseudacacis*) and different shrubs (chiefly *Lycium barbarum*) on them. Subsequently, these species spread onto the valuable, natural habitats as well. Being resistant to the extreme site conditions of this habitat, these two plants cover and shade the walls quickly, and so they displace native species, adapted to semi-desert like open habitats.

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# NOTES ON SOME RARE *ALISMATACEAE* SPECIES IN REPUBLIC OF MOLDOVA

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**Summary.** *The paper contains information of investigation on two species of Alismataceae family: Alisma gramineum Lej. and Luronium natans (L.) Raf., species considered rare or extremely rare in the Republic of Moldova. As results* *there was confirmed rarity status of the first one and proven the necessity of exclusion of Luronium natans from the local flora. There are some suggestion given on the current factors affecting the aquatic habitats in the republic.*

## Introduction

The *Alismataceae* family worldwide embodies 13 genera and over 90 species, distributed mainly in extratropical regions of Northern Hemisphere, but are also present in the tropical countries of South-East Asia, Eastern Africa and Central America [12, 14, 18]. In the Republic of Moldova *Alismataceae* family is represented by 4 genera and 6 species [9, 17].

The European species of *Alismataceae* family grow in marshes or in shallow waters and edges of lakes, ponds, canals or slow rivers. Most of them, when growing in water, can produce linear, phylloidal submerged leaves which may or may not persist. When growing in relatively dry habitats the plants are usually dwarfed and may be misleadingly different from plants growing in water conditions.

The subject of this article is *Alisma gramineum* Lej. (=*A. loeselii* Gorski) and *Luronium natans* (L.) Rafin. (=*Alisma natans* L., *Elisma natans* (L.) Buchenau) – two species considered rare or extremely rare in the Republic of Moldova. The lack of detailed habitat data on these two species in the republic and scarce literature records were the reason for undertaking this study.

## Materials and methods

we first reviewed all published information on the presence of these two taxa in the Republic of Moldova, and consulted documentation in herbaria with Moldovian material (Herbarium of the Botanical Garden (Institute) of ASM, Herbarium of the State University of Moldova, Herbarium of the Botanical Institute Komarov (Saint-Petersburg, Russian Federation), Herbarium of National Museum of Ethnography and Natural History of Moldova, etc. where possible with direct examination.

During our investigation on the local flora in last decade we visited all sites from which these species have been reported, as well as a number of other sites at which they might potentially occur. When the samples of *Alisma gramineum* were detected, we recorded geographical location, habitat and phenological data.

## Results and discussions

the species of *Alisma*, like many other aquatics, are extremely plastic, and the characters derived from the flowers and fruits offer the most reliable means of identification. Species *A. gramineum* is readily distinguished from other taxa occurring in Republic of Moldova by spirally coiled style and the shape of the achene, which is broadest near the apex. The vegetative characters vary extremely widely with differences in water level and sometimes the typical species as it occurs in some Prut valley localities with flowers, fruit and narrow (3-5 mm), elongated (60-70 cm) leaves all submerged, can hardly be taken for any other species. At the same time and in the different habitat conditions, such as plants growing in shallow water or in mud may be confused with *A. lanceolatum* With., or even *A. plantago-aquatica* L.

Our herbarium studies indicate that *Alisma gramineum* continue to be confused with other *Alisma* species, therefore we bring here the key to the taxa of this genus.

**Key to determine the *Alisma* species in local flora**

| | | |
|---|---|---|
| 1. | Styles equalling or longer than the ovaries, ± erect; anthers elliptical; at least some leaves aerial or floating, petiolate, ± acuminate ...................... | 2 |
| -- | Styles shorter than the ovaries, recurved; anthers sub-orbicular; leaves all submerged or aerial, elliptical to narrowly oblong-elliptical, not acuminate .......................................................... | A. gramineum |
| 2. | Leaves ovate or elliptic-ovate to lanceolate, usually subcordate or truncate at the base but sometimes cuneate; styles stigmatose in the upper 1/8-1/5; fruitlets with thickish opaque lateral pericarp ............................................................ | A. plantago-aquatica |
| 2 | Leaves lanceolate to elliptical, cuneate at the base; styles stigmatose in the upper 1/2-2/3; fruitlets with thin translucent lateral pericarp .................. | A. lanceolatum |

*Alisma gramineum* Lej. falls into two subspecies: – subsp. *gramineum* with thick-walled achenes (2 mm or more in lenght) and – subsp. *wahlenbergii* with thin-walled achenes (1,5-2 mm in length and with other differences). The known range of the latter round the Gulf of Bothnia and northern side of the Gulf of Finland suggests that it is very unlikely to be found in Moldova, and only subsp. *gramineum* (subsp. *arcuatum*) will be further considered here. This occurs in two extreme forms which may be distinguished as follows:

– forma *gramineum* Tournay et Lawalrée. Plant submerged with all parts elongated. Flowering stem 20-60 cm long. Leaves ribbon-like, 40-60 cm long and 0,5-1,5 cm wide but dilated at the base. Nerves all parallel.

– forma *arcuatum* (Michalet *sensu stricto*)Tournay et Lawalrée (=*A. arcuatum* Michalet). Plant not submerged. Flowering stem 10-25 cm tall. Leaves with slender petiole 1/6,5 cm long, with clearly distinct ablong-lanceolate limb 2-5,5 cm long with 5-7 subparallel nerves joined by distinct transverse nerves to form a grid.

Glück [5], who illustrates plants similar to those from our territory, has shown beyond doubt that these forms have no taxonomic significance. The names employed by Tournay and Lawalrée are used here for convenience in drawing attention to the extreme variations.

For the first time *Alisma gramineum* was indicated for the local flora in 1975 as a rare plant which supposedly was growing in groups or solitary in shallow waters from the valleys of big and medium size rivers [16].

It grows mainly in shallow water in the valleys of river Prut and Dniester, as well as in the valleys of some medium sized rivers. At the time when the water-levels are very low, the plant is most abundant in a few centimeters of water or on the mud associated with *Eleocharis palustris* (L.) Roem. et Schult., *Persicaria amphibia* (L.) S. F. Gray, *Iris pseudacorus* L., *Eleocharis acicularis* (L.) Roem. et Schult. etc. It extends into a zone of deeper water with *Persicaria amphibia*, *Butomus umbellatus* L., *Potamogeton pectinatus* L., *Potamogeton crispus* L. etc., and on to exposed mud with *Mentha aquatica* L., *Lycopus europaeus* L., *Carex acutiformis* Ehrh., *Oenanthe aquatica* (L.) Poir., *Rumex maritimus* L., *Rumex palustris* Smith, *Persicaria hydropiper* (L.) Spach etc.

The submerged plant is extremely difficult to see except in bright sunlight and it may be very well overlooked in permanent or temporarily flooded areas. In the conclusion we consider *Alisma gramineum* more widely distributed in the flora. The densest populations are found in lentil habitats, although we have found that some populations show temporal instability, and indeed may disappear from one year to the next. Flowering al low level sites appears to be related to water depth – it tends to be earlier in water bodies that dry up in the summer, and later in permanent water bodies.

*Luronium natans* (L.) Raf., the Floating Water-plantain, is a rare aquatic plant, endemic to Europe, whose distribution is decreasing in most areas. It is a small, perennial, stoloniferous aquatic plant with a heterophyllous growth form. The floating-leaved form (f. *repens* Buch.), found in shallow water or occasionally along channel margins (Hanspach and Krausch, 1987) and on exposed wet mud, has small, ovate leaves carried on ascending petioles arising either from a submerged basal rosette or, in emergent plants, directly from the stolon. The three-petalled flowers, borne usually at the water surface, are small (12 to 16 mm across), white, hermaphrodite and normally solitary. The fruits (achenes) comprise small, buoyant, single-seeded capsules which are beaked and finely ribbed and are probably dispersed by both drift and waterfowl.

*Luronium* has a distribution centered on Belgium, France, Great Britin, the Netherlands and northern Germany [6]. Outlying populations have been reported from Scandinavia (southern Sweden, [4]; west Denmark and south Norway, [2]. Tutin *et al.* [12] mention occurrence in Spain, Italy and Yugoslavia, extending eastwards into Bulgaria, Poland, and the regions of southwest and possibly Baltic Russia. They consider it to be extinct in Czechoslovakia and Romania. Its recorded habitats include lakes, reservoirs, ponds, bog pools, ditches, canals and slowly flowing rivers.

Throughout its continental range, *Luronium* is reportedly extremely scarce [6] and many remaining sites are now endangered [4, 8, 13]. Serious declines of *Luronium* or its phytosociological grouping have been documented in the Netherlands [1] and Germany [6, 13] as a result of acidification or eutrophication of formerly oligotrophic waters [1, 10, 13]. This has led to its inclusion in the IUCN list of Rare, Threatened and Endemic Plants as a species vulnerable to extinction [7]. Recently *Luronium* was also added to Annexe I of the Berne Convention on the Conservation of European Wildlife and Natural Habitats, which affords special protection for listed plants and their habitats.

The first Moldovian reords of this taxon were in 1954 [15], as *Elisma natans* (L.) Buchen. (=*Alisma natans* L.) without any existing locality. It was just mentioned that it is a rare species growing along rivers, canals and lakes. There were subsequently other reports, though the first report which can not be confirmed on the basis of existing herbarium material (it had never existed) from the river Byk in vicinity of Calarash town [9, 16, 17, 18] the occurrence of the species in the adjacent territories is doubtful for the Romania (it is considered Extinct [3], and was never indicated for the Ukraine.

The apparently contradictory information in the literature on *Luronium natans* is probably due not only to it morphological similarity with the species of *Alisma*, but also to the fact that they can occur in the same habitat conditions, such as shallow pools, channels, or lake margins, and also in slow-flowing parts of rivers and streams.

The existence of the Floating Water-plantain in the republic was analyzed from all the literature concerning local flora and other records from reports of botanical excursions, details of herbarium specimens, and our personal observations unpublished data from canal and river valley surveys made during extensive surveys of water vegetation since 1994. Its presence in Republic of Moldova was not confirmed more recently and in the last decades it has also not been reported from this territory. As a result of this study we consider that *Luronium natans* had never been existed in the flora of Republic of Moldova and ought to be excluded from the lists of vascular plants.

Current factors affecting the aquatic habitat are:

o water pollution, mainly due to nutrient enrichment from artificial fertilizers and fisheries;

o land-use changes in the catchment areas, leading to nutrients being released from the soil and damaging the ecology of water bodies;

o water abstraction , possibly leading to reduced water levels;

o total loss of water bodies due to infilling, tipping, draining and built development;

o neglect and lack of appropriate management leading to siltation and succession;

o fragmentation and isolation due to changing land use, leading to extinction of some species;

o inappropriate clearing of canals and use of river valleys, leading to loss of bankside vegetation;

o introduction of species, particularly those that multiply quickly or replace resident species, for example alien plants;

o recreational use of multiple-use water bodies can cause disturbance and damage;

o inappropriate restoration of waterways.

## Conclusions

In the conclusion we consider *Alisma gramineum* more widely distributed in the flora. The densest populations are found in lentil habitats, although we have found that some populations show temporal instability, and indeed may disappear from one year to the next.

The presence of *Luronium natans* in Republic of Moldova was not confirmed. As a result of this study we consider that *Luronium natans* was brought to the local flora by mistake and had never been existed in the flora of Republic of Moldova, and therefore have to be excluded from the lists of vascular plants.

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# THE RARE SPECIES OF *TRAGOPOGON* L. (*ASTERACEAE*) IN THE BESSARABIA´S FLORA

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**Summary**. *The research results of three rare species of the Tragopogon L. genus: T. floccosus Waldst. et. Kit., T. pratensis L., T. borysthenicus Artemcz are present in this article. The synonymy, morphological description, ecology, habitat and corology of highlighted rare species are given. Identification key for all Bessarabian species of Tragopogon is provided in the article.*

## Introduction

The *Tragopogon* L. genus includes 100 species, widespread in warm temperate and subtropical regions of Eurasia and North Africa, excluding East Asia and a considerable part of taiga; the largest being in the Mediterranean countries, Central and South-West Asia. For the Republic of Moldova are given 6 species [5]. In the Bessarabia`s flora the *Tragopogon* genus is represented by 7 species: *T. orientalis* L., *T. floccosus* Waldst. et. Kit., *T. pratensis* L., *T. boristhenicus* Artemcz., *T. desertorum* (Lindem.) Klok., *T. dubius* Scop., *T. podolicus* (DC.) Artemcz., of which 3 taxa are rare: *T. floccosus* Waldst. et. Kit., *T. pratensis* L. and *T. boristhenicus* Artemcz. [6].

## Materials and methods

The study of *Tragopogon* genus was conducted based on processing herbarium materials collected in the field during the last years, critical analysis of existing herbarium and following a review of published works on the topic. The critical analysis of *Tragopogon* species was performed by the classical comparative-morphological method [16]. The material collected in the field was herbarized then determined in office conditions, using contemporary floristic literature [5, 8, 10, 12, 13, 14, 18]. The indices of ecological groups, vital forms and geoelements of the taxa from the studied genera were taken from the fundamental works of the field [1, 9]. General Map of Bessarabia was taken from: Flora Basarabiei. Vol I [7].

## Rezults and discussions

*Tragopogon* L. genus

Annual, biennial or perennial herbs. Stems usually solitary, simple or sparingly branched. Leaves linear-lanceolate to linear, entire, the cauline sheathing. Capitula solitary or few. Involucral bracts arranged in 1 row. Receptacle without scales. Ligules yellow. Achenes fusiform, with 5-10 more or less distinct ribs, often rostrate [10]. Pappus formed usually from plumose hairs of 8-35 mm length.

The genus includes species that vegetate through hay-fields and grasslands, forest edge and glades, on marine and river sands.

As a result of our investigation there are three species considered rare in Bessarabia´s flora: *T. floccosus*, *T. pratensis* and *T. boristhenicus*. The dichotomic key for all *Tragopogon* species is given, as well as morphological description for the genus and sections, ecology, habitat and corological features of rare species.

The key to determining *Tragopogon* species

| | | |
|---|---|---|
| 1a. | Peduncle distinctly inflated. Involucral bracts longer than the ligules.................. | 2 |
| 1b. | Peduncle not inflated. Involucral bracts shorter than the ligules (rarely equal) ...... | 3 |
| 2a. | Plants glabrous........................................ | *T. dubius* Scop. |
| 2b. | Plants at the bottom of the stem, leaves, involucral bracts arachnoid-hairy............. | *T. desertorum* (Lindem.) Klok |
| 3a. | Involucre less than 30 mm long ............... | 4 |
| 3b.. | Involucre more than 30 mm long............ | 5 |
| 4a. | Upper leaves nearly oval and abruptly narrowed into a short aculeu. Achenes unpronounceable muricate. Beak absent.. | *T. borysthenicus* Artemcz. |
| 4b. | Upper leaves oblong ovate, gradually narrowed into a relatively long peak. Achenes pronounced muricate. Beak up to 3 mm .................................................. | *T. floccosus* Waldst. et. Kit. |
| 5a. | Leaves narrow-linear. Achene with beak shorter than 1/2 of their length ................ | *T. podolicus* (DC.) Artemcz. |

| | | |
|---|---|---|
| 5b. | Leaves linear-lanceolate. Achene with beak equal or longer than 1/2 of its length ..................................................... | 6 |
| 6a. | Anthers yellow, with dark violet tip.......... | *T. pratensis* L. |
| 6b. | Anthers yellow, violet striate. Beak shorter than achene ............................................. | *T. orientalis* L. |

Section 1. **Brevirostres** Kuth. 1957, Кавк. предст. *Tragopogon*: 12. – *Tragopogon* sect. *Bessera* Boriss. 1964, Фл. СССР, 29: 724, 162. – *Tragopogon* sect. *Nikitinia* Boriss. 1964, l. c.: 725, 180.

Flowers yellow, with different shades. At the top of peduncles not inflated. Beak of achenes shorter than ½ of their length or absent. Plants biennial, rarely perennial with fusiform root.

T y p e: *T. brevirostris* DC.

***Tragopogon borysthenicus*** Artemcz. 1937, Тр. Наук.-досл. інст. бот. Харків. унів. 2: 47, рис. 5; Борис. 1964, Фл. СССР, 29: 174. Цвел., 1989, Фл. евр. Части СССР, 8: 51; Negru, 2007, Det. pl. fl. R. Mold.: 266; – *T. brevirostris DC.* subsp. *borysthenicus* (Artemcz.) C. Regel, 1937, Scripta Horti Bot. Univ. (Kaunas), 5: 41. – *T. dolichocarpus* Klok. 1965, Фл. УРСР, 12: 565, 236, рис. 47. – *T. brevirostris* auct. non DC.: I. Richards. 1976, Fl. Europ. 4: 324, pp.

Biennial, up to 30-160 cm, more or less pubescent. with a fusiform vertical rootstock. Stems branched, with branches striped, obliquely inclined. Upper leaves strong shortened, 5-10 mm long, at the base cordate ovate, abruptly acute, with short aculeu, curved. Cauline leaves on the lower part whitish-violet, at base dilated, gradually cuneate into a narrowed limb. Basal leaves norrower than the cauline, narrow linear. Involucral bracts 15-23 mm long, shorter than flowers. Achene 10-16 mm long, furrowed, rough on the rib, without beak. Pappus white or greenish white, achen length or shorter. Flowering-fruiting V-IX.

Terophyte, grows on marine and river sands. Pontic element; xerophyllous, termophyte, prefer the low acid-neutrophilous soils.

Rare species, detected only in Southern Bessarabia, in district VIII – South Bugeac steppes and district X – Chilia, characterized by coastal vegetation (picture1). Endemic to the Black Sea between Pericop and Danube delta [18]. Species introduced in the Red Book of Vascular Plants in Romania. Status - vulnerable (VU). It is protected by Danube Delta Biosphere Reserve. Habitats low specific resort, is often consumed by insects, particularly in reproductive sphere [2] .

In the European flora *T. borysthenicus* Artemcz.is synonymy with

*T. brevirostris* DC, but *T. borysthenicus* Artemcz. is much closer after characters with *T. floccosus* Waldst. et. Kit.

***Tragopogon floccosus*** Waldst. et. Kit. Pl. Rar. Hung. II (1805) 116, tab. 112; Nyar. 1965, Fl. Rep. Pop. Rom. 10: 78; I. Richards. 1976, Fl. Europ. 4: 325; Ciocârlan, 2009, Fl. Il. Rom.: 854 pp; – *T. brevirostre* DC. Prodr. VII (1838) 114, s.l.

Plant 30-60 cm tall. Root pivoting. In the juvenile phase the plant is covered with white toment, in adult status tomentous dispersed. Stem erect, branched expanded, leafy. Leaves broad-based, semiamplexicaul, attenuated, linear subulate. Peduncle cylindrical, not thickened or minimally thickened at the top. Anthodium during flowering 12-15 cm long, fruiting long by 27(30) mm, with 8 involucral leaflets shorter than the external ligules. Flowers light-yellow. Achenes 11-15 mm long, 5-ribbed, with a short beak (1-1.5 (3) mm), not thickened. Pappus whitish brown, slightly longer than the achenes. 2n = 12. Flowering-fruiting VI-VII.

Hemicriptophyte identified on sandy places, dune grass land. Pontic-pannonian element; xeromezophyllous, mesothermal, euryonic. The species is characteristic for river sands in the middle and lower stretches of the Danube. The habitat belongs to the Pannonic inland dunes type [11].

On the Bessarabia´s territory the species was highlighted in districts VIII – South Bugeac steppes and X – Chilia, characterized by coastal vegetation (picture 1). It is considered as rare species for the flora of Romania and Bulgaria [1, 11]. The habitat of *T. floccosus,* Pannonic inland dunes, is a priority habitat for the European Union [3]. The most similar places along the Danube were drained and converted into arable land in the past. In Bulgaria rating according to the IUCN criteria (IUCN 2001) resulted in the following national IUCN category: Critically Endangered [4, 11].

Section 2. ***Tragopogon***

Flowers yellow, with diferent shades. Peduncle not thickened or very slightly thickened at the top. The beak equal or longer than the ½ of achenes length. Biennial plants with fusiform root.

T y p e: genus lectotype.

***Tragopogon pratensis*** L. 1753, Sp. Pl.: 789; Борис. 1964, Фл. СССР, 29: 143; Nyar. 1965, Fl. Rep. Pop. Rom. 10: 85; I. Richards. 1976, Fl. Europ. 4: 324, pp.; Цвелев, 1989, Фл. евр. части СССР, 8: 54; Доброчаева, Котов, Прокудин, 1999, Опред. высш. раст. Укр.: 370; Ciocârlan, 2009, Fl. Il. Rom.: 855 pp; Negru, 2007, Det. pl. fl. R. Mold.: 266.


Figure 1. The spread of rare species of
Tragopogon L. on the Bessarabia´s territory
● – *T. floccosus*, ■ – *T. borysthenicus*, ▲ – *T. pratensis*

Biennial or perennial plant, 30-70 cm tall. Vertical root, pivoting, unbranched, to head with brown fibers and remnants of old leaves. Erect stem, simple or branched, glabrous, with long branches, leafy, finely striated. Leaves long, attenuated upwards, linear lanceolate, very long and thin sharp peak often circinate, sessile, amplexicaul, covering secondary branches and buds (when present), glabrous, with parallel veins, 6-15 mm wide, straight edges or slightly wavy. Branches with only one anthodium, with long stems, not thickened. Anthodium with involucre longer than 30 mm. Involucral leaflets shorter than the ligules (rarely equal). Flowers light-yellow, the marginal usually involucre length. Anthers yellow in the lower part only, black-purple top. Marginal achenes, 5 edges, rough warty or trivial spinulose, top less thick, with beak longer than the ½ of their length or the length beak achenes. Pappus dirty white, 15-20 mm long. 2n = 12. Flowering-fruiting VI-VIII.

Terophyte-hemicriptophyte identified on grass places, meadows, glades and forest edge, often is confused with *Tragopogon orientalis.* Eurasian element, mezophyllous, microtherm, prefer acid-neutrophilous soils.

In Bessarabia´s flora the *T. pratensis* L. was reported for the first time at the end of 19th century by Lipskii and Zelenețkii [15, 17]. For flora of the Republic of Moldova was mentioned by A. Negru [5].

In Bessarabia is rarely spread in districts V - Codrii and VI – Forest-steppe of garnet. In summer of 2011 was identified a new place of growth: near Movila Măgura (the Țighira territory, Ungheni district) the edge of a stand of oak, in boundaries of the Bălți Steppe district (figure 1).

The species area includes Scandinavia (south), Atlantic and Central Europe.

## Conclusions

Numerous investigations and field monitoring of highlighted rare species are required, in order to determine the rarity and endangered status of these taxa and to elaborate the special conservation measures.

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# NOTES ON SOME GENERA *ASTRAGALUS L. (FABACEAE)* SPECIES IN DNIESTER-PRIT RIVER REGION

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**Summary.** *The article brings the list of the biggest genera in the Fabaceae Lindl family – Astragalus L., which embodies 17 species in the Dniester-Prut region. The dichotomic key for genera Astragalus, as well as brief ecological and habitat characters for each species are given.*

## Introduction

The maintenance of floristical diversity nowadays is based on fundamental monographic studies and knowledge (in fundamental and practical aspect) on separate taxonomic groups. Genera *Astragalus* L. - ancient, heterogeneous, variable in morphology and ecological characteristics, takes tone of the central position in system of family *Fabaceae* Lindl. It plays a significant role in vegetation cover and is an important component in structure of the grassland cover of the region. There are many fodder grass, melliferous, decorative and medicinal in the given genera.

## Materials and methods

during our investigation concerning genus *Astragalus* for the flora of Dniester-Prut region we performed all necessary research on field and laboratory examination. Firstly we reviewed all published information on the presence of species in the territory, and consulted specimen materials in different scientific herbaria (Herbarium of the Botanical Garden (Institute) of ASM, Herbarium of the State University of Moldova, Herbarium of the Botanical Institute Komarov (Sankt-Petersburg, Russian Federation), Herbarium of National Museum of Ethnography and Natural History of Moldova etc.

## Results and discussions

Genus *Astragalus* L. is the largest in the family *Fabaceae* which comprises over 2200 species, represented world wide, with exception of Australia. In the local flora it embodies 17 species.

Genus *Astragalus* L. – Coşaci – Астрагал
Linnaeus, 1753, Sp. Pl.: 755

LT.: *A. christianus* L.

### Key to determine the *Astragalus* species

| | | |
|---|---|---|
| 1. | Hairs on leaves and stems simple ...................... | 2 |
| - | Hairs on leaves and stems medifixed ................ | 8 |
| 2. | Plants caulescent or almost so (stems with height up to 3 cm), the peduncles or racemes arising from a rosette of leaves ..................................... | 3 |
| - | Plants caulescent, with leaves separated by well-developed inter nodes ...................................... | 4 |
| 3. | Standard glabrous ............................................ | A. excapus |
| - | Standard hairy on back ..................................... | A pubiflorus |
| 4. | Legume curved to form a ±complete ring, wrinkled ........................................................... | A. contortuplicatus |
| - | Legume not forming a ring, smooth ................. | 5 |
| 5. | Legume 3-4 cm, slightly curved. Leaves with (3-) 4-6(-7) pairs of leaflets. Calyx glabrous or with black hairs on the teeth .............................. | A. glycyphyllos |
| - | Legume 0,7-2 cm, straight. Leaves with 8-20 pairs of leaflets. Calyx entirely hairy ................ | 6 |

| | | |
|---|---|---|
| 6. | Racemes with peduncles up to 1,5 cm. Legume 7 x 4 mm ........................................................ | A. ponticus |
| - | Racemes with peduncles 5-15 cm. Legume de 10-20 x 8-10 mm ............................................ | 7 |
| 7. | Calyx black hairy Standard 12-16 mm, glabrous. Legume ovoid-globose, inflated, with short, black and white hairs ....................................... | A. cicer |
| - | Calyx white villous. Standard 17-20 mm, hairy on back. Legume ovoid, trigonous, uninflated, white villous .................................................... | A. dasyanthus |
| 8. | Calyx strongly inflated in fruit .......................... | 9 |
| - | Calyx scarcely inflated in fruit ........................... | 11 |
| 9. | Corolla whitish or light-yellow ......................... | 10 |
| - | Corolla purple with keel white .......................... | A. albidus |
| 10. | Legume with white hairs .................................. | A. glaucus |
| - | Legume with short, black and white long hairs | A. pseudoglaucus |
| 11. | Plants with rosette basal. Racemes with peduncles very short or absent .......................... | A. dolichophyllus |
| - | Plants without rosette basal. Racemes with peduncles long .................................................. | 12 |
| 12. | Racemes umbelliform-globose or globose ........ | 13 |
| - | Racemes elongate ........................................... | 14 |
| 13. | Racemes 1,5-2 cm, lax, umbelliform-globose, with 3-5 flowers. Stipules 2-3 mm ..................... | A. corniculatus |
| - | Racemes 1,5-5 cm, dense, globose, elongate in fruit, with 10-20 flowers. Stipules up to 12 mm | A. onobrychis |
| 14. | Corolla bicolorous (blue and violet). Calyx 2-3 mm .................................................................. | A. austriacus |
| - | Corolla unicolorous (white, blue or purple). Calyx 6-15 mm ................................................ | 15 |
| 15. | Racemes elongate up to 30 cm in fruit. Corolla purple ............................................................. | A. varius |
| - | Racemes elongate up to 10-12 cm in fruit. Corolla white or yellow ..................................... | 16 |
| 16. | Corolla white. Leaflets 0,7-1,2 cm. Flowers in racemes lax ...................................................... | A. pallescens |
| - | Corolla yellow. Leaflets 1,5-3 cm. Flowers in spikes dense ..................................................... | A. asper |

Subgenus 1. ***PHACA*** (L.) Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16: 25, p. p. – *Phaca* L. 1753, Sp. Pl.: 755

LT.: *A. frigidus* (L.) A. Gray

***Astragalus glycyphyllos*** L. 1753, Sp. Pl.: 758; Chater, 1968, Fl. Europ. 2: 115; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 317; Л. Васил. 1987, Фл. Европ. ч. СССР, 6: 58; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 195; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 386. – *Coşaci glicifil. - Астрагал сладколистный.* V-VII. 2n=16.

The area of distribution is most of Europe, except the extreme north, but mainly on mountains in the south (Pont-Medit•). It is common for the region (with exception of south parts). Grows in the forest areas, under the trees, in clearings and forest edges, in meadows, sometimes on limestone slopes.

Subgenus 2. ***ASTRAGALUS.* -** Subgen. *Caprinus* Bunge, 1880, Изв. Общ. любит. естествозн. антроп. этногр. 26, 2 : 218. – Subgen. *Phaca* Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16: 18, pp.

T.: *A. christianus* L.

***Astragalus dasyanthus*** Pall. 1776, Riese, 3: 749; Chater, 1968, Fl. Europ. 2: 116; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 317; Л. Васил. 1987, Фл. Европ. ч. СССР, 6: 58; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 194; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 386. – *Zăvăcustă. – Астрагал шерстистоцветковый.* (V)VI-VII. 2n=16.

The area of distribution is South-Eastern Europe (Balc-Pont). It is met in all parts of the flora excluding extreme South. Grows steppe slopes with chernoziomic soil, sometimes on sandy and limestone grounds, in clearings of arid forests and shrub stands. Measures of protection: protected by law in the Republic of Moldova, Romania and Ukraine (CRM[*], CRU[**], LRR[***]).

***Astragalus pubiflorus*** DC. 1802, Astrag.: 216; Chater, 1968, Fl. Europ. 2: 116; Гейдеман, 1986, Опред. высш. раст. Молд. ССР, изд. 3: 317; Л. Васил., 1987, Фл. Европ. ч. СССР, 6: 59; Крицкая, 1999, Опред.

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The area of distribution covers Ukraine and adjacent regions of South and Central Russia; outlying stations in East Romania and Bulgaria (Balc-Pont). The species is rare in local flora, met only on steppe slopes in the south. Measures of protection: protected by law in the Republic of Moldova and Romania (CRM; LRR).

***Astragalus exscapus*** L. 1771, Mant. Pl. Alt.: 275; Chater, 1968, Fl. Europ. 2: 116; Гейдеман, 1975, Опред. высш. раст. Молд. ССР, изд. 2: 287; Л. Васил. 1987, Фл. Европ. ч. СССР, 6: 59; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 194; Ciocârlan, 2009, Flora ilustrată a României: 385-386, pro syn. *A. exscapus* L. subsp. *exscapus.* – Coşaci acaul. – Астрагал бесстебельный. IV-V. 2n=16.

The area of distribution includes Central Europe, extending to South Alps, South-Eastern Spain; Albania; Bulgaria and North-Eastern Greece (Euc-Medit). Rare in Dniester basin and in South parts of the region. Grows on steppe and limestone slopes.

Subgenus 3. *Hypoglottis* Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 46. – ***Cystium*** Stev. 1856, Bull. Soc. Nat. Moscou, 29, 3 : 147.

LT.: *A. hypoglottis* L.

***Astragalus cicer*** L. 1776, Riese, 3: 749; Chater, 1968, Fl. Europ. 2: 116; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 317; Л. Васил., 1987, Фл. Европ. ч. СССР, 6: 58; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 194; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 386. – Coşaci năutiu. – Астрагал нутовый, Хлопунец. VI-VIII. 2n=64.

Distributed from Belgium and North-Central Russia southwards to North Spain, Bulgaria and Krym; occasionally naturalized further north (Eur). The species is widely distributed in the region in various habitat conditions (forest margins, clearings, shrub stands and different types of grasslands, along roadsides).

Subgenus 4. *Triminiaeus* Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16: 6, pp.

LT.: *A. oxyglottis* L.

***Astragalus contortuplicatus*** L. 1753, Sp. Pl.: 758; Chater, 1968, Fl.

Europ. 2: 111; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 317; Л. Васил., 1987, Фл. Европ. ч. СССР, 6: 61; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 193; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 385. – Coşaci răsucit. – Астрагал свернутый. VI-VII(VIII). 2n=16.

Distributed in Eastern and Central Europe, extending to North Bulgaria and South-Eastern Russia (Eua). In the region met only in the south (Danube estuary in meadows, wetlands, sometimes on sandy and salty grounds. On the territory of Republic of Moldova this species is probably extinct. Protected by law in Romania (LRR).

Subgenus 5. *Calycophysa* Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16: 56

LT.: *A. coluteoides* Willd.

***Astragalus ponticus*** Pall. 1800, Spec. Astrag.: 14; Chater, 1968, Fl. Europ. 2: 118; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 317; Л. Васил., 1987, Фл. Европ. ч. СССР, 6: 65; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 194; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 386. – Coşaci pontic. – Астрагал понтийский. V-VI.

Distributed in South-East Europe, from Bulgaria to South-Eastern Russia (Pont-(Medit). It is met through the region as rare species, in arid oak forests, on steppe and limestone slopes. Protected by law in Romania (LRR).

Subgenus 6. Cercidotrix Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 94.

LT.: *A. incanus* Willd.

***Astragalus asper*** Jacq. 1781, Misc. Austr. Bot. 2: 335; Chater, 1968, Fl. Europ. 2: 120; Гейдеман, 1986, Опред. высш. раст. Молд. ССР, изд. 3: 319; Л. Васил. 1987, Фл. Европ. ч. СССР, 6: 66; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 195; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 113; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 390. – Coşaci aspru. – Астрагал шершавый. V-IX(X). 2n=48, 64.

Area of distribution covers East and Central Europe and south part of Russia, extending southwards to North Bulgaria (Pont-Pan). It is more frequently met in the central parts of the region on steppe and limestone slopes, in forest margins and clearings, shrub stands, rarely in arid grasslands.

***Astragalus austriacus*** Jacq. 1762, Enum. Stirp. Vindob.: 263; Chater, 1968, Fl. Europ. 2: 120; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 319; Л. Васил. 1987, Фл. Европ. ч. СССР, 6 : 66-67; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 195; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 113; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României : 389. – Coşaci austriac. – Астрагал австрийский. VI-VIII.

Area covers Central and Eastern Europe, from Austria to South Ural, extending locally southwards to North Bulgaria and Krym; South-West Alps; North-East Spain (Eua). The species is widely met in the region, grows in margins and clearings of arid forests as well as in steppe.

***Astragalus onobrychis*** L. 1753, Sp. Pl.: 760; Chater, 1968, Fl. Europ. 2: 120; Гейдеман, 1986, Опред. высш. раст. Молд. ССР, изд. 3: 319; Л. Васил., 1987, Фл. Европ. ч. СССР, 6: 69; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 196; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 391. – Unghia găii. – Астрагал эспарцетный. VI-VIII(IX). 2n=64, 72.

Area of distribution covers Europe, eastwards to Central Ural (EuaV(Medit). The species is common in the region, inhabiting margins and clearings of arid forests, on steppe slopes, pastures and sandy grounds.

***Astragalus dolichophyllus*** Pall. 1800, Spec. Astrag.: 84; Săvul. et Rayss, 1934, Mat. Fl. Bas. 3: 100; Chater, 1968, Fl. Europ. 2: 121; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 318; Л. Васил., 1987, Фл. Европ. ч. СССР, 6: 72; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 196; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 389. – C. longifil. – Астрагал длиннолистный. VI-VII.

Distributed in the South-Eastern Europe (Pont). In the regional flora the species is rare. Its area covers the Dniester basin (northern and southern parts). Grows on steppe and limestone slopes. It is protected by law in Romania (LRR).

***Astragalus corniculatus*** Bieb. 1810, Cent. Pl. 1: tab. 45; Chater, 1968, Fl. Europ. 2: 122; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 319; Л. Васил. 1987, Фл. Европ. ч. СССР, 6: 73; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 197; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 389. – Coşaci corniculat. – Астрагал рожковый. VI-VII.

Area of distribution covers Pontic region (Pont). Species is rarely met in central and south parts of the region in steppes. Protected by law in Romania (LRR).

***Astragalus varius*** S. G. Gmel. 1770, Riese Russl. 1: 116; Chater, 1968, Fl. Europ. 2 : 123; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 318; Л. Васил., 1987, Фл. Европ. ч. СССР, 6: 74; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 197; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 115; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 390. - *A. virgatus* Pall. 1800, Spec. Astrag.: 20. – Coşaci variat. – Астрагал изменчивый. V-VII.

Distributed in South parts of Russia, extending to Eastern Hungary and Bulgaria (Eua). It is rarely met in central and south parts of the region. Grows on steppe slopes, vineyards and sandy terrain along the Black Sea. Protected by law in Romania (LRR).

***A. pallescens*** Bieb. 1895, Fl. Taur.-Cauc. 3: 489; Chater, 1968, Fl. Europ. 2: 123; Гейдеман, 1986, Опред. высш. раст. Молд. ССР, изд. 3: 318; Л. Васил. 1987, Фл. Европ. ч. СССР, 6: 74; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 197; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154. – Coşaci palescent. – Астрагал бледноватый. V-VII.

Distributed in South-Eastern Ukraine and adjacent parts of Russia (Pont (endemic). The species is rare and met in the region only in the south. Grows in steppes on loess soil, often on sandy grounds.

Subgenus 7. *Calycocystis* Bunge, 1868, Mém. Acad. Sci. Pétersb. (Sci. Phys. Math.), sér. 7, 11, 16 : 138.

LT.: *A. cysticalyx* Ledeb.

***Astragalus glaucus*** Bieb. 1808, Fl. Taur.-Cauc. 2: 186; Chater, 1968, Fl. Europ. 2: 123; Л. Васил. 1987, Фл. Европ. ч. СССР, 6: 76; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154; Ciocârlan, 2009, Flora ilustrată a României: 390. – *A dealbatus* Pall. 1800, Asep. Astrag.: 26, pp., nom. illeg.; Гейдеман, 1986, Опред. высш. раст. Молд. ССР, изд. 3: 318; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 196. – Coşaci glauc. – Астрагал сизый. IV-VI(VII).

Area of distribution covers Mediterranean region (Balkan peninsula), South-Eastern Europe, Krym (Pont-Balc). It is met in Dniester basin and in the south of the region, mainly on steppes.

***Astragalus albidus*** Waldst. et Kit. 1800-1801, Descr. Icon. Pl. Rar. Hung. 1: 39; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 318; Л. Васил., 1987, Фл. Европ. ч. СССР, 6: 76; Крицкая, 1999, Опред.

высш. раст. Укр., изд. 2: 197; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 113; Negru, 2007, Determ. Plant. Fl. R. Moldova: 154. – ***A. vesicarius*** auct., non L.: Chater, 1968, Fl. Europ. 2: 123, pp.; Ciocârlan, 2009, Flora ilustrată a României: 390, pro syn. *A. vesicarius* L. subsp. *albidus* (Waldst. et Kit.) Br.-Bl. – Coşaci alburiu. – Астрагал беловатый. IV-VI. 2n=16.

Distributed in Central (south-est) and (south) Eastern Europe, Krym (Pont-Medit). The species is rarely met throughout the region, only on limestone slopes.

***Astragalus pseudoglaucus*** Klok. 1935, Бот. мат.(Ленинград), 15: 150; Гейдеман, 1986, Опред. высш. раст. Молд.ССР, изд. 3: 288; Л. Васил., 1987, Фл. Европ. ч. СССР, 6: 76; Крицкая, 1999, Опред. высш. раст. Укр., изд. 2: 197; Т. В. Васильева и С. Г. Коваленко, 2003, Консп. флори Півден. Бессарабії: 114; Ciocârlan, 2009, Flora ilustrată a României: 390, pro syn. *A. vesicarius* L. subsp. *pseudoglaucus* (Klok) Ciocârlan. – Coşaci pseudoglauc. – Астрагал ложносизый. V-VI.

Area of species comprises Central – Romania and Eastern Europe – Pontic region (Pont). The taxa is randomly met in Dniester basin. Grows in limestone steppe slopes, clearings of the arid oak forests.

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# *CERASTIUM* L. SPECIES IN THE FLORA OF THE REPUBLIC OF MOLDOVA

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**Summary.** *The result of taxonomical study of Cerastium L. genus for the flora of the Republic of Moldova is presented. The genus Cerastium comprises 9 species: Cerastium arvense L., C. brachypetalum Desp. ex Pers., C. diffusum Pers., C. holosteoides Fries., C nemorale Bieb., C. perfoliatum L., C. pumilum Curtis, C. semidecandrum L., C. sylvaticum Waldst. et Kit. The dichotomic key for species determination, as well as bioecological and phytogeographical peculiarities for each species are given.*

## Introduction

The *Cerastium* L. genus in Terra`s flora is represented by over 150 species spread throughout the Northern Hemisphere, North Africa, the Alpine region of North Africa and South America [11]. In Europe comprises 58 species [8]. According to previous research the spontaneous flora of the Republic of Moldova includes nine species of cerastium [2, 3].

## Materials and methods

During floristic investigations as a study material has served both *Cerastium* L. collections from Botanical Garden herbarium of ASM and that of the Department of Botany of the State University of Moldova and our own collections, made during the years 2008–2011. In the research process of the genus was performed by the classical comparative-morphological method [10]. The material collected in the field was hebarized then determined in office conditions, using contemporary floristic literature [1, 3, 7, 8, 9, 11, 12] and some basic guidance on the nomenclature and bioecology of infragenerical taxa [1, 6].

## Results and discussions

***Cerastium*** L. - 1753, Sp. Pl.: 437; id. 1754, Gen. Pl., ed. 5:199.

Annual or perennial, sometimes slightly woody at the base, usually hairy. Leaves opposite, entire, sessile. Flowers usually in cymose inflorescences, sometimes solitary. Sepals free. Petals white, usually bifid or emarginate, sometimes absent; stamens 5-10, rarely fewer; nectaries present; styles usually 5, opposite the sepals, sometimes 3, 4 or 6. Fruit a cylindrical or oblong capsule, often more or less curved, dehiscing with twice as many teeth as styles. Seeds numerous, spherical or reniform.

The genus includes species that vegetates through meadows, glades, steppe slopes, sands and forests.

As a result of investigations were found nine species of *Cerastium*: *Cerastium arvense* L., *C. brachypetalum* Desp. ex Pers., *C. diffusum* Pers., *C. holosteoides Fries.*, *C nemorale* Bieb., *C. perfoliatum* L., *C. pumilum* Curtis, *C. semidecandrum* L., *C. sylvaticum* Waldst. et Kit.

Next we present the key to determining species of *Cerastium*, the biomorphological, ecological and corological features, synonymy and detailed morphological description of the species.

**The key to determining species**

| | | |
|---|---|---|
| 1a. | Styles 3, 4, or 6; capsule-teeth 6, 8 or 12 | *C. diffusum* Pers. |
| 1b. | Styles 5; capsule-teeth 10 .......................... | 2 |
| 2a. | Annual. Sterile shoots absent in the axils of leaves...................................................... | 3 |
| 2b. | Perennial. Sterile shoots usually present.... | 7 |
| 3a. | Upper leaves conspicuously scarious......... | *C. semidecandrum* L. |
| 3b. | Upper leaves herbaceous or inconspicuous narrowly membranaceous........................... | 4 |
| 4a. | Plant glabrous, glaucous. Lower leaves connate at the base in pairs......................... | *C. perfoliatum* L. |
| 4b. | Plant pubescent. Lower leaves free............ | 5 |
| 5a. | Capsule-teeth erect .................................... | 6 |
| 5b. | Mature capsule-teeth revolute.................... | 7 |
| 6a. | Petals equaling or longer than sepals......... | *C. pumilum* Curtis |
| 6b. | Petals shorter than sepals........................... | *C. diffusum* Pers. |
| 7a. | Sepals narrowly membranous at the apex. Capsule twice as long as the sepals............ | *C. nemorale* Bieb. |
| 7b. | Sepals with membranous margins. Capsule length exceeds with ½ the sepals length.... | *C. brachypetalum* Desp. ex Pers. |
| 8a. | Sepals and petals nearly the same length... | *C. holosteoides* Fries |
| 8b. | Sepals twice shorter than the petals............ | 8 |
| 9a. | Sterile shoots absent. Lower leaves petiolate..................................................... | *C. sylvaticum* Waldst. et Kit |
| 9b. | Sterile shoots present. All leaves sessile.... | *C. arvense* L. |

**Morphological description**

***C. nemorale*** Bieb**.** 1819, Fl. Taur. - Cauc., 3: 317; Мурав., 1936, Fl. URSS, 6: 444; P.D. Sell a. Whitehead, 1964, Fl. Europ. 1: 138; Гейдеман, 1986, Опред. Высш. Раст. Молд. ССР: 183; И. В. Соколов, 2004, Флора Вост. Евр., 11: 169; Negru, 2007, Det. pl. fl. R. Mold.: 56.

Annual with weak, ascending stems (8-)15-60 cm, hairy. Leaves 20-70 Ч 3-20 mm, the basal obovate-spathulate, the cauline lanceolate, acute, weakly cordate at the base; all more or less hairy. Inflorescence furcate, many-flowered; pedicels hairy, 1-4 times as long as the sepals. Sepals 6-10 mm, lanceolate, acute, narrowly scarious at the apex, with dense eglandular hairs, without glandular hairs; petals bifid for 1/3 their length, equalling or a little shorter than the sepals, with a ciliate claw; stamens hairy at the base; styles 5. Capsule twice as long as the sepals, more or less bent; teeth deflexed. Seeds 0,7 mm, reddish-brown, tuberculate. V-VI.

Grows on steppe hills. Critically endangered species in the Republic of Moldova, registered in Codrii and Sourth Bugeac.

***C. perfoliatum*** L. 1753 Sp. Pl.: 437; Мурав., 1936, Fl. URSS, 6 : 446; Whitehead, 1964, Fl. Europ. 1: 138; Гейдеман, 1986, Опред. Высш. Раст. Молд. ССР: 183; И. В. Соколов, 2004, Флора Вост. Евр., 11:169; Negru, 2007, Det. pl. fl. R. Mold.: 56.

Glaucous, glabrous annual up to 50 cm. Leaves up to 40 mm, very narrowly elliptical to ovate-lanceolate, subacute, connate at the base. Inflorescence furcate, with a dichasium of 2-7 flowers at the end of each branch; pedicels 1-2 times as long as the sepals; bracts herbaceous. Sepals 9-11 mm, lanceolate, acute, with a scarious margin at the apex; petals shorter than the sepals, bifid at the apex. Capsule twice as long as the sepals, bent near the apex; teeth deflexed. Seeds 1·2-1·5 mm, acutely tuberculate. IV – V.

Terophyte, vegetates on meadows and herbaceous slopes. Eurasian element; xeromesophyte, moderately thermophyte, low acid-neutrophilous. Rare species in the Sourth Bugeac.

***C. arvense*** L. 1753, Sp. Pl. I: 438; Мурав., 1936, Fl. URSS, VI: 460; Prod., 1953, Fl. Rep. Pop. Rom., 2: 61; Richards. 1976, Fl. Europ. 1: 169; Гейдеман, 1986, Опред. Высш. Раст. Молд. ССР: 184; Negru, 2007, Det. pl. fl. R. Mold.: 56; Ciocârlan, 2009, Fl. Il. Rom.: 217; - *C. incanum* Ldb. 1815, Mem. Ac. Sc. Petersb. V: 540.

Perennial, 5-30 cm, with sterile and fertile shoots. Stem erect, covered with reflexed hairs, usually the top glandulous. Leaves linear or lanceolate, short hairy, up to 25 mm long, 1-5 mm wide, acute or obtuse. Inflorescences with 5-15 flowers. Hairy bracts, ovate-lanceolate, with broad membranous margins. Pedicels with glandular hairs. Flower 12-30 mm in diameter. Sepals ovate, 8 mm wide, with membranous margins, on the dorsal-side glandulous. Petals equaling or 2 times longer than sepals. Capsule longer than calyx. Fruits peduncles 2-4 times longer than calyx. Seeds brown, about 1 mm wide, the margins aculeate. IV-IX.

Chamaephyte, prefers dry meadows, glades and grassed areas. Circumpolar; mesophyte, amphitolerant, low acid-neutrophilous. Rare in the republic`s flora, identified in Briceni, Rezina and Codrii geobotanical districts.

***C. sylvaticum*** Waldst. et Kit. 1802, Pl. rar. Hung. I: 100; Prod. 1953, Fl. Rep. Pop. Rom., 2: 55; Jalas, 1964, Fl. Europ. 1: 142; Гейдеман, 1986, Опред. Высш. Раст. Молд. ССР: 184; Negru, 2007, Det. pl. fl. R. Mold.: 56; Ciocârlan, 2009, Fl. Il. Rom.: 216 – *C. microcarpum* Kit. in Schult. Osterr. 1818, Fl. I, II: 696.

Hirsute, glandular, biennial or perennial 15-70 cm, with runner-like rooting, leafy basal branches. Stems ascendant, Lower cauline leaves up to 75 × 18 mm, the lower oblanceolate, petiolate; upper sessile, elliptical to lanceolate-elliptical; leaves of non-flowering shoots oblanceolate to rhombic-elliptical. At least the upper bracts usually with scarious margins. Floral peduncles short hairy and glandulous. Flower 13 mm in diameter. Sepals usually 3-6(-8) mm, acute, with margins membranous and glandulous outside. Stamens ciliate or glabrous. Capsule up to 10 mm, often conspicuously curved. Seeds ovate, 1,2 mm wide, densely tuberculate. VI-VII.

Terophyte (hemicryptophyte) grows in shady forests. European central element; mesohydrophyte, mesothermal, euryonic. Rare taxa, registered in the Codrii district.

***C. brachypetalum*** Desp. ex Pers. 1805, Syn., 1: 520; Prod., 1953, Fl. Rep. Pop. Rom., 2: 45; Richards. 1976, Fl. Europ. 1: 173; И. В. Соколов, 2004, Флора Вост. Евр., 11:167; Negru, 2007, Det. pl. fl. R. Mold.: 56; Ciocârlan, 2009, Fl. Il. Rom.: 214. – *C. tauricum* Spreng. 1818, Nov. Provent.: 10; Мурав. 1936, Фл. СССР, 6: 449; Гейдеман, 1986, Опред. Высш. Раст. Молд. ССР: 183.

Annual up to 40 cm; stem with long, deflexed, patent or ascending eglandular hairs, with or without glandular hairs. Leaves up to 20 mm, the lower spathulate or obovate, the upper ovate, elliptical or oblong, obtuse to acute, hairy. Inflorescence more or less lax; pedicels 3-27 mm, bent just below the flower, with patent or ascending-appressed eglandular hairs, with or without glandular hairs; bracts herbaceous. Sepals 3-6·5 mm, lanceolate to oblong-lanceolate, obtuse to acute, the margin scarious, with eglandular hairs exceeding the apex, with or without glandular hairs; petals shorter than or longer than the sepals, bifid for up to 1/3 their length, with a small auricle at the base; stamens up to 10; styles 5. Capsule 6-9 mm. Seeds 0·4-1 mm, minutely tuberculate. IV-V.

Terophyte vegetates to the oak forest edge. Mediterranean element; mesophyte, mesothermal, euryonic. Rare taxa in the flora of the Republic of Moldova, identified in Codrii district.

***C. semidecandrum*** L. 1753, Sp. pl. 1: 438; Мурав., 1936, Fl. URSS, 6: 450; Gren. 1841, Monogr. Cerast.: 28; Prod. 1953, Fl. Rep. Pop. Rom., 2: 46; Лащенкова, 1976, Фл. Сев. – Вост. Европ. Части СССР, 2: 211; Richards. 1976, Fl. Europ. 1: 174; Гейдеман, 1986, Опред. Высш. Раст. Молд. ССР: 183; И. В. Соколов, 2004, Флора Вост. Евр., 11: 169; Negru, 2007, Det. pl. fl. R. Mold.: 56; Ciocârlan, 2009, Fl. Il. Rom.: 216.- *C. pentandrum* Krock. 1790, Fl. Siles. II, 1:81. Procumbent to erect annual up to 20 cm; stem with eglandular and dense glandular hairs, rarely glabrous. Leaves up to 18 mm, the basal oblanceolate, the cauline ovate to broadly elliptical. Pedicels equalling or slightly longer than the sepals; pedicels and sepals usually with dense glandular and few eglandular hairs; bracts sometimes almost entirely scarious, always scarious in upper 1/3. Sepals 3-5 mm, lanceolate, acute, with wide scarious margins; petals shorter than the sepals, slightly notched. Capsule 4·5-7 mm. Seeds 0·4-0·5 mm, yellowish-brown, finely tuberculate. III — VI.

Terophyte grows on meadows and glades. European element; xeromesophyte, moderately termophyte, euryonic. Endangered species for the flora of the republic, registered in Briceni, Codrii, Malaiesti and Bugeac districts.

***C. pumilum*** Curtis 1777, Fl. Lond. VI; Prod. 1953, Fl. Rep. Pop. Rom., 2: 49; Whitehead, 1964, Fl. Europ. 1: 144; И. В. Соколов, 2004, Флора Вост. Евр., 11:168; 2009 Ciocârlan, Fl. Il. Rom.: 216. - *C. glutinosum* Fries 1817, Novit. Fl. suec 1: 51; Мурав., 1936, Fl. URSS, 6: 452 Negru, 2007, Det. pl. fl. R. Mold.: 56. – *C. ucrainicum* Pacz. ex. Klok. Гейдеман, 1986, Опред. Высш. Раст. Молд. ССР : 183.

Annual up to 14 cm; stem with numerous glandular and some eglandular hairs. Leaves 4-15 mm, the lower oblanceolate, the upper ovate or ovate-oblong, obtuse, hairy. Pedicels longer than the sepals; bracts scarious for up to 1/8 their length. Sepals 4-5 mm, lanceolate to oblong-lanceolate, acute, scarious for up to 1/4 their length, with glandular hairs, and eglandular hairs reaching near to but not exceeding the apex; petals sometimes purple-tinged, equalling or slightly longer than the sepals, bifid for up to 1/4 their length, with branched veins; stamens 5-10; styles 5. Capsule 6-8 mm. Seeds 0·5-0·6 mm, chestnut-brown, finely tuberculate. IV–VI.

Terophyte grows in meadows, forest glade, steppe slopes. European element; xeromesophyte, mesothermal, euryonic. Rare species on the republic`s territory, in Briceni, Rascani, Balti, Codrii, Bugeac and Tigheci geobotanical districts met.

***C. diffusum*** *Pers.* 1805 Syn. Pl. 1: 520; Richards. 1976, Fl. Europ. 1: 175.

Annual up to 30 cm; stem with glandular and usually some eglandular hairs. Leaves 5-20 mm, the lower oblanceolate to spathulate, the upper ovate to elliptical, hairy. Pedicels much longer than the sepals; bracts usually herbaceous. Sepals 4-9 mm, ovate-lanceolate to lanceolate, acute or acuminate, with a scarious margin at the apex for up to 1/10 their length, with glandular hairs, and some eglandular hairs not exceeding the apex. Petals shorter than the sepals, bifid for c. 1/5 their length, with branched veins; stamens and styles 4 or 5. Capsule 5-7 mm. Seeds 0·4-0·7 mm, yellowish to chestnut-brown, bluntly tuberculate.

Prefers dry habitats, open, sandy and rocky spaces. Identified in "Codrii" Reserve.

***C. holosteoides*** Fries 1814 Novit. Fl. Suec.: 32; Гейдеман, 1986, Опред. Высш. Раст. Молд. ССР: 183; Цвел. 2000, Опред. Сосуд. Раст. Сев.-Зап. Росс.: 318; Negru, 2007, Det. pl. fl. R. Mold.: 56; Ciocârlan, 2009, Fl. Il. Rom.: 216 - *C. caespitosum* Gilib 1781, Fl. Lithman. 2: 159, nom. Illegit; Мурав., 1936, Фл. СССР, 6: 455; Prod. 1953, Fl. Rep. Pop. Rom., 2: 53; Лащенкова, 1976, Фл. Сев. – Вост. Европ. Части СССР, 2: 211; И. В. Соколов, 2004, Флора Вост. Евр., 11: 162.

Stem up to 30 (60) cm tall, prostrate, ascending or erect, simple or branched, short hairy, sometimes glandulous, sometimes reddish at the bottom. Leaves oblong or narrowly oblong, obtuse or acute, 1-3 cm long and 9 mm wide. Brushes on the leaf 1 mm long. Flowers dichazii, multiflorous, pedicels dense and short hairy, after flowering fruit length or up to 3 times longer than this. Lower bracts green or with membranous stripes, the upper with margins membranous. Sepals ovate-lanceolate, acute, 5-6 mm long with membranous margins, hairy on the outside. Petals white; sepals and petals nearly the same length. Capsule cylindrical, up to 2 times longer than calyx. Seeds brown, long 0.8 m. IV-X.

Chamephyte (hemicryptophyte) vegetates on meadows, grass slopes, glades and forest edge. Cosmopolitan element; mesophyte, amphitolerant, euryonic. In the flora of the republic recorded in Briceni, Rascani, Codrii, Tighina and Malaiesti districts.

## Conclusions

1. The flora of the Republic of Moldova includes nine species of the cerastium*: Cerastium arvense* L., *C. brachypetalum* Desp. ex Pers., *C. diffusum* Pers.*, C. holosteoides Fries., C nemorale* Bieb.*, C. perfoliatum* L.*, C. pumilum* Curtis, *C. semidecandrum* L. and *C. sylvaticum* Waldst. et Kit.

2. Of oll highlighted taxa, 7 are rare: *C. arvense*, *C. brachypetalum*, *C nemorale, C. perfoliatum, C. pumilum*, *C. semidecandrum* and *C. sylvaticum.*


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## DINAMICA SEZONIERĂ A DIVERSITĂŢII ALGOFLOREI R.COGÂLNIC


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**Summary.** *The paper represent result of the studies seasonal dinamic of the algal flora from Cogâlnic River which was studied in 2004. There was observed an increase in algal diversity in the spring and summer season and reduction of algal diversity in autumn and winter season, which is due to intense water pollution during the suumer of the year.*

## Introducere

Poluarea intensă a apelor conduce la sporirea cantității substanțelor organice, reducerea oxigenului dizolvat şi schimbarea pH-ului apei. Toate acestea influențează negativ asupra răspândirii şi dezvoltării algelor. În investigația algoflorei bazinelor acvatice din R. Moldova de problema frecvenței, abundenței şi structurii algocenozelor fitoplanctonice au fost preocupați profesorul V. Şalaru, P. Obuh, L. Ungureanu, Grabco N. ş.a., care în multiple lucrări au elucidat diversitatea specifică şi gradul de saprobilate a algelor [2, 3 ,4, 5,6].

Analiza lucrărilor publicate în acest domeniu demonstrează că în comparație cu anii '60 ai secolului trecut, în majoritatea ecosistemelor acvatice a avut loc reducerea diversității fitoplanctonului, a efectivului numeric şi biomasei algelor. Cauza principală a micşorării diversității florei acvatice este, în primul rând, factorul antropic [1]. Astfel, în prezent problema prioritară a societății este păstrarea biodiversității prin dezvoltarea biotehnologiilor noi de cultivare a algelor in-situ. De asemenea este foarte importantă studierea dinamicii sezoniere a diversității algoflorei anume a râurilor mici care nu sunt pe deplin studiate.

Râul Cogâlnic este unul din râulețe mici din partea de sud a Republicii care în present devine tot mai puternic poluat şi anume datorită deversării apelor reziduale. Algoflora râului a fost cercetată secvențial de profesorul Şalaru V., Obuh P. şi Danilov I. [2,3,7] dar nu sunt redate schimbările sezoniere din cadrul algoflorei, din acest motiv scopul lucrării date este analiza schimbărilor sezoniere a diversității algoflorei râului.

## Materiale şi metode

Vegetația algală a r. Cogâlnic a fost studiată pe parcursul anilor 2004 în tronsonul or. Hânceşti – s. Gradişte – or. Cimişlia – s. Bogdanovca. Colectarea şi analizarea probelor a fost efectuată conform metodelor utilizate pe larg în algologie [8,9,10,11,12]. Algele au fost examinate în stare vie şi conservate cu ajutorul microscopului Ergaval la mărirea ×10; × 40; ×100.

## Rezultate şi discuții

Pe parcursul anului 2004 a fost investigată dinamica sezonieră a diversității algoflorei r. Cogânic. Am constatat că taxonii din filumurile dominante vegetează pe parcursul anului întreg, dar suferă schimbări calitative în dependență de condițiile climaterice şi de influența factorilor de poluare. De regulă cele mai bogate în alge sunt apele de primăvară şi vară. În linii generale iarna numărul taxonilor se reduce considerabil şi în unele relevee vegetează doar 4-7 specii.

Cea mai mică diversitate a algoflorei (124 taxoni) a fost determinată în perioadă de iarnă. În acest sezon de regulă predomină cianofitele din genul *Oscillatoria* şi bacilariofite din genurile *Cyclotella, Surirella, Gyrosigma, Nitzschia*.

Primăvara numărul speciilor creşte de 2,2 ori şi algoflora este constituită din 277 taxoni şi unități taxonomice intraspecifice de alge (figura 1). În această perioadă a anului în apele râului vegetează intens 3 specii de alge verzi filamentoase, 2 plante superioare acvatice, 3-xantofite şi 2- crizofite, care în sezonul rece nu se dezvoltă.

În perioada estivală se observă o reducere ne însemnată a biodiversității (cu 11 specii) şi algoflora este constituită din 266 specii cu indicele saprob înalt. Dintre acestea mai frecvent sunt întâlnite speciile genului *Euglena* şi *Oscillatoria* deşi mai diverse sunt diatomeele.

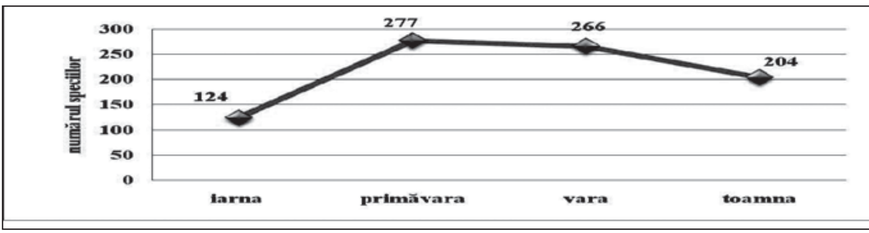


Figura 1. Dinamica sezonieră a diversității algoflorei r. Cogâlnic an. 2004

Totodată are loc dezvoltarea mai abundentă a unor specii mai tolerante față de poluarea organică a apelor. Odată cu scăderea temperaturii în decursul viiturilor de toamnă se observă reducerea numărului de taxoni de 1,3 ori şi anume de la 266 până la 204 specii (figura 1). În acestă perioadă algoflora este constituită din 204 specii cu predominarea diatomeelor urmate de clorofite şi cianofite. În unele mostre cele mai frecvente au fost euglenele (*Euglena acus* Ehr., *E. polimorpha* Dang., *E. texta* Duj. *etc)* care au cauzat înflorirea apei din albia veche a râului.

Analiza sezonieră a diversității filumului *Cyanophyta* (figura 2) ne arată o creşte a numărului de specii primăvara (45 taxoni), ceea ce în mediu este de 1,25 ori mai bogat decât diversitatea algocenozelor de iarnă (36 specii) şi toamnă (36 specii). Totodată în râu au fost depistate algele edafice cum sunt: *Nostoc linkia* Roth. sau *Phormidium molle* Kütz., care vegetează activ în solurile din lunca râului. Creşterea diversității algelor este determinată de faptul că în perioada primăverii un număr mare de cianofite pătrund în râu cu apele pluviale.

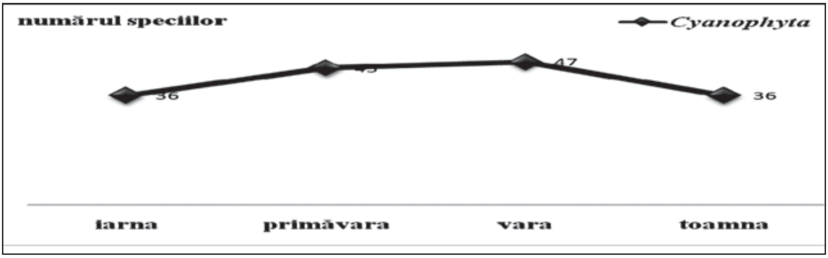


Figura 2. Dinamica sezonieră a diversității filumului *Cyanophyta* din algoflora r. Cogâlnic, anul 2004

Vara a fost atinsă diversitatea maximală a cianofitelor când numărul speciilor creşte de 1,04 ori şi ajunge la 47. În toate mostrele cele mai abundente sunt speciile g.*Oscillatoria*. În această perioadă şi condițiile climaterice şi prezența substanțelor nutritive favorizează dezvoltarea abundentă a cianofitelor care provoacă frecvent fenomenul de „înflorire ” a apelor cu speciile *Oscillatoria chalybea* Mert.*,O. Redekei* van. Goor.*, O. agardhii* Gom.*, O. tenuis* Ag. *etc.*

Iarna în râu vegetează, de regulă, speciile oligo-beta mezosaprobe (*Anabaena spiroides* Kleb.), iar în afluenții râului foarte frecvent se întâlnesc specii polisaprobe (*Anabaena flos-aguae* Lyngb.) care indică poluarea organică sporită a apei.

Vara în apele râului vegetează intens speciile indicatoare a poluări moderate: *Oscillatoria agardhii* Gom., *O. amphibia* Ag., *O. formosa* Bory, *O. chalybea* Mert. care au indicele de saprobitate foarte înalt (1,75- 3,0). În mostrele de lângă fabrica de vinuri or. Cimişlia un număr mare de cianofite provoacă frecvent fenomenul de „înflorire” a apei.

Diversitatea cianofitelor sporeşte în direcția curgerii râului şi predomină în apele din centrul şi aval de or. Cimişlia precum şi în tronsonul s. Bogdanovca. O mare parte din cianofitele dominante din perioada estivală sunt alfa-mezosaprobe, alfa-beta-mezosaprobe sau beta-mezosaprobe, ceea ce ne indică poluarea organică sporită. Concomitent cu dezvoltarea mai intensă a algelor cianofite a fost observată reducerea considerabilă a compuşilor biogeni fapt care demonstrează că aceste organisme au un rol esențial în epurarea naturală a apelor râului.

Similară este dinamica sezonieră a diversității chlorofitelor. Astfel cel mai mic număr de specii a fost determinat la fel iarna-27. În acest sezon mai frecvent se întâlnesc speciile genului *Hyaloraphidium* şi *Scenedesmus* care defapt indică poluarea râului.

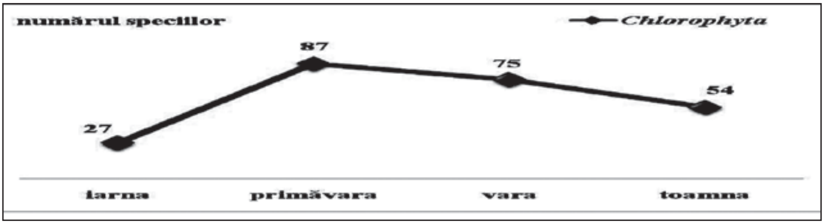


Figura 3. Dinamica sezonieră a diversității filumului *Chlorophyta* din algoflora r. Cogâlnic, anul 2004

Primăvara diversitatea chlorofitelor sporeşte de peste 3 ori fiind compusă din 87 specii (figura 3). În această perioadă vegetează intens speciile genului *Monoraphidium, Tetraëdron, Ankistrodesmus, Schroideria, Hyaloraphidium* etc. din care o frecvență mai înaltă au taxonii: *Schroideria robusta* Korsch., *Ankistrodesmus acicularis* Korsch., *Hyaloraphidium arcuatum* Korsch., *M. contortum* (Thur.) Kom. şi un număr mare de specii din genul *Scenedesmus*.

Vara cu toate că condițiile de dezvoltare sunt favorabile, diversitatea algoflorei scade până la 75 specii cu predominarea speciilor tolerante la concentrații mari ai compuşilor organici şi ai azotului. Spre toamnă numărul speciilor continuă să scadă de 1,4 ori şi ajunge la 54 taxoni.

După cum vedem din figura 4, cea mai mică diversitate diatomeile au la fel iarna (45 specii) şi toamna (74 specii) dar abundența unor specii în acest sezon este cea mai înaltă, datorită faptului că diatomeele preferă temperaturile scăzute. Analizele algologice ne arată că în bentos vegetau intens speciile genului *Surirella, Gyrosigma, Rhoicosphaenia, Caloneis etc.*, care în sectorul din s. Gradişte au acoperit parțial eluviile cu un strat de culoare cafenie. Toamna pe malurile râului au fost găsite cruste ruginii de alge de 1-3 cm cu predominarea speciilor genului: *Nitzschia*, *Navicula,* şi *Surirella.*

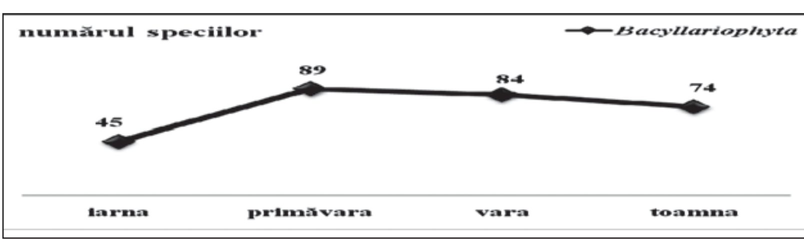


Figura 4. Dinamica sezonieră a diversității filumului *Bacillaryophyta* din algoflora r. Cogâlnic, anul 2004

În sezonul de primăvară a fost observată cea mai mare diversitate a diatomeelor. Numărul speciilor sporeşte de 2,0 ori în comparaţie cu sezonul de iarnă. Acest fapt se datorează condiţiilor climaterice optimale şi pătrunderii apelor alohtone în râu, care aduc specii cu grad de saprobitate foarte variat de la xeno - oligosaprob până la alfa-mezosaprob. Vara diversitatea diatomeelor se reduce neesenţial până la 84 specii, după ce în perioada viiturilor continuă să scadă până la 74 specii.

Dinamica sezonieră a diversităţii euglenInelor an. 2004 se deosebeşte de a celorlalte filumuri prin faptul că euglenofitele sunt cele mai diverse în perioada estivală. În acest sezon sunt determinate 56 specii pe când primăvara numai 49.

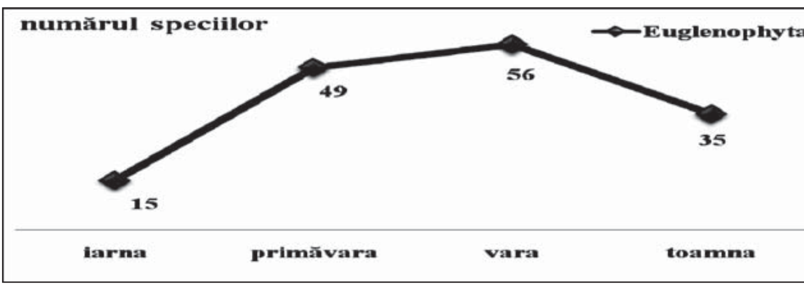


Figura 5. Dinamica sezonieră a euglenofitelor din algoflora r. Cogâlnic, anul 2004

Din totalitatea euglenInelor vrem să menţionăm dezvoltarea abundentă în tronsonul cercetată a speciilor: *Euglena acus* Ehr., *E. oxyuris* Schmardo., *E. polimorpha* Dang., *E. sanguinea* Ehr. Etc., care adesea provoacă înflorirea apei în diferite sectoare ale râului. Anume deversarea apelor reziduale menajere conduce la creşterea efectivului numeric al euglenInelor şi din acest motiv în albia veche a fost determinată dezvoltarea abundentă a euglenelor care au conferit apei culoarea verde. În cazul dezvoltării speciei *E. sanguinea* Ehr. apa avea o nuanţă cărămizie, ceea ce se datorează creării pigmentului hematohrom de culoare roşie.

Ca şi în analizele anterioare, cele mai puţine specii de euglenine au fost în perioada rece a anului 2004. Iarna în algoflora râului au fost depistate numai 15 specii de euglenine, iar toamna - 35 specii (figura 5).

## Concluzii

- Din datele expuse mai sus putem concluziona că algoflora râului este instabilă şi se schimbă sub influenţa factorilor de poluare a apei, printre care cel mai important este factorul antropic. În dinamica sezonieră se observă creşterea diversităţii algelor în sezonul de primăvară-vară şi reducerea efectivului numeric al diversităţii algoflorei iarna şi toamna, ceea ce în mare parte se datorează poluării mai intense a apelor în perioada estivală a anului.

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# FOREST STANDS FROM OCNITA FOREST DISTRICT

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**Summary.** *This article presents forest stand diversity from Ocnita Forest District and make a classification based on productivity stands. Keywords: diversity, forest stand, productivity.*

## Introduction

Ocnita Forest District is spread in Ocnita county and partly in Edinet county and Donduseni county and covers a total area of 4858.1 ha. Ocnita Forest District includes natural and planted forests and also meadows and arable land. The current status of forest stands can provide clues on the past of their management. The present paper proposes to make an analysis of the current state of forest stands from Ocnita Forest District.

## Materials and methods

The assessment of forest stands from Ocnita Forest District is based on materials of forest planning (2005). Analysis has been carried out according to the methodology described by Gh. Postolache (2008). According to their origin forest stands can be divided in three categories: natural fundamental, artificial and derived. The forests stands can also be categorized according to their productivity in high, middle and low productivity.

## Results and discussions

Fundamental natural stands occur in 179 subplots with a total area of 1889.2 hectares which represents 41% of the Ocnita forest district.

Fundamental natural stands of pedunculate (Quercus robur) occupy most of the area, occurring in 168 subplots, covering an area of 1870.9 ha and are spread at the altitude of 120-275 m. Pedunculate oaks forest stands are of middle and high productivity and occur on moderate slopes with southwest, southeast, northeast and east orientation. The stands are dominated by oaks (*Quercus robur*) and also by cherry (*Cerasus avium*). Accompanying species are aspen (*Populus tremula*), ash (*Fraxinus excelsior*), field maple (*Acer platanoides*), linden (*Tilia cordata, Tilia tomentosa*). Often are stands with composition 10STP, 9STP1CI.

Partially derived forest stands occur in eight stands of oak with a total area of 149.2 hectares. Accompanying species are hornbeam (*Carpinus betulus*), sycamore maple and field maple. The composition of forest stand is 2 ST 5 CA 2 TE 1 DT. In the Ocnita forest district have been planted

2602.5 hectares. The largest areas have been established with pedunculate oak 941.6 ha and acacia 899.9 ha. Besides have been created forest stands with ash, walnut, poplar, mountain maple, lime, pine and spruce. The most common are artificial stands with next composition: 10STP; 10SC; 10FR; 10PI; 10PA. It has been observed that acacia forest stands have been planted in non suitable forest station being planted in areas more suitable for pedunculate oaks and sessile oak. The species share in artificial forest stands is presented in Figure 1.

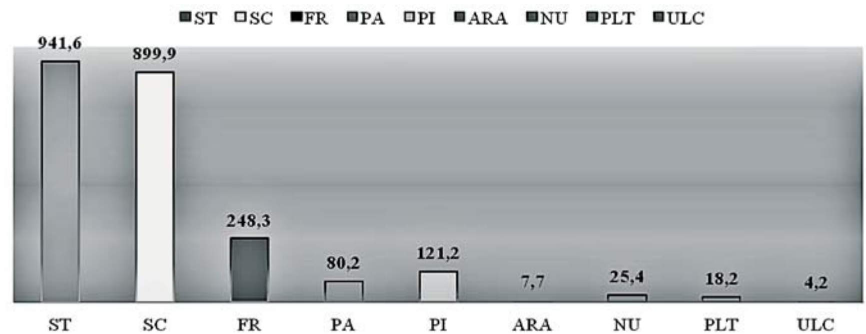


Figure 1. Species share the artificial stands

In the Ocnita Forest District occur next forest tree species in Figure 2: pedunculate oak 50%, 18% acacia, ash 6%, 5% maple, cherry 4%, 3% red oak, hornbeam 3%, pine 2%, 1% spruce, aspen 1%, 1% lime, common walnut 1%, and other species 5%. The age of most oak forest stands ranges between 60 and 80 years. The most damaged forest tree species is cherry of 80-100 years old which usually is in biological decline after cherry trees reach the age of 60-70 years old.

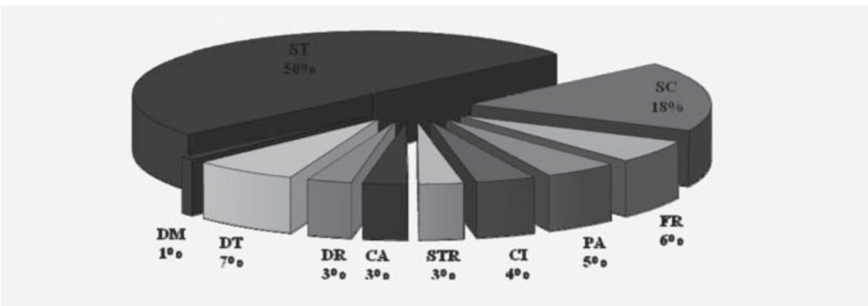


Figure 2. Weightspecies in the forest stands Ocnița

The total wood volume in the Ocnita Forest District is 832,814 $m^3$. The average increment is about 5.5$m^3$/an/ha. According to forest stands productivity from Ocnita Forest District about 24% of forest stands are of high productivity, 58% are of middle productivity and 18% of lower productivity. Generally the lower productivity of forest stands is due to local stationary conditions. According to the consistence level of forest trees in forest stands there have been found that 1% of surface is covered with stands with less than 0.4; forest stands with 0,4 and 0,6 have consistence about 7%; and 92% of forest stands have a consistence higher than 0.6.

Land not occupied by forest stands represents an area of 217.2 hectares from which 14.8 ha have been destination for afforestation and 202.4 ha for the administrative needs.

According to the type of forest stands; the natural fundamental forest stands cover 1889,2ha (41%), derived forest cover 149,2 ha and artificial forest stands cover 2602.5ha (56%) being mostly of acacia plantation.

## Conclusions

Forests from the Ocnita Forest District are classified according to their origin in three categories: natural fundamental, derived and artificial forest stands. Natural fundamental forest stands are present in 179 subplots and cover an area of 1889.2 ha which is 41% of the forest district. Derived forest stands of oak have been recorded in 8 plots covering 149.2 ha. Artificial forest stands were planted in 1030 ha and occupies an area of 2602.5 ha. We have noted a higher share of acacia plantations which could be reduced in stands where are suitable for autochthonous oak species.

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# INFLUENȚA PARTICULARITĂȚILOR DE BIOTOP ASUPRA STRUCTURII ŞI REZISTENȚEI COMUNITĂȚILOR DE ALGE EDAFICE

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**Summary.** *In this article is present information about changes in species composition of soil algae, after stored the samples of the soil in laboratory conditions. After 20 years of storage in moist soil samples germinated first of all the nitrogen-fixing blue green algae's from genus Nostoc, Anabaena and Cylindrospermum. Among the most hardly species can also be called the species from genus Lyngbya, Schizothrix and Microcoleus for which is characteristically mucous membrane. Less resistant became hydrophilic amphibians from diatoms. It also founded that the hardly degree of the same species depends of the environmental conditions original habitat.*

## Introducere

Problemele ce țin de păstrarea îndelungată a microorganismelor, inclusiv şi a algelor, în stare uscată în condiții de laborator şi menținerea vitalității lor cu reactivarea ulterioară a funcțiilor sunt la moment de o importanță mare. Păstrarea îndelungată a organismelor fototrofe inferioare reprezintă o problemă complicată care poate fi rezolvată utilizând un spectru larg de metode complexe.

Una din cele mai simple şi ieftine metode de păstrare a culturilor de microorganisme şi alge este cea de trecere a lor în stare deshidratată, de anhidrobioză. Anhidrobioza, o varietate de anabioză, este o stare de încetinire profundă şi îndelungată a metabolismului în cazul condițiilor nefavorabile a mediului. Capacitatea de reactivare a organismelor până la starea inițială normală depinde de durata perioadei de anabioză în care ele s-au aflat. Această stare a organismelor este însoțită de multiple schimbări fiziologice, biochimice, morfologice şi citologice [1, 4, 7, 8, 9].

Celulele cu un conținut mai mare de azot şi acizi nucleici mai rău suportă deshidratarea decât acelea care conțin aceste substanțe în cantități mai mici. Pe de altă parte celulele cu un conținut mai mare de hidrocarburi mai bine î-şi păstrează viabilitatea la deshidratare.

Multe organisme posedă capacitatea de a suporta o deshidratare mai mult sau mai puțin completă. Comun pentru ele este o cantitate sporită de dizaharide. Multe cianofite şi microalge edafice şi aerofile din alte încrengături formează în jurul celulelor capsule cu un conținut sporit de polizaharide, devenind în aşa mod mai rezistente la temperaturi ridicate. Lipidele la fel joacă un rol important la protejarea celulelor împotriva deshidratării.

Algele edafice şi aerofile posedă o proprietate fiziologică importantă obţinută în procesul evoluţiei. În prezenţa condiţiilor nefavorabile a mediului, la insuficienţă de umiditate sau la temperaturi joase, devenind fie uscate sau îngheţate şi parcă complet lipsite de viaţă, în cazul unor condiţii favorabile de temperatură, iluminare şi umiditate reînvie din nou, păstrându-şi capacitatea de reproducere.

Luând în consideraţie că starea de anabioză prevede anumite schimbări fiziologice, morfologice şi biochimice a organismelor ca rezultat al acomodării la condiţiile nefavorabile, datele referitor la durata perioadei de anhidrobioză pe care o pot suporta diferite specii de organisme, poartă o informaţie concretă referitor la componenţa biochimică şi particularităţile morfo-fiziologice a organismelor de diferită apartenenţă sistematică. Aceste rezultate ar permite în viitor de a selecta cu o precizie mai mare şi efort mai puţin tulpini de microalgelor valoroase din punct de vedere a compuşilor chimici pe care îi conţin. Pe de altă parte informaţia de acest gen ar contribui simţitor la elaborarea unor procedee mai eficiente şi puţin costisitoare de menţinere a microalgelor în stare uscată în colecţii în condiţii de laborator, deoarece în acest caz ele pot fi păstrate în cantităţi mult mai mici şi nu necesită utilaj costisitor. Totodată aceste elaborări ar uşura procedura de reactivare „reînviere" a culturilor uscate de microalge în caz de apare necesitatea obţinerii lor în cantităţi mai mari.

Din aceste considerente scopul lucrării constă în analiza schimbărilor din cadrul componenţei comunităţilor de alge edafice apărute în rezultatul păstrării lor în stare uscată timp de aproape 20 de ani şi să stabilim în ce măsură viabilitatea la reprezentanţii aceloraşi unităţi taxonomice depinde de natura biotopului iniţial de unde au fost colectate.

## Materiale şi metode

Releveele edafice au fost colectate în anul 1984 din vegetaţie naturală silvică, de stepă, de luncă şi cultivată ca plantaţii forestiere artificiale, vii şi agrofitocenoze. Colectarea probelor şi analiza lor, respectiv în anii 1984 şi 2002, a fost efectuată conform metodelor aplicate pe larg în algologia edafică [2,3,5,10].

În rezultatul analizei releveelor de sol colectate în anii 1984-1987 şi păstrate timp de 15-18 ani în condiţii de laborator la temperatura camerei de tot au fost evidenţiate 101 specii şi varietăţi.

## Rezultate şi discuţii

În rezultatul analizei releveelor de sol colectate în anul 1984 şi păstrate timp de 20 de ani în condiţii de laborator la temperatura camerei de tot în anul 2002 au fost evidenţiate 101 specii şi varietăţi.

Numărul inițial de specii care au fost prezente în aceleaşi probe în anul 1984 este aproximativ de 3 ori mai mare – 258 specii. Din numărul total de cianofite evidențiate în anul 1984 (82 specii) în anul 2002 au fost stabilite aproximativ 40% (33 specii).

Analiza comunităților algale ne-a demonstrat că, după o perioadă de păstrare îndelungată în condiții de laborator, în primul rând dispar formele hidrofile, amfibiene, formele filamentoase de alge din genul *Vaucheria*, care de obicei abundent se dezvoltă pe suprafața solurilor umede şi diatomeele la care se referă alge monocelulare mobile din genurile *Hantzschia* şi *Navicula*, întâlnite în straturile de la suprafața solului umed sau în mucozitatea altor specii de alge (figurile 1, 2).

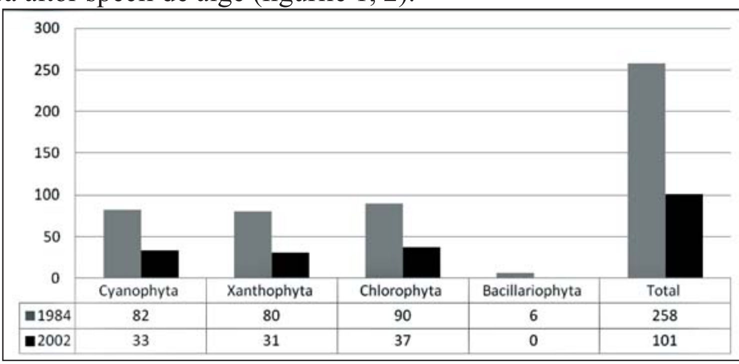


Figura 1. Numărul de specii evidențiate în probele de sol analizate în anii 1984 şi 2002

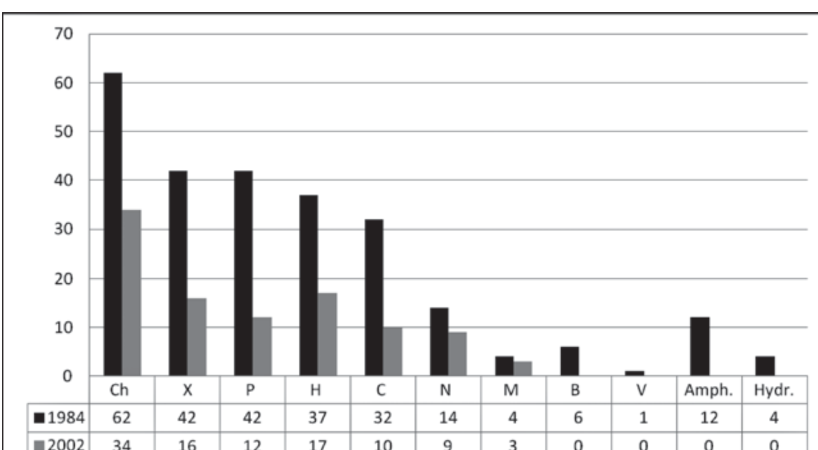


Figura 2. Numărul ecobiomorfelor evidențiate în probele de sol analizate în anii 1984 şi 2002

Practic nu s-a schimbat numărul speciilor de alge care aparțin formelor filamentoase de cianofite cu o teacă mucilaginoasă bine pronunțată. Printre ele mai des pot fi nominalizate speciile genurilor *Lyngbya, Schizothrix* şi *Microcoleus*.

Printr-o rezistență înaltă față de o perioadă îndelungată de insuficiență de umiditate se caracterizează şi speciile familiilor *Nostocaceae* şi *Anabaenaceae*, mai ales reprezentanții genurilor *Nostoc*, *Anabaena* şi *Cylindrospermum.* Numărul algelor monocelulare verzi atribuite ecobiomorfei „Ch" practic s-a micşorat de 2 ori. Dacă în culturile analizate în anul 1984 au fost prezente 62 specii, în solurile cercetate în anul 2002 au fost nominalizate doar 34 specii. În primul rând dispar speciile familiilor *Ankistrodesmaceae*, *Closteriacaeae* şi altele.

Pe parcursul perioadei de păstrare lista speciilor filamentoase de alge verzi şi xantofite din ecobiomorfa "H" s-a micşorat de 2,2 ori, de la 37 specii la 17. În anul 2002 nu au mai fost depistate speciile genurilor *Heterothrix, Tribonema,Ulothrix, Klebsormidium.*

Mai puțin rezistente la păstrare îndelungată s-au dovedit a fi reprezentanții xantofitelor monocelulare diversitatea cărora s-a micşorat de la 42 specii la 16 în 2002. Din componența comunităților algale dispar speciile genurilor *Akantochloris, Nephrodiella* şi altele.

Cele mai puțin rezistente s-au dovedit a fi cianofitele filamentoase lipsite de teaca mucilaginoasă diversitatea cărora s-a micşorat practic de 4 ori. Cele mai vulnerabile sunt multe specii din genurile *Oscillatoria* şi *Phormidium*. La fel s-a micşorat diversitatea speciilor genurilor *Lyngbya*, *Symploca* şi altele.

În aşa mod am constatat că cele mai rezistente la o păstrare îndelungată, în condiții de laborator s-au dovedit a fi speciile de alge care aparțin ecobiomorfelor „M" şi „N" şi în mare măsură sunt reprezentante de genurile *Nostoc*, *Schizothrix* şi *Microcoleus.* La ele se referă *Nostoc coeruleum, N. commune, N. edaphicum, N. enthophytum, N. linckia, Schizothrix friesii, Sch. lardaceae, Microcoleus vaginatus*. Aceasta înseamnă că reprezentanții acestor grupe sistematice care aparțin ecobiomorfelor respective îşi pot păstra viabilitatea rămânând timp îndelungat în stare de repaos. Dimpotrivă algele ecoboimorfelor „P" şi „C" s-au dovedit a fi mai pretențioase. Pentru aşi păstra viabilitatea ele necesită ca perioada de vegetație activă şi cea latentă să urmeze una după alta peste un interval de timp mai redus, ceea ce înseamnă că în caz dacă am păstra speciile acestor ecobiomorfe în stare uscată în colecțiile de microalge în condiții de laborator, algele care aparțin formelor vitale „P" şi „C" ar fi trebuit să fie reînsămânțate, în comparație cu cele ce aparțin ecobiomorfelor „M" şi „N" , mai des.

În dependenţă de principalii factori ecologici fitocenozele studiate pot fi aranjate într-un şir ecologic bine determinat, începând cu cele mai umede tipuri de vegetaţie şi terminând cu cele care se dezvoltă în condiţii mai mult sau mai puţin aride. Convenţional le putem grupa în trei categorii. Prima o constituie pădurile de fag, gorun cu fag, gorun cu carpen şi gorun cu tei şi frasin. A doua reuneşte pădurile de tip mai uscat cum sunt cele de stejar cu scumpie şi stejar pufos, împreună cu plantaţiile forestire artificiale. Cea din urmă include agrofitocenozele şi comunităţile erbacee ca vegetaţiile de stepă şi de luncă.

Vegetaţia de stepă în primul rând, după care urmează vegetaţia de luncă, plantaţiile forestiere artificiale şi pădurile de fag ocupă unele din primele locuri, printre cele 11 tipuri de vegetaţie studiate, în ceea ce priveşte cantitatea speciilor reapărute în culturi peste 20 ani de stare latentă.

Anume în aceste tipuri de fitocenoze speciile de alge se caracterizează printr-o rezistenţă mai ridicată, ceea ce le permite să-şi păstreze vitalitatea un timp mai îndelungat. Trei din cele patru fitocenoze numite mai sus ocupă poziţiile extreme în cadrul şirului ecologic respectiv.

Pădurile de gorun cu carpen şi solurile ocupate de vii, din punct de vedere a numărului de specii reapărute ocupă ultimele locuri printre vegetaţia studiată. În ambele cazuri acest lucru se datorează micşorării diversităţii algelor verzi, a xantofitelor în vii şi a cianoftelor în pădurile de gorun cu carpen.

Printre pădurile existente în Moldova cele de gorun cu carpen se caracterizează printr-un regim hidric moderat. Oscilaţiile de umiditate în aceste soluri sunt mai mici şi algele pe parcursul evoluţiei s-au adaptat la un nivel de umiditate mai mult sau mai puţin constant. Din această cauză algele din pădurile de gorun cu carpen sunt mai puţin adaptate la micşorarea bruscă, rapidă şi îndelungată a umidităţii. În acelaşi timp suprafeţele ocupate cu vii se caracterizează prin cel mai înalt procent de cianofite reapărute.

În general analiza procesului de revenire la un mod de viaţă activ a algelor după o perioadă îndelungată de stare latentă, ne arată că speciile unuia şi aceluiaşi gen se adaptează la condiţii de viaţă diferite.

Rolul anumitor forme biotice în formarea comunităţilor algale după o perioadă îndelungată de anhidrobioză se schimbă. De exemplu vegetaţia pădurilor de stejar cu scumpie, de stejar pufos, vegetaţiile de luncă şi cea de stepă după ponderea algelor ecobiomorfei „C” şi „X” în componenţa algoflorei în anul 1984 ocupau ultimele locuri printre fitocenozele studiate. În cadrul comunităţilor algale evidenţiate în anul 2002 aceste tipuri de vegetaţie după ponderea algelor acestor grupe ecologice ocupau primele locuri. Putem presupune că anume în aceste tipuri de vegetaţie, în comparaţie cu celelalte, reprezentanții grupelor ecologice „C" şi „X" sunt capabile să-şi păstreze vitalitatea în starea de anhidrobioză un timp mai îndelungat ca rezultat al adaptării la condițiile xerofite a mediului.

Pe de altă parte speciile ecobiomorfei „M", în comparație cu alte forme vitale, în vegetația de stepă, plantații forestiere artificiale şi pădurile de stejar pufos în solurile proaspăt colectate şi analizate în anul 1984 ocupau primele locuri. Algoflora acestor tipuri de vegetație, analizată în anul 2002, a demonstrat că ponderea reprezentanților biomorfelor respective scade simțitor. Aceeaşi constatare, comparând algoflorele evidențiate în anii 1984 şi 2002, o putem face pentru algele ecobiomorfei „N" din fitocenozele de stepă unde diminuarea rolului lor plasează vegetația de stepă de pe primul loc ocupat de ele în anul 1984 pe penultimul în 2002 fiind urmată doar de pădurea de stejar cu scumpie.

În anul 1984 speciile filamentoase de alge verzi şi xantofite în formarea comunităților algale din pădurile de gorun cu carpen şi stejar cu scumpie aveau aceeaşi pondere, le revenea câte 14-16% din numărul total de specii evidențiate. Peste 20 ani de repaos în componența algoflorei din pădurile de gorun cu carpen ponderea lor s-a mărit până la 22%, iar în pădurea de stejar cu scumpie s-a diminuat până la 10%, ceea ce plasează primul tip de pădure pe locul doi, iar pădurea de stejar cu scumpie pe ultimul.

Consecutivitatea aranjării fitocenozelor analizate luând în considerație ponderea algelor ecobiomorfelor „Ch" şi „P" după o stare de anhidrobioză de 20 de ani practic se păstrează neschimbată.

În general se poate constata că pentru vegetația silvică edificată de fag şi gorun este caracteristică dominarea speciilor ecobiomorfelor „Ch", „H", iar pentru vegetația de stepă şi de luncă cele mai reprezentative sunt formele vitale „P" şi „M".

Cele mai rezistente s-au dovedit a fi reprezentanții ecobiomorfelor „M" şi „N". Toate speciile din aceste grupe ecologice evidențiate în anul 1984 în 2002 au fost stabilite în vegetația de stepă, vii şi pădurea de fag. Pe lângă aceasta prezența de 100% a formelor vitale „M" a fost constatată în pădurile de gorun cu carpen, gorun cu tei şi frasin, pădurile de stejar cu scumpie, iar a formei „N" – în pădurea de stejar pufos. Este cazul de menționat că reprezentanții ecobiomorfei „N" au cel mai înalt procent de specii reapărute. Chiar şi în pădurea de gorun cu tei şi frasin unde ele au fost stabilite în proporții cele mai mici, în comparație cu alte tipuri de vegetație, în anul 2002 numărul lor a constituit 50% din speciile evidențiate în anul 1984, ceea ce nu a fost stabilit pentru alte grupe ecologice. Numai în cazul pădurilor de stejar pufos nici una din speciile ecobiomorfei „M" în anul 2002 nu a mai fost evidențiată.

Speciile ecobiomorfelor „C” şi „X” practic au reapărut toate (100%) în fitocenozele pădurilor de stejar pufos şi cele de stepă. Mai mic este procentul de reapariție a lor (45-57%) în vegetația de luncă, pădurile de stejar cu scumpie şi plantații forestiere artificiale.

Cel mai înalt procent de specii reapărute din ecobiomorfa „Ch” a fost stabilit pentru vegetațiile pădurilor de fag şi plantațiile forestiere artificiale. Algele filamentoase din biomorfa „P”, în primul rând, se reactivau în pădurile de gorun cu frasin şi vii.

Cele mai vulnerabile sunt ecobiomorfele „B”, „V”, „amfibiene” şi „hidrofile”, care în algoflora evidențiată în anul 2002 nu au fost prezente nici în una din fitocenozele analizate.

Cum s-a menționat mai sus rezistența celulelor microorganismelor în timpul uscării lor în mare măsură depinde de conținutul lor biochimic. Reieşind din aceasta şi luând în considerație datele noastre referitor la rezistența unor specii concrete sau a reprezentanților anumitor unități sistematice în stare de anhidrobioză, putem cu o anumită precizie presupune în general conținutul lor biochimic. Astfel se simplifică procesul de căutare a unor noi surse de materie primă valoroasă din punct de vedere biochimic sub aspect de microorganisme şi microalge perspective în calitate de obiecte biotehnologice.

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# PHYTOSOCIOLOGICAL SURVEY OF SEMI-DESERT STEPPES WORMWOOD COMMUNITIES (*ARTEMISIA AUSTRIACAE*) IN THE REPUBLIC OF MOLDOVA

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**Summary.** *Survey of semi-desert steppes vegetation belonging to the Festuco-Brometea class (As. Artemisio austriacae – Poëtum bulbosae I. Pop 1970 Syn.: Poëtum bulbosa Răv. et al. 1956 (art. 36); Artemisietum austriacae Răvăruț et al. (1956) 1958 (art. 2b, 36, 37) is presented. Syntaxa was characterized by taking into consideration main aspects of chorology, ecology, physiognomy and floristic composition, biological forms, floristic elements, ecological indexes. Association analysis is presented in phytosociological tables comprising in total 138 species and is of scientific importance. This phytosociological survey was carried out based on (Braun-Blanquet, Borza A., Boşcaiu N.) method and encompassed distribution area of wormwood communities in semi-desert steppes.*

## Introduction

Association of wormwood formation from the semidesert steppes of the southern Moldova is widespread in the territory of three districts: Vulcăneşti, Cahul and Taraclia. This category formation represents a transition zone from the steppe to the desert. (Postolache 1993, 1995) The study area of analyzed wormwood communities included areas along rivers courses Prutul-Inferior, Cahul and protected area Ciumai-Vinogradovca. The maximum altitude is of 124 m, the mean altitude is of 14 m and a general relief declivity of 10-40º. Substrate consists of clay and loess deposits. The territory is being characterized by a hilly relief of a plateau, interrupted by several valleys. It is characterised by a temperate continental climate, with dry and cold winters and hot or even very hot and dry summers. Due to the fact that in literature very few information can be found about natural distribution of wormwood communities in the Republic of Moldova we decided to realize phytosociological surveys during 2007-2011 in order to bring new information with the identification of species and plant communities.

## Materials and methods

Our research was carried out during the period of 2007 – 2011 when several field trips have been carried out in the semi-desert steppes area in order to perform phytosociological surveys. Floristic investigations have been performed using the itinerary method over all vegetation seasons. The phytosociological surveys were based on (Braun-Blanquet, *Borza A., Boşcaiu N.)* methods.

## Results and discussions

The ecology and phytocoenological characterisation: the communities of *Artemisio austriacae-Poëtum bulbosae* are distributed all over the studied zone in the southern part of Moldova, most of them being used in the present as pastures with high intensity. The studied phytocenoses occurred in river valleys and arid plateaus. The floristic composition of this association is rich comprising 138 species and varied. The dominant species *Artemisia austriacae* realizes a covering of vegetation with values between 80 and 90%, while the characteristic species poa bulbosa has a high constancy in the frame of the association. The characteristic species to the class Festuco - Brometea , Festucetalia valesiacae, Festucion valesiacae Klika 1931 and *Molinio-Arrhenatheretea*. The spectrum of the bioformes illustrates the dominance of hemicryptophytes with 42,75%, followed by therophytes with 28.26%, terophytes biennial - 9,4%, geophytes - 7,24%, chamaephytes – 4,34%, mezophanerophytes – 3,62%, nanophanerophytes – 1,44% and megaphanerophytes is one species. The analysis of the phytogeographic elements displays high frequencies of euroasiatic element 44,92% and pontic species 24.63%, followed by european 7.97%, central-european and mediterranean species, each with 5.0%, cosmopolite 1,44%, followed by circumpolar and atlantic represented by one species. The analysis of the ecologic spectra indicates the dominance of xeromesophytes species 64.48%, xerophytes 28,97% and amphytolerant species 6,52%. The thermic factor is predominated by temperate-thermophile 60,72%, microtherm 40,57%, amphytolerant 5,79% and thermophile only one species. According to soil reaction the most of species are slightly acid-neutrophilious 57,24%, euryionics 23,18%, acid-neutrophile 11,59%, neutrobasiphile 2,89% and acidophile 2,17%. Trophic soil reaction is represented by oligotrophic 19,39%, mesotrophic 2,89%, euritrophic 1,4%, eutrophic one species. In the floristic composition 15,9% of species are indicators of the level of nitrogen soil fixation. The most numerous, ensured with nutritive elements, are the plant of very poorly supplied N1 –

7,24%, poor soil N2 – 5,0% and medium soil N3 - 4,34%. In the wormwood formation one halophyte species from the total number of species were identified. The economical plant importance. Analyses of plant from wild flora is represented by seven categories of economical plant importance. The most numerous are the medicinal 22,46%, melliferous 10,86%, toxic 7,24%, alimentary 4,34%, ornamental and decorative with 2,17%, aromatic plant have 1,44%.

## Conclusions

In conclusion, the floristic composition of the *wormwood* associations (Artemisia austriacae) proves pronounced arid, steppe characteristics of vegetation based on the dominance of euroasiatic element. The sinecologic analysis demonstrates the semi-desert characteristics of the flora and vegetation. From a qualitative point of view the analysis of bioforms reveals the dominance of hemicryptophytes with 42,75% that gives stability to the present phytocoenosis. The strong anthropic influence on the flora and vegetation is reflected in the high proportion of temperate-thermophile with 60,72%. The analysis of phytogeographic elements spectrum illustrates dominance of the euriasiatic element 44,92% which confirms the belonging of the studied territory to the Euro-Siberian region. The presence of the nutritive elements proves a very poorly supplied N1 – 7,24% which may be explained by intensive agricultural activities in studied area and by strong anthropic influences.

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Table1

# Asociația Artemisio austriacae – Poëtum bulbosae I. Pop 1970

| Nr. | Economical plant importance | Bioformes | Phytogeographic elements | Categorii ecologice: Halophyte | Nutritive elements | U | T | R | Trophic reaction | Nr. relevees | 1 | 4 | 7 | 9 | 12 | 15 | 16 | 19 | 20 | 23 | 25 | 28 | 29 | 30 | 45 | 67 | 98 | 103 | 106 | 112 | 134 | 157 | 178 | 183 | 195 | 196 | K | ADm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Surface (mp) | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | *100* | | |
| | | | | | | | | | | Covering (%) | *80* | *90* | *70* | *90* | *90* | *90* | *95* | *90* | *90* | *90* | *90* | *90* | *90* | *90* | *90* | *80* | *90* | *90* | *90* | *90* | *90* | *90* | *80* | *90* | *90* | *70* | | |
| *1* | | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *12* | *13* | *14* | *15* | *16* | *17* | *18* | *19* | *20* | *21* | *22* | *23* | *24* | *25* | *26* | *27* | *28* | *29* | *30* | *31* | *32* | *33* | *34* | *35* | *36* | *37* | *38* |
| | | | | | | | | | | ***Car. de as.*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | med. mel. | Ch. | Eua. | | N1 | 2 | 4 | 4,5 | | Artemisia austriaca | *3* | *3* | *3* | *4* | *4* | *2* | *3* | *4* | *3* | *2* | *3* | *4* | 3 | 4 | 3 | 3 | 4 | 3 | 4 | 3 | 3 | 4 | 2 | 3 | 4 | 3 | V | 43,84 |
| | | | | | | | | | | **Festucion valesiacae** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | G. | Pt | | | 2 | 4 | 4,5 | | Bellevalia sarmatica | | | | + | + | | + | | + | | | | + | + | | + | | + | + | | + | | | | | | II | 0,19 |
| 3 | tox. | T. | Eua | | | 2 | 4 | 4,5 | | Ceratocephala testiculata | | | | | | | | | | | | | + | | | | | | | | | | | | | | I | 0,02 |
| 4 | | T. | Pt | | | 2,5 | 4 | 0 | | Carthamus lanatus | | | + | | | | | + | | | | | | | | | | | | | | + | | + | | | I | 0,07 |
| 5 | | G. | Pt | | | 2 | 4 | 4 | | Scorzonera mollis | | | | | | | | | | | | | | | | | + | | | | | | | | + | | I | 0,03 |
| 6 | | H. | Pt | | | 2 | 4 | 4,5 | | Taraxacum serotinum | + | | | | | | | | | + | | | | | | | | + | | | + | + | | + | + | | II | 0,13 |
| 7 | | G. | Pt | | | 1,5 | 4 | 4 | | Colchium triphyllum | | | + | | | | | + | | | | | | | | | | + | | | | | | | | | I | *0,05* |
| 8 | | G. | Eua | | | *1,5* | *3,5* | *4* | oligo-tr. | Gagea pusilla | | | | | | | + | | | | | | | | | + | | | | | | | | | | | I | 0,03 |
| 9 | | H. | Pt | | | 1,5 | 3,5 | 4 | | Inula oculus-christi | | | | | | | + | | | | | + | | | | | | | | | | + | | | | | I | *0,05* |
| 10 | | H. | Pt | | | 1,5 | 4 | 4 | | Tanacetum millefolium | + | | | + | 1 | 1 | | | + | 1 | | | | | | | + | | | | + | + | + | | | | II | 0,71 |
| 11 | med. alim. | H. | Eua. | | N3-4. | 2 | 3 | 4 | | Artemisia absinthium | | | | | | | | | + | | | | | | + | + | + | + | + | | + | | | | | | II | 0,13 |
| 12 | | TH. | Pt | | | 2 | 4 | 4 | | Echium russicum | | | | + | | | | | + | | | | | | | | | | + | | | | | | | | I | *0,05* |
| 13 | | TH. | E. | | | 2 | 4 | 3 | | Nonea pulla | | | | | | | | | | | | | | + | | | | | + | + | | | | | | | I | 0,05 |
| 14 | | T. | T. | | | 2,5 | 4 | 4,5 | | Ajuga chia | + | + | | | | | + | | | | | | | | | | | | | | | | | | | | I | 0,05 |
| 15 | | Ch | Med. | | | 1,5 | 4 | 4,5 | | Teucrium polium | | | | | | | | | | | | | | | | | | + | + | + | | | | | | | I | 0,05 |
| 16 | | H. | Pt | | | 2 | 4 | 0 | | Marrubium peregrinum | | | | | | | | + | | | + | + | | | | | | | | | | | + | | + | | I | 0,09 |
| 17 | mel. | H. | Eua. | | | *2* | *3* | *0* | | Nepeta pannonica | | | | + | + | | + | + | + | + | + | | | + | | + | + | + | | + | + | | | | + | + | III | 0,28 |
| 18 | | H. | Pt | | | 2 | 3,5 | 4 | | Salvia austriaca | | + | | | | | + | | | | | | | | | | + | | | | | | | | | | I | *0,05* |
| 19 | | T. | Eua. | | | 1 | 4 | 3 | | Thymelaea passerina | + | + | | | | + | | | | | | | | | | | | | + | | | | | | | | I | *0,05* |
| 20 | decor. | H. | Pt. | | | 1,5 | 3,5 | 4 | oligo-tr. | Linum hirsutum | | | | | | + | | | | | | | | | | | | | | | | | | | + | | I | 0,03 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | med. alim. | TH. | Eua. | | N2-3. | 2 | 4 | 4 | | Falcaria vulgaris | | + | + | | | | + | | | + | + | | | | + | | | | + | + | | | | + | | | II | *0,17* |
| 22 | | H. | Med. | | | *1,5* | *3,5* | *5* | | Althaea cannabina | | | | | | + | | + | | | | + | | | + | | | | | | | | | | | | I | 0,07 |
| 23 | | H. | Pt. | | | *1* | *4* | *4,5* | | Gypsophila glomerata | | | | | | | | | + | | | | | + | | | | | + | + | | | | | + | | I | 0,09 |
| 24 | | H. | Pt. | | | 1,5 | 4,5 | 4 | | Silene longiflora | | | | | | | | | + | | | | | + | | | | | + | | | | | | | | I | 0,05 |
| 25 | | H. | Pt. | | | 1,5 | 4,5 | 4 | | Goniolimon besse-rianum | | | + | | | | | + | | | | | | | | | | | | | | + | | + | | | I | *0,09* |
| 26 | | H. | Eua. | | N1 | 1,5 | 3,5 | 4 | oligo-tr. | Astragalus austriacus | 1 | + | | + | | + | + | | + | + | | + | + | + | + | | | + | | + | | + | | + | | + | IV | *0,76* |
| 27 | med. | H. | Pt | | | 2 | 3,5 | 4 | oligo-tr. | Astragalus dasyanthus | + | | | | | | | | | + | | | | | | | | + | | | + | + | | + | + | | II | 0,13 |
| 28 | | | | | | | | | | **Festucion vaginatae** | | | | + | | | | | + | | | | | | | | | | + | | | | | | | | I | 0,05 |
| 29 | | T. | Eua | | | 1,5 | 4,5 | 4,5 | | Kochia laniflora | | | | | | | + | | | | | | | | | + | | | | | | | | | | | I | 0,03 |
| 30 | | T. | Eua | | | 2 | 4 | 4,5 | | Salsola ruthenica | + | + | | | | | + | | | | | | | | | | | | | | | | | | | | I | 0,05 |
| 31 | | H. | Eua | | | 1,5 | 4 | 4,5 | oligo-tr. | Astragalus varius | | | | | | | | | | | | | | | | | | + | + | + | | | | | | | I | 0,05 |
| 32 | | T. | Pt. | | | 1,5 | 4 | 4 | | Syrenia cana | | | | | | | | + | | | + | + | | | | | | | | | | | + | | + | | I | 0,09 |
| 33 | | T. | Eua. | | N2 | 1 | 5 | 4 | oligo-tr. | Plantago scabra | | | | + | + | | + | + | + | + | + | | | + | | + | + | + | | + | + | | | | + | | III | 0,26 |
| 34 | | H. | Pt | | | 1 | 4,5 | 4 | | Scabiosa ucrainica | | | + | | | | | + | | | | | | | | | | + | | | | | | | | | I | 0,05 |
| 35 | | T. | Ec | | N1-2 | 2 | 4 | 4 | oligo-tr. | Anthemis ruthenica | + | + | | | | + | | | | | | | | | | | | | + | | | | | | | | I | *0,05* |
| 36 | | H. | Eua | | | 2 | 3,5 | 3 | | Hieracium echioides | | | | | | + | | | | | | | | | | | | | | | | | | | + | | I | 0,03 |
| 37 | | T. | Med. | | | 0 | 0 | 4 | | Tragus racemosus | | + | + | | | | + | | | + | + | | | | + | | | | + | + | | | | + | | | II | 0,17 |
| 38 | med. | N | Eua. | | | 2 | 4,5 | 4,5 | | Ephedra distachya | + | | | + | + | | + | + | | + | | | | | + | | | + | | | | + | | + | | + | III | 0,21 |
| 39 | | | | | | | | | | **Artemision – Ko-chion** | | | | | | | | | | | + | + | + | | | | | | | | | | | | | | I | *0,05* |
| 40 | | Ch. | Eua | | | 1,5 | 4 | 4,5 | | Kochia prostrata | + | | | | | + | | | | | | | | | | + | | | | | | | | | | | I | *0,05* |
| 41 | | TH. | Eua | | | 1,5 | 4 | 4 | | Brassica elongata | | | | + | + | | + | | | | + | | | + | | | | + | | + | + | | | | | | II | 0,15 |
| | | H. | Eua | | | 2 | 4 | 4,5 | | Agropyron pectinatum | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 42 | | | | | | | | | | **Polygono-*Chenopodi-etalia albi*** | | | | | | | | + | | | | | | | | | | | | | | + | | | | | I | 0,03 |
| 43 | | T. | E. | | | 2 | 3 | 2 | | Scleranthus annuus | | | | | | | + | + | + | | + | + | + | | + | | | | | | | | | | | | II | 0,13 |
| 44 | | T. | Cp. | | | 0 | 0 | 0 | | Atriplex patula | | | | | + | | | | | | + | | | | | | | | | | | | | | | | I | 0,03 |
| 45 | | TH. | Med. | | | 2,5 | 4,5 | 4,5 | | Diplotaxis muralis | | + | | | | | | | | | | | | | + | | | | | | + | | | | | | I | *0,05* |
| 46 | tox. med. | T. | Cp. | | | 2 | 3 | 4 | | Anagallis arvensis | | | + | + | + | | | + | + | + | | | | | + | + | + | | + | + | + | + | | | | | III | 0,25 |
| 47 | | T. | Cosm. | | | 2,5 | 4 | 0 | | Setaria glauca | + | | | + | | | | | | + | | | | | | | | | | | | | | | | + | I | *0,05* |
| 48 | | T. | Eua | | | 2 | 3,5 | 0 | | Setaria viridis | | | + | | | | + | | | | + | | | | | | | | | | | | | | | | I | *0,05* |
| 49 | | | | | | | | | | **Festucietalia vale-siacae** | | + | | | | | + | | | | | | | | | | + | | | | | | | | | | I | *0,05* |
| 50 | | Ch. | Pt. | | | 1,5 | 0 | 4 | | Minuartia setacea | | + | | | | | | | | | + | | | | | | | | | | | | | | | | I | 0,03 |
| 51 | | T. | Ec. | | | 1,5 | 4 | 4 | | Minuartia glomerata | | | | | | | | | | | | | + | | | | | + | + | + | | + | | | | | I | 0,09 |
| 52 | | H. | Pt | | | 1,5 | 4 | 4,5 | | Dianthus leptopetalus | + | | | | | + | | | | | | | | | | + | | + | | | + | | | + | | + | II | 0,13 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53 | | H | Pt. | | | 2 | 4 | 4,5 | | Dianthus mebranaceus | | | | | | | | | | | | | + | + | | | | | | | | | | | | | I | 0,03 |
| 54 | | T. | Eua | | | 2,5 | 4 | 4 | | Ceratocarpus arenarius | | | | | | | | + | | + | | | + | + | | + | + | | + | | | | | | | | II | 0,13 |
| 55 | | H. | E. | | | *2* | *3* | *0* | oligo-tr. | Sedum maximum | | | | | | | | + | | | | | | + | | | | + | | | | | | | | | I | *0,05* |
| 56 | | H. | E | | N2. | 2 | 3,5 | 4,5 | oligo-tr. | Potentilla arenaria | | | | | | | | | | + | | | | | | | | | | | | | | | | + | I | 0,03 |
| 57 | med. | H. | Eua | | N1-2. | *1,5* | *3,5* | *4* | oligo-tr. | Potentilla recta | | | | | | | | | + | | + | | | | | + | | | | | | | | | | | I | *0,05* |
| 58 | med. | H. | Eua | | | 2 | 4 | 3 | mezo-tr. | Fragaria viridis | | | | | | + | | | | | | | | | | + | + | | | | | | | | | | I | *0,05* |
| 59 | med. mel. | N. | Pt | | N1 | 2 | 3,5 | 4 | oligo-tr. | Chamaecytisus au-striacus | | | | | | | | | | | | | | | | + | | + | | | | | | | | | I | 0,03 |
| 60 | | H. | Pt. | | | *1,5* | *3,5* | *4,5* | | Astragalus corniculatus | | + | + | | | | + | | | + | + | | | | + | | | | + | + | | | | + | | | II | 0,17 |
| 61 | | H. | Eua | | | 1,5 | 4 | 5 | oligo-tr. | Astragalus onobrychis | + | | | + | + | | + | + | | + | | | | | + | | | + | | | | + | | + | | + | III | 0,21 |
| 62 | | H. | Pt. | | | 1,5 | 4 | 4,5 | | Astragalus ponticus | | | | | | | | | | | + | + | + | | | | | | | | | | | | | | I | *0,05* |
| 63 | med. mel. | H. | Eua. | | | 2,5 | 0 | 0 | | Lotus corniculatus | + | | | | | + | | | | | | | | | | + | | | | | | | | | | | I | *0,05* |
| 64 | mel. | H. | Eua. | | | 2 | 4 | 4,5 | oligo-tr. | Onobrychis viciifolia | | | | + | + | | + | | | | + | | | + | | | | + | | + | + | | | | | | II | 0,15 |
| 65 | | H. | Eua. | | N1 | 1 | 3,5 | 4 | oligo-tr. | Euphorbia seguieriana | | | + | | | | | + | | | | | | | | | | + | | | | | | | | | I | *0,05* |
| 66 | | H. | Pt | | | *2* | *4* | *4,5* | | Galium humifusum | | | | | | | | + | | | | | | | | | | | | | | + | | | | | I | 0,03 |
| 67 | | TH. | Eua. | | | 2 | 4 | 4 | oligo-tr. | Scabiosa ochroleuca | | | | | | | + | + | + | | + | + | + | | + | | | | | | | | | | | | II | 0,13 |
| | | H. | Pt | | N1 | 2 | 3,5 | 4,5 | | Achillea nobilis | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 68 | | H. | E. | | | *2* | *4* | *3,5* | | Achillea pannonica | | + | | | | | | | | | + | | | | | | | | | | | | | | | | I | 0,03 |
| 69 | | T. | Eua. | | | 2 | 3 | 5 | oligo-tr. | Achillea setacea | | | | | | | | | | | | | + | | | | | + | + | + | | + | | | | | I | 0,09 |
| 70 | med. | Ch. | Eua | | | 2 | 3 | 3,5 | | Artemisia campestris | | | | | | | | | | | | | | | | | | + | | | + | | | + | | + | I | 0,07 |
| 71 | | H. | Pt | | | 1,5 | 4 | 4,5 | oligo-tr. | Echinops ruthenicus | + | | | | + | | | | | | | | + | + | | | | | | | | | | | | | I | 0,07 |
| 72 | | H. | Pt | | N1 | *2* | *4* | *4,5* | oligo-tr. | Centaurea arenaria | | | | | | | | + | | + | | | | | + | | | | | | | | | | + | | I | 0,07 |
| 73 | | H. | Eua | | N1-2. | *1,5* | *3,5* | *4* | | Poa bulbosa | | | | | | | | + | | | | | | + | | | | + | | | | | | | | | I | *0,05* |
| 74 | alim. | G. | Ec | | | 1,5 | 3,5 | 4 | oligo-tr. | Allium sphaerocephalon | | | | | | | | | | + | | | | | | | | | | | | | | | | + | I | 0,03 |
| 75 | | T. | Eua. | | N1-2. | 1,5 | 3 | 4 | oligo-tr. | Trifolium arvense | | | | | | | | | + | | + | | | | | + | | | | | | | | | | | I | *0,05* |
| 76 | mel. | H. | Ec | | | 2 | 3 | 4 | | Coronilla varia | | | | | | + | | | | | | | | | | + | + | | | | | | | | | | I | *0,05* |
| 77 | mel. | H. | Pt | | | 1,5 | 4 | 0 | | Onobrychis gracilis | | | | | | | | | | | | | | | | + | | + | | | | | | | | | I | 0,03 |
| | | H. | Pt | | | 2 | 4 | 0 | | Euphorbia agraria | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 78 | | T. | E. | | N3-4. | 2,5 | 3 | 0 | | Geranium pusillum | | | | | | | | | | | | | + | + | | | | | | | | | | | | | I | 0,03 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 79 | | H. | Eua. | | N2 | 2 | 3 | 5 | | Medicago falcata | | | | | | | | + | | | | | | | | | | | | | | + | | | | | I | 0,03 |
| 80 | | N. | Eua. | | | 2 | 4 | 4,5 | | Caragana frutex | | | | | | | | + | | | | | | + | | | | + | | | | | | | | | I | *0,05* |
| 81 | | T. | E. | | | 2 | 3,5 | 0 | | Holosteum umbellatum | | | | | | | | | | + | | | | | | | | | | | | | | | | + | I | 0,03 |
| 82 | | T. | Alt. | | | 1,5 | 4 | 3 | | Kohlrauschia prolifera | | | | | | | | | + | | + | | | | | + | | | | | | | | | | | I | *0,05* |
| | | T. | Cp. | | | 2,5 | 5 | 0 | | Arenaria serpyllifolia | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 83 | med. mel. decor. alim. | H. | Eua | | | 2,5 | 3 | 0 | oligo-tr. | Filipendula vulgaris | + | + | | + | | | | | | + | | | | | | + | | + | | | | + | + | | | | II | 0,15 |
| | med. | H. | Eua | | | 2,5 | 3 | 4 | | Agrimonia eupatoria | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 84 | | H. | Eua | | | 2 | 3,5 | 4 | oligo-tr. | Poterium sanguisorba | | | | | | | | | | | | | | | | | + | + | | | | | | | | | I | 0,03 |
| 85 | | H. | Eua | | N2 | 2 | 4 | 2 | | Potentilla argentea | | | | | | | | | | | | | + | | | | | | | | | | + | | | | I | 0,03 |
| 86 | | | | | | | | | | **Molinio-Arrhena-theretea** | + | | | | | + | | | | | | | | | | + | | | | | | + | | + | | | I | 0,09 |
| 87 | | TH. | Eua. | | N2-3 | 2,5 | 3 | 0 | | Daucus carota | | + | | | | | + | | | | | | | | | | + | | | 1 | | | | | | | I | 0,63 |
| 88 | med. | H. | Eua. | | | 2,5 | 0 | 4,5 | | Plantago media | | | | | | + | | | | | + | | | | | | | | | | + | | | | | | I | *0,05* |
| 89 | | H. | Circ. | | | 2 | 4 | 5 | | Koeleria cristata | | | | | | | + | | | | | | | | | | | | | | | | | | + | | I | 0,03 |
| | | G. | Eua | | | 2 | 3 | 0 | | Calamagrostis epigeios | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 90 | tox. | H. | Eua | | | 0 | 3,5 | 4 | olig-otr. | Linum perenne | | + | | + | | | | | + | | | | + | + | | | + | | + | | | | | + | | | II | 0,15 |
| 91 | | | | | | | | | | **Puccinellio-Salicor-nietea** | | | | | | | | + | | | | | | | | | | | | | + | | | | | | I | 0,03 |
| 92 | | Ch. | Eua | hal. | | 2,5 | 4 | 0 | | Artemisia santonica | | | | | | | | + | | | | | | + | | | | + | | | | | | | | | I | *0,05* |
| | | | | | | | | | | **St Stellarietea Mediae** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 93 | | T. | Eua | | | 1,5 | 3,5 | 4 | | Bromus japonicus | | | | | | | | | + | | + | | | | | + | | | | | | | | | | | I | *0,05* |
| 94 | | T. | Eua | | N3-4 | 2,5 | 3 | 0 | | Hordeum murinum | | | + | + | | | | | | | | | | | | | | | | | | | | | | | I | 0,03 |
| 95 | | T. | Ec | | | 1,5 | 4 | 4 | | Phleum paniculatum | + | | | | | + | | | | | | | | | | + | | | | | | + | | | | | I | 0,07 |
| 96 | | Th. | Eua | | | 2 | 4 | 4 | | Consolida paniculata | | | | + | | | | | + | | | | | | | | | | + | | | + | | | | | I | 0,07 |
| 97 | med. | Th. | Th. | | | 2 | 4 | 4 | | Consolida regalis | | | | | | | + | | | | | | | | | | | | | | + | | | | | | I | 0,03 |
| 98 | | Th. | Pont | | | 2 | 4 | 4 | | Nigella arvensis | | | + | | | | + | | | | | | | | | | | | | | 1 | | + | | | | I | 0,63 |
| 99 | med. tox. orn. | H. | Eua | | | 2 | 3,5 | 4 | | Adonis vernalis | | + | | | | | + | | | | + | | | | | + | | | | | | | | | | + | I | 0,09 |
| 100 | tox. | T. | Med. | | | 2 | 4 | 3 | | Glaucium corniculatum | | | + | | + | | | | | + | | | | | | | | | | + | | | | | | | I | 0,07 |
| 101 | aromat. | H. | Cosm. | | N3-4 | 2,5 | 3 | 0 | | Verbena officinalis | + | | | | | + | | | | | | | | | | + | | | | | | | | | | | I | 0,05 |
| 102 | mel. | H. | Ec. | | N4 | 2 | 3,5 | 4 | | Ballota nigra | | | | | | + | | | | | | | | | | | | | + | | | | | | | | I | 0,03 |
| 103 | | Th. | Pt. | | | 1,5 | 4 | 4 | | Verbascum ovalifolium | | + | | | | | + | | | | | | | | | | + | | | | | | | | | | I | *0,05* |
| 104 | | T. | Eua. | | | 2,5 | 3 | 3 | | Veronica arvensis | | | | | | | | | + | | | | | + | | | | | | | | | | + | | | I | *0,05* |
| 105 | | T. | Adv. | | | 2,5 | 0 | 0 | | Erigeron canadensis | + | | | | | | | | | | | | | | | | | | | + | + | + | | | | + | I | 0,09 |
| 106 | med. | T. | Adv. | | N3-4 | 2,5 | 4 | 0 | | Xanthium spinosum | + | 1 | | + | | | | | | + | | | | | | | | | | | | | | | | + | I | 0,26 |
| 107 | | T. | Eua. | | | 2,5 | 4 | 0 | | Senecio vernalis | | + | | | | + | | | | + | | | | | | | | | | | | | | | | | I | *0,05* |
| 108 | alim. | T. | Eua. | | | 2,5 | 3 | 3 | | Sisymbrium officinale | | | | | | | | | | + | | | | | | | | + | | | | | | | | | I | 0,03 |
| 109 | | H. | Ec. | | | 2 | 4 | 0 | | Diplotaxis tenuifolia | | + | | | | | | | | | + | | | | | | | | | | | | | | | | I | 0,03 |
| 110 | mel. | T. | E. | | | 2,5 | 3,5 | 2,5 | euritr. | Vicia villosa | | | | | | | | | | | | | + | | | | | + | + | + | | + | | | | | I | 0,09 |
| 111 | aromat. med. | Th. | Eua. | | N2 | 2,5 | 3 | 0 | | Melilotus albus | | | | | | | | | | | | | | | | | | + | | | + | | | + | | + | I | 0,07 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 112 | mel. aromat. med. | Th. | Eua. | | | 2,5 | 3,5 | 0 | euritr. | Melilotus officinalis | | | | | | | | + | | + | | | | | + | | | | | | | | | | + | | I | 0,07 |
| | | | | | | | | | | **Artemisietea vulgaris** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 113 | med. alim. | H. | Cp. | | N3-4 | 2,5 | 3 | 4 | | Artemisia vulgaris | | | | | | | | | + | | + | | | | | + | | | | | | | | | | | I | *0,05* |
| 114 | med. | G. | Cp | | | 0 | 0 | 0 | | Elytrigia repens | | | + | + | | | | | | | | | | | | | | | | | | | | | | | I | 0,03 |
| | | | | | | | | | | **Diverse** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 115 | med. | T. | Cp. | | | 2,5 | 3 | 3 | | Fallopia dumetorum | + | | | | | + | | | | | | | | | | + | | | | | + | | | | | | I | 0,07 |
| 116 | med. decor. tox. | M. | Eua. | | | 2 | 4 | 4,5 | me-zotr. | Amygdalus nana | | | | | | | + | | | | | | | | | | | | | + | | | | | | | I | 0,03 |
| 117 | | N. | E. | | | 2,5 | 3 | 3 | | Rosa corymbifera | | | + | | | | + | | | | | | | | | | | | | | | + | | | | | I | *0,05* |
| 118 | med. alim. mel. | M. | E | | | 2 | 3 | 3 | me-zotr. | Prunus spinosa | | | | | | | | | | | | | + | | | | | + | | | | | | | | | I | 0,03 |
| 119 | tox. | T. | Eua. | | | 0 | 3 | 0 | | Cuscuta lupuliformis | | | + | | | | | | | + | | | | | | | | | | | | | | | | | I | 0,03 |
| 120 | | H. | Pt. | | | 1,5 | 4,5 | 4,5 | | Achillea coarctata | + | | | | | + | | | | | | | | | | + | | | | | | | | | + | | I | 0,07 |
| 121 | | G. | Pt. | | | 2 | 4 | 0 | | Gymnospermium odessanum | | | | | | + | | | | | | | | | | | | | + | | | | | | | | I | 0,03 |
| 122 | med. | T. | Eua. | | | 2,5 | 4 | 4 | eutr. | Hibiscus trionum | | | | | | | | | | | | | | | + | | | | | | + | | | | | | I | 0,03 |
| 123 | | H. | Eua. | | | 2,5 | 4 | 4 | me-zotr. | Viola suavis | + | + | + | | + | | | | | | | | | | | | | | | | | | | | | | I | 0,07 |
| 124 | med. | H. | Pt. | | | 2,5 | 4 | 0 | | Cynanchum acutum | | | | | + | | | | + | | | | | | | | | | | | | | | | + | | I | *0,05* |
| 125 | med. mel. | M. | Eua. | | | 2,5 | 3 | 3 | | Ligustrum vulgare | | | + | | + | | | | | + | | | | | | | | | | | | | | | | | I | *0,05* |
| 126 | med. alim. mel. | H. | Eua. | | | 2 | 3 | 3 | | Origanum vulgare | | + | | | | | | | | | | | | | | | | | | | | + | | | | | I | 0,03 |
| 127 | | T. | Eua- | | | 1 | 3 | 0 | olig-otr. | Filago arvensis | | | | | | | + | | | | | | | | | | | | | + | | | | | | | I | 0,03 |
| 128 | med. mel. | G. | Eua | | | 0 | 3 | 4 | | Tussilago farfara | | | | | + | | | | | | | | | | | | + | | | | | | | | | | I | 0,03 |
| 129 | tox. | H. | Eua | | | 0 | 4 | 4,5 | | Lactuca tatarica | | | + | | | | | | | | + | | | | | | | | | | | | | | + | | I | *0,05* |
| 130 | tox. | H. | Eua | | | 1,5 | 4 | 5 | | Adonis wolgensis | + | + | | + | | | | | | | | | | | | | | | | | | | | | | | I | *0,05* |
| 131 | med. orn. | M. | Eua. | | | 0 | 3,5 | 4 | | Tamarix ramosissima | | | | + | | | | + | | | | | | | | | | | | | | | + | | | | I | *0,05* |
| 132 | orn. | M. | Adv. | | | 0 | 0 | 0 | | Ailanthus altissima | | | | | + | | + | | | | | + | | | | | | | | | | | | | | | I | *0,05* |
| 133 | | T. | E. | | | 2,5 | 4 | 3 | | Papaver argemone | + | | + | | | | | + | | | | | | | | | | | | | | | | | | | I | *0,05* |
| 134 | med. | T. | Eua. | | | 2,5 | 4 | 4 | | Fumaria schleicheri | | | | | | + | | | | + | | | | | | + | + | | + | | | | | | | | I | 0,07 |
| 135 | | MM | Adv. | | | | | | | Elaeagnus angustifolia | | + | | + | | | | | + | | | | | | | | | | + | | | + | | | | | I | 0,09 |
| 136 | | H. | Pt. | | | 1,5 | 4 | 4 | | Galium volhynicum | + | | + | | | | | | + | | | | + | | | | | | | + | | + | | | | | II | 0,11 |
| 137 | | N. | Med. | | | 2,5 | 4 | 0 | | Rubus canescens | | + | | | | + | | | | | | | + | | | | | | | | | | | | | | I | *0,05* |
| 138 | med. tox. | G. | Med. | | | 2,5 | 3,5 | 5 | | Aristolochia clematitis | | | | | | | | | | | + | | | | + | | | | | | + | | | | | | I | *0,05* |

Place and data of relevees:

**1**- s. Vadul lui Isac, r. Cahul, lat :45.765356° long 28.189253°, 03.04.2008; **4, 7** - s. Brânza, r. Cahul, lat : 45.659102° long 28.174737°, 23.06.2008; **9, 12** - s. Colibași, r. Cahul, lat : 45.692954° long 28.180926°, 26.06.2009; **15, 16** - s. Văleni, r. Cahul, lat : 45.609913° long 28.169503°, 01.07.2009; **19, 20, 23, 25, 28** - s. Slobozia Mare, r. Cahul, lat : 45.593706° long 28.163971°, 03.07.2009; **29, 30, 45, 67** - s. Câşliţa Prut, r. Cahul, lat : 45.528251° long 28.169913°, 08.07.2009; **98, 103, 106, 112** - s. Giurgiuleşti, r. Cahul, lat : 45.505240° long 28.554237°, 24.06.2009; **134**, - s. Ciumai, r. Taraclia, lat : 45.786593° long 28.554383°, 24.06.2010; **157, 178** – s. Etulia, r. Vulcăneşti, lat : 45.542736° long 28.449097°, 23.06.2010; **183, 195** - s. Cişmichioi, r. Vulcăneşti, lat : 45.539074° long 28.368404°, 25.07.2010; **196** - s. Alexandru Ioan– Cuza, r. Vulcăneşti, lat : 45.564443° long 28.449451°, 21.07.2010.

# SEMI-DESERT STEPPES VEGETATION COMMUNITIES OF YELLOW BLUESTEM (BOTRIOCHLOETUM ISCHAEMI) IN THE REPUBLIC OF MOLDOVA

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**Summary.** *This paper presents phytosociological survey of semidesert steppes belonging to the Festuco-Brometea class (As. Taraxaco serotinae – Botriochloa ischaemum* **(***Burduja et al., 1956) Sârbu, Coldea et Chifu 1999 Syn.: ass. Botriochloa ischaemum Burduja et al., 1956 (art. 2b, 36); Botriochloa ischaemum moldavicum Dobrescu 1971 (art. 34); Non: Botriochloetum ischaemi (Krist 1937), (I. Pop 1977), described in phytocenological table and analysed by bioforms, floristic elements, and ecological indices. This phytosociological survey was carried out based on (Braun-Blanquet, Borza A., Boşcaiu N.) methods. The association of Botriochloa ischaemum is represented by steppes xerophile vegetation.*

## Introduction

Plant communities of *Botriochloa ischaemum* are widespread in the territory of three districts (Vulcăneşti, Cahul and Taraclia) in the semi-desert steppes from the southern part of Moldova. Our study has covered the *Botriochloa ischaemum* vegetation along the river course Prutul-Inferior, Cahul and protected area Ciumai-Vinogradovca. The substrate consists of clay and loess deposits. The territory is characterized by hilly relief and several valleys and it is characterized by a temperate continental climate, with dry and cold winters and hot or even very hot and dry summers. Regarding the relief induced by action of exogenous processes they display next morphosculptures types: fluvial, denudational and anthropical. Its development was favoured by the presence of sand and rock clusters on account of which thick deluvial covers were formed. We have realized the phytosociological study during the period of 2007-2011, that had as a result the identification of species and plant communities.

## Materials and methods

Our research was performed in the period of 2007 – 2011 when several field trips have been carried out in the semi-desert steppes areas, in order to study *Taraxaco serotinae – Botriochloa ischaemum* association. The phytosociological surveys were based on (Braun-Blanquet, *Borza A., Boşcaiu N.***)** methods based on the principles of the Central-European floristic phytocoenologic school.

## Results and discussions

The ecology and phytocoenological characterisation: *Taraxaco serotinae – Botriochloa ischaemum* association is widespread in the steppe zones as secondary vegetation type in semi-desert steppes, developing mostly on base rich terrains and river valley. The floristic composition of the association is rich comprising 59 species and is characteristic to the class Festuco – Brometea. The spectrum of the bioformes is dominated by hemicryptophytes with 40,67%, followed by therophytes with 32.20%, geophytes with 15.25% , terophytes biennial 11,86%, chamaephytes one species. The analysis of the phytogeographic elements displays high frequencies of euriasiatic element with 32,20% and pontic species 24.63%, followed by european 7.97%, central-european and mediterranean species, each with 5.0%, cosmopolite 1,44%, circumpolar and atlantic represented by one species. The analysis of the ecologic spectra indicates the dominance of xeromesophytes species 61,0%, followed by xerophytes 35.59% and one species 6,52% represented by amphytolerant species. The thermic factor is predominated temperate-thermophile 62,72%, microtherm 25,42%, thermophile 6,77% and amphytolerant 3,38%. According to soil reaction the most of species are slightly acid-neutrophilious 67,79%, euryionics 15,25%, acid-neutrophilious 13,35%, neutrobasiphile and acidophile represented by one species. Trophic soil reaction is represented by oligotrophic 23,72%, euritrophic and eutrophic one species. The most numerous, ensured with nutritive elements, are plants species of poor soil N2 – 8,47%, very poorly supplied N1 – 6,27%, and medium soil N3 - 3,38%. The analysis of economical plant importance show the dominance of medicinal plant species with 15,24% followed by melliferous 10,16%, alimentary 5,0% and toxic 3,3%.

## Conclusions

The floristic composition of *Taraxaco serotinae –Botriochloetum ischaemi* is represented by pioneer plant communities in the studied area, reflecting local conditions of the grassland semi-desert steppes, that confirms species dominant class Festuco-Brometea. The dominance of hemicryptophytes over 40,67% and the high percentage of euriasiatic element 32,20% and pontic species 24.63% species show the affiliation to the euroasiatic area. From the analysis of ecologic elements spectrum we may observe the dominance of xeromesophytes species 61,0% and of temperate-thermophile with 62,72%. The development of succession processes of vegetation communities *Taraxaco serotinae – Botriochloetum ischaemi* increases differentiation of the floristic composition and structure

Table

As. **Taraxaco serotinae – *Botriochloa ischaemum* (**Burduja et al. 1956) Sârbu, Coldea et Chifu 1999

Syn.: ass. *Botriochloa ischaemum* Burduja et al. 1956 (art. 2b, 36); *Botriochloa ischaemum moldavicum Dobrescu 1971*(art. 34);

Non: *Botriochloetum ischaemi ( Krist 1937) I. Pop 1977*

| Nr | Economical plant importance | Bioformes | Phytogeographic elements | Categorii ecologice | | | | | | Nr. relevees | 1 | 4 | 7 | 9 | 12 | 15 | 16 | 19 | 20 | 23 | 25 | 28 | 29 | 30 | 45 | 67 | 98 | 103 | 106 | 112 | K | ADm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Halophyte | Nutritive elements | U | T | R | Trophic reaction | Surface (mp) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | | |
| | | | | | | | | | | Covering (%) | 80 | 90 | 70 | 90 | 90 | 90 | 95 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 80 | 90 | 90 | 90 | 90 | | |
| 1 | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | |
| | | | | | | | | | | *Car. de as.* | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | H. | Eua. | | | 1,5 | 5 | 3 | | Bothriochloa ichaemum | 3 | 5 | 4 | 3 | 4 | 3 | 3 | 4 | 5 | 4 | 3 | 5 | 4 | 3 | 3 | 3 | 4 | 3 | 3 | 4 | V | 53,75 |
| | | | | | | | | | | **Festucion valesiacae** | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | T. | Pt. | | | 0 | 3,5 | 3 | oligotr. | Trifolium diffusum | | | | + | | | + | | + | | | | + | | | + | | | | | II | 0,12 |
| 3 | | H. | Pt. | | | 2 | 4 | 4 | oligotr. | Viola ambigua | | | | | + | | + | | | | | | + | | | | + | | | | I | 0,1 |
| 4 | med. | TH. | Eua. | | | 2 | 3 | 0 | | Reseda lutea | 1 | | + | | | | | + | | | | | | + | | | | | | | I | 0,32 |
| 5 | med. | H. | Pt. | | N1 | 2 | 5 | 4 | | Vinca herbacea | | | | + | | | | | | | | + | | | | | + | 1 | | | I | 0,32 |
| 6 | | T. | Pt. | | | 2,5 | 4 | 4,5 | | Ajuga chia | | | | | | + | | | | + | | | | | | | | + | | | I | 0,07 |
| 7 | | H. | Pt. | | | *2* | *4* | *4,5* | | Taraxacum serotinum | | | | + | | | | | | | | + | | | + | | | + | | | I | 0,1 |
| 8 | | TH. | Pt. | | | 2 | 4 | 4 | | Verbascum speciosum | | | | | | | + | | + | | | | | | | | | | + | | I | 0,07 |
| 9 | | T. | Med. | | | *1,5* | *5* | *4* | | Valerianella coronata | | | | | | | + | | | + | | | | | | + | | | | | I | *0,07* |
| 10 | | H. | Pt. | | | 1,5 | 4 | 4,5 | oligotr. | Cephalaria uralensis | + | | | + | | | | | + | | | | + | | + | | + | | | | II | 0,15 |
| 11 | | H. | E. | | | 2,5 | 3 | 0 | euritr. | Knautia arvensis | | + | | | | + | | | | | | + | | | | | + | + | + | | II | 0,15 |
| 12 | med. mel. | Ch. | Eua. | | N1 | *2* | *4* | *4,5* | | Artemisia austriaca | | | | + | | | + | | | | + | | | | | | + | | + | | II | *0,12* |
| 13 | | T. | Pt. | | | 2 | 4 | 3 | oligotr. | Xeranthemum annuum | | | | 1 | | | | + | | + | | | | + | | | | | + | + | II | 0,37 |
| 14 | | H. | Pt. | | | 2 | 3,5 | 4 | | Jurinea calcarea | + | + | | | | | + | | | | + | | + | + | | + | | | | | II | 0,17 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | | H. | Pt. | | | 2 | 3,5 | 4 | | Jurinea mollissima | | | | | | | + | | + | + | | | | | | | | + | + | + | II | 0,15 |
| 16 | | TH. | Pt. | | | 2 | 4 | 2 | oligotr. | Carduus hamulosus | | | 1 | | | | | + | | | + | + | | + | | + | | | | | II | 0,37 |
| 17 | | G. | Pt. | | | 1,5 | 4 | 4 | | Gagea taurica | | | | + | | | + | | + | | + | | | + | | + | | + | | + | II | 0,2 |
| 18 | | G. | Pt. | | | *2* | *3,5* | *4* | | Ornithogalum amphibolum | | + | | | | | + | + | | | + | | + | | | | + | | | | II | *0,15* |
| 19 | | G. | Pt. | | | 1 | 4 | 4,5 | oligotr. | Allium guttatum | + | + | | + | | + | | + | | | | | | | + | | | | + | 1 | II | 0,42 |
| 20 | | G. | Med. | | N1 | 1,5 | 4,5 | 4 | oligotr. | Sternbergia colchiciflora | | | | | | + | | | | + | + | | | | | | + | | | | I | 0,1 |
| 21 | | H. | Eua. | | N2 | 1,5 | 4 | 4 | | Festuca rupicola | | + | + | | + | | | | | + | + | | | + | + | | | | | + | II | *0,2* |
| 22 | | G. | Pt. | | | 1 | 4 | 4 | | Cleistogenes bulgarica | | | + | | | | | | + | | | + | | + | + | | | | | | I | 0,12 |
| 23 | | G. | Pt. | | | 2 | 4 | 4,5 | | Bellevalia sarmatica | | | | | | | | | + | | | | | + | | | + | + | | + | II | 0,12 |
| 24 | tox. | T. | Eua. | | | 2 | 4 | 4,5 | | Ceratocephala testiculata | + | + | | | | | 1 | + | | + | + | | + | | | + | | + | + | | III | 0,47 |
| | | | | | | | | | | **Festucion vaginatae** | | | | | | | | | | | | | | | | | | | | | | |
| 25 | | T. | Eua. | | | 1,5 | 4,5 | 4,5 | | Kochia laniflora | 1 | + | | + | | + | | | + | + | | | + | | + | | | | | + | III | *0,45* |
| 26 | | T. | Eua. | | | 2 | 4 | 4,5 | | Salsola ruthenica | + | | | | | | | | | + | 1 | | | | | | | + | | | I | 0,32 |
| 27 | | H. | Eua. | | | 1,5 | 4 | 4,5 | oligotr. | Astragalus varius | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | **Sisymbrion officinalis** | + | + | + | | | | + | | + | | + | | | 1 | | + | | | 1 | | III | 0,67 |
| 28 | | T. | Eua. | | | 2,5 | 4 | 4,5 | | Erysimum repandum | + | + | | | | | + | | | | + | | | | | | + | | | | II | 0,12 |
| 29 | | T. | Adv. | | | 2,5 | 4 | 0 | | Xanthium italicum | | | | + | | | | | | + | | | | | | | | | + | + | I | 0,1 |
| | | | | | | | | | | **Festucetalia vaginatae** | | | | | | | | | | | | | | | | | | | | | | |
| 30 | med. decor. | H. | Eua. | | | *2,5* | *4* | *3,5* | oligotr. | Helichrysum arenarium | | | | + | + | | | + | | | + | | | + | | + | | | | + | II | 0,17 |
| 31 | | T. | Eua. | | | 2,5 | 0 | 0 | | Crepis tectorum | | | + | | | | | | | + | | | | | | + | | + | | | I | 0,1 |
| | | | | | | | | | | **Festucetalia valesiacae** | + | | | | + | | + | | | | + | | | | | | | | + | | I | 0,12 |
| 32 | | H. | Pt. | | | 2 | 4 | 4,5 | | Dianthus mebranaceus | | | | + | | | | | | + | | | | | | | | | | | I | 0,05 |
| 33 | | T. | Eua | | | 2,5 | 4 | 4 | | Ceratocarpus arenarius | | + | + | | | | + | | + | + | + | | | | + | | | | | + | II | 0,2 |
| 34 | | H. | E. | | | 2 | 3 | 0 | oligotr. | Sedum maximum | + | | | + | | | + | | | | | | | | + | | | + | | | II | 0,12 |
| 35 | | H. | E | | N2 | 2 | 3,5 | 4,5 | oligotr. | Potentilla arenaria | | | | | | | + | | | | + | | | | | | + | | | | I | 0,07 |
| 36 | | H. | Ec | | | 2 | 4 | 5 | oligotr. | Linum tenuifolium | + | | | | | | | | | | | + | | | | | | + | | | I | 0,07 |
| 37 | med. mel. | T. | Eua. | | N1 | 1,5 | 3 | 4 | | Erysimum diffusum | | | | + | + | | | | | | + | | | + | | | | | | + | II | 0,1 |
| 38 | | H. | Pt. | | | 1,5 | 4 | 4,5 | | Convolvulus lineatus | | | + | | | + | | | + | | | | | | | | | | | | I | 0,07 |
| 39 | mel. | H. | Pt. | | | 1,5 | 4,5 | 4 | | Anchusa italica | | | | + | | | | + | | | | + | | | | | | + | | | I | 0,1 |
| 40 | | T. | Eua. | | | 2 | 4 | 4 | | Sideritis montana | | | | | | | + | | + | | | + | | | + | | | | | | I | 0,1 |
| 41 | | TH. | Pt. | | | 1,5 | 4 | 4,5 | | Centaurea besseriana | | | | | + | | | + | | | | | + | | | | | | + | | I | 0,1 |
| 42 | | H. | Pt. | | | 1,5 | 4 | 4,5 | | Centaurea trinervia | | + | | | | | | | | | | | + | | | | | | + | | I | 0,07 |
| 43 | | H. | Eua. | | | 1,5 | 3,5 | 4 | | Chondrilla juncea | | | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44 | | G. | Pt. | | | 1,5 | 4 | 4,5 | | Allium flavescens | + | | | | + | + | | | | | | + | | | | | | | | | I | 0,1 |
| 45 | | G. | Pt. | | | 1,5 | 4 | 4 | | Allium paniculatum | | | + | | | | + | + | | | | | + | | | | | | | | I | *0,1* |
| | | | | | | | | | | ***Festuco-Brometea*** | | + | | | | + | | | | | | + | | | | | + | | | | I | 0,1 |
| 46 | | TH. | Eua. | | N2 | 2,5 | 3 | 4 | | Medicago lupulina | | + | | | + | | | | | | | | | | | | | | + | | I | 0,07 |
| 47 | | T. | sMed. | | N2 | *1,5* | *4* | *4* | oligotr. | Medicago minima | | | + | | | | | | | | | | + | | | | | | | + | I | 0,07 |
| 48 | mel. | H. | Pt. | | | 1 | 5 | 4 | oligotr. | Eryngium campestre | + | | | | | + | | | | | | | | | | | | + | | | I | 0,07 |
| 49 | med. alim. | H. | E. | | | 2,5 | 0 | 3 | | Pimpinella saxifrage | + | | | | + | | | | | | | | | + | | | | | | | I | 0,07 |
| 50 | med. mel. | G. | Cosm. | | | 2,5 | 2,5 | 3,5 | eutr. | Convolvulus arvensis | | | | | | | | | | | | | | | | | | | | | | |
| 51 | med. tox. | TH. | H. | | | 2 | 3 | 4 | | Echium vulgare | | | | | | | | + | | | | | | | | | | + | | | I | 0,05 |
| 52 | med. mel. | H. | Pt. | | | 2 | 4 | 3 | | Stachys germanica | + | | + | | | | + | | | + | | | | | | + | | | | | II | 0,1 |
| | | | | | | | | | | **Stellarietea Mediae** | | | | | | | | | | | | | | | | | | | | | | |
| 53 | | H. | Pt. | | | 1,5 | 4 | 4 | | Centaurea stereophylla | | + | | + | | | | + | | | + | | | | | | + | | | | II | 0,12 |
| 54 | | TH. | Eua. | | N2-3 | 1,5 | 3,5 | 0 | | Lactuca serriola | | | | | | | | | | | | | | | | + | | + | | | I | 0,05 |
| 55 | | T. | sMed. | | | 2 | 4 | 0 | | Heliotropium europae | | + | | | | | + | | | | + | | | | | | | | | + | I | 0,1 |
| 56 | | T. | Eua. | | | 2 | 3,5 | 4 | | Lappula squarosa | + | | | | | | | | | + | | | | | + | | | + | | | I | 0,07 |
| 57 | | T. | Adv. | | | *2* | *4* | *0* | | Amaranthus blitoides | | | | | | | | | | | + | | + | | | | | | | | I | *0,05* |
| 58 | alim. | T. | Eua. | | *N3* | *2* | *3,5* | *0* | | Sisymbrium altissimum | + | | | | | | | | | | | | | | | + | | | | | I | *0,05* |
| 59 | alim. | T. | Eua. | | N3 | 2,5 | 4 | 3 | | Sisymbrium loeselii | | | | | | | + | | | | | | | | | | | | | + | I | 0,05 |

Place and data of relevees:

**5,8** - s. Vadul lui Isac, r. Cahul, lat : 45.764219° long 28.181442°, 04.04.2008;
**13, 17** - s. Brânza, r. Cahul, lat : 45.658964° long 28.174891°, 22.06.2008;
**18, 22, 26, 34** - s. Văleni, r. Cahul, lat : 45.609913° long 28.169503°, 02.07.2009;
**37, 49, 23, 68, 77** - s. Slobozia Mare, r. Cahul, lat : 45.563840° long 28.162465°, 08.07.2009;
**89, 110** - s. Câşliţa Prut, r. Cahul, lat : 45.523455° long 28.167927°, 08.07.2009;
**122, 148** - s. Giurgiuleşti, r. Cahul, lat : 45.497853° 28.177106°, 04.06.2009;
**176** - s. Ciumai, r. Taraclia, lat : 45.788790° long 28.554706°, 23.06.2010;
**179** - s. Etulia, r. Vulcăneşti, lat : 45.520115° long 28.432646°, 25.06.2010;
**190** - s. Cişmichioi, r. Vulcăneşti, lat : 45.540844° long 28.364138°, 25.07.2010;
**194** - s. Alexandru Ioan– Cuza, r. Vulcăneşti, lat : 45.566908° long 28.447146°, 21.07.2010.

of phytocoenoses of Pontic-mediterranean to steppe and semi-desert steppes, as well as the connection with the neighboring arid land territories.

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## STRUCTURA TAXONOMICĂ ŞI DISTRIBUȚIA ALGOFLOREI ÎN BAZINELE ACVATICE DIN MOLDOVA

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**Summary.** *This article is present study results of taxonomical structure and distribution Moldova basins algoflora. It was detected 1571 the species and interspecific taxonomic unites, with predominance phylum Bacillariophyta – 511, Chlorophyta – 480, Cyanophyta – 289 the Euglenophyta – 197. All other phylum's combined together only 9% of the total number of species detected. The most varied composition of algae was found in rivers and accumulation basins but the poorest in meadow's lakes of Dniester.*

Algoflora bazinelor acvatice din R.Moldova în linii generale este satisfăcător studiată. Primele publicații destre algoflora Moldovei apar spre sfârşitul secolului XIX şi începutul sec. XX (Срединский, 1973; Дорофеев, 1926; Хмелевский, 1885; Егерман, 1925; Свиренко, 1926; Аксентьев, 1926; Иванов, 1953, 1954). Lucrările numite aici erau consacrate studierii algoflorei unor bazine mici din împrejurimile or. Chişinău, sectorului inferior al Nistrului şi  unor lacuri din lunca lui. În toate aceste publicații erau nominalizate circa 100 specii de alge.

Studierea planificată a algoflorei tuturor tipurilor de bazine a început în anii ’50 al sec. XX din insistența  şi cu susținerea permanentă a mult regretatului director al Institutului de Zoologie a AŞM, academicianului M. Ярошенко.

Pe parcursul a circa 50 de ani a fost studiată algoflora Nistrului, bazinelor de acumulare Dubăsari, Novodnevstrovsc şi lacurilor din lunca lui, Prutului şi bazinului de acumulare Costeşti-Stânca, afluenților Nistrului şi Prutului, bazinelor de acumulare mici şi circa 220 iazuri din toate zonale botanico-geografice  ale Republicii Moldova. O deosebită atenție la primele etape de cercetare s-a acordat inventarizării componenței specifice, distribuției speciilor de alge în diferite tipuri de bazine şi evidențierii factorilor care contribuie atât la răspândirea speciilor, cât şi la intensitatea dezvoltării speciilor reprezentative (Шаларь, 1963, 1971, 1972, 1984; Шаларь, Боля, 1973; Обух, 1963, 1996; Ector Sances, 198; Charl, Abba, 1992; Mohamed Ali, 1994; Ungureanu, 1985; Grabco, 2003; Nedbaliuc, 1994; Ungureanu, 2011; Danilov, 1979, 1997 ş.a.).

În rezultatul investigațiilor autorilor menționați efectuate pe parcursul a peste 50 de ani în algoflora acvatică a R. Moldova au fost evidențiate circa 1600 specii şi unități taxonomice intraspecifice. Repartizarea acestor unități taxonomice pe ranguri clasificaționale este elucidată în tabelul 1.

Tabelul 1

**Structura taxonomică a algoflorei acvatice din R. Moldova**

| *Încrengătura* | *Clase* | *Ordine* | *Familii* | *Genuri* | *Specii şi unități intraspecifice* |
|---|---|---|---|---|---|
| Cyanophyta | 3 | 6 | 23 | 48 | 289 |
| Rhodophyta | 2 | 2 | 4 | 4 | 7 |
| Cryptophyta | 1 | 1 | 1 | 3 | 9 |
| Bacillariophyta | 2 | 5 | 12 | 48 | 511 |
| Crysophyta | 3 | 5 | 7 | 11 | 20 |
| Dinophyta | 1 | 3 | 3 | 7 | 17 |
| Xantophyta | 2 | 2 | 3 | 16 | 34 |
| Euglenophyta | 1 | 1 | 3 | 10 | 197 |
| Chlorophyta | 5 | 7 | 19 | 144 | 480 |
| Charophyta | 1 | 2 | 3 | 3 | 7 |
| Total | 21 | 33 | 78 | 293 | 1571 |

După cum reiesă din datele acestui tabel, în algoflora acvatică a Moldovei au fost identificate 1571 reprezentanți incluşi în 10 încrengături constituite din 21 clase, 33 ordine, 78 familii şi 293 genuri.

În ceea ce priveşte varietatea speciilor se evidenţiază 4 încrengături: *Cyanophyta* cu 289 specii şi unităţi taxonomice intraspecifice; *Bacyllariophyta* – 511; *Euglenophyta* – 197 şi *Chlorophyta* – 480.

Cele mai valoroase familii după varietatea speciilor sunt: *Naviculaceae* cu 236 specii şi unităţi taxonomice intraspecifice, *Euglenaceae* – 187, *Oscillatoriaceae* –141, *Nitzschiaceae* – 130, *Scenedesmaceae* – 120, *Fragilariaceae* – 72, *Chlamydomonaceae* – 52, *Ankistrodesmaceae* – 40, *Cosmodiscaceae* – 36 şi *Surirellaceae* – 36. După cum vedem, cele mai bogate în specii sunt familiile din încrengatura *Bacillariophyta*, care constituie 50% din cele 10 familii valorose. Câte o singură familie se referă la *Euglenophyta* şi *Cyanophyta,* şi 3 familii din încrengătura *Chlorophyta.*

Cele mai bogate în specii sunt genurile *Nitzschia* – 122, *Scenedesmus* – 87, *Navicula* – 80, *Oscillatoria* – 75, *Trachelomonas* – 64, *Euglena* – 47. Aceste 6 genuri cuprind 468 specii şi unităţi taxonomic intraspecifice, sau 23% din numărul total de specii. Încă 10 genuri includ de la 18 până la 40 specii. Aceste genuri sunt: *Cymbella* – 33, *Gomphonema* – 36, *Synedra* – 30, *Fragilaria* – 18, *Achnanthes* – 20, *Closterium* – 33, *Cosmarium* – 33, *Surirella* – 25, *Lyngbya* – 27. Împreună toate aceste 10 genuri întrunesc 272 specii, sau 17% din numărul total de specii. De aici observăm că 16 genuri din cele 294 din algoflora Moldovei întrunesc 37% din speciile şi unităţile taxonomice intraspecifice depistate până acum. Celorlalte 278 de genuri le revin doar 63% din componenţa speciilor de alge acvatice. E de menţionat faptul că 164 genuri întrunesc de la 2 până la 20 specii şi unităţi taxonomice intraspecifice, iar 107 genuri sunt monotipice. Toate acestea ne vorbesc despre caracterul instabil al componenţei algoflorei acvatice din Moldova, în care se întâlnesc cele mai diverse tipuri taxonomice, biologice, ecologice etc.

O asemenea corelaţie dintre grupele taxonomice demonstrează situaţia nestisfăcătoare a calităţii apei din bazinele acvatice. Merită atenţie faptul că printre reprezentanţii acestor încrengături multe specii, care se referă la grupa de indicatori ai zonei β şi β-α - mezosaprobe, se dezvoltă ambundent, provocând fenomenul "înfloririi" apei cu consecinţe negative atât din punct de vedere ecologic, cât şi economic. Din cele 1571 specii şi unităţi taxonomice intraspecifice identificate în bazinele acvatice din Moldova circa 180 în anumite condiţii se dezolvă abundent modificând putermic calitatea apei (Şalaru V.M., Şalaru V.V., 2011). O grupă de specii ca, de exemplu cianofitele *Microcystis aeruginosa, Aphanizomenom flos – aquae, Anabaena spiroides,* unele specii din genurile *Anabenopsis, Oscillatoria; diatomeele: Melosira granulata, M. italica, Stephanodiscus astraea var. minutulus Cyclotella knetzinghiana, C. meneghiniana,* unele specii din

g. *Nitzschia, Navicula, Rhoicosphenia, Cymbella, Coccnies, Achmanthes* etc.; eugleninele: *E.polymorpha, E.proxima, unele specii din genurile Trahelomonas, Phacus şi Strombomonas;* volvocophyceele: *Carteria globosa, C.pallida, Pandorina marum, Eudorina elegans;* clorococoficeele: *Scenedesmus quadricanda, S.acuminatus, S.acutus, Pendiastrum boryanum, P.duplex, Ankistrodemus angustus, Actinastrum hantzschii* etc., în cantităţi exagerate au fost întâlnite în toate tipurile de bazine acvatice, preponderent în perioada caldă a anului. Alte specii, ca *Oscillatoria redekei, Chaematococcus pluvialis, Cryptomonas erosa, Dynobrion sertularia* etc., intensiv se dezvoltă toamna târziu sau chiar în perioada de iarnă, uneori provocând fenomenul "înfloririi" apei sub gheaţă. O altă grupă de specii se dezvoltă masiv în condiţii strict determinate. Către acestea se referă *Gymnodinium aerugimasum, Microcystis grevillei, Spirulina platensis, Anabaenopsis rokiborskii, Asterionella formosa, Ceratium hiruudinella, Tetraspora limnetica* şi multe altele, care în cantităţi masive au fost întâlnite într-un număr redus de bazine în condiţii ecologice specifice. Alga *Spirulina platensis*, de exemplu, în cantităţi masive a fost întâlnită într-un iaz cu apă mineralizată în apropierea or. Ungheni şi într-un canal cu ape reziduale lângă or. Iaşi, România, iar specia *Microcystis grevillei* în cantităţi enorme a fost întâlnită o singură dată într-un singur iaz mic în r. Floreşti. Alga Asterionella formosa în abundenţă se dezvoltă în bazinul de acumulare Costeşti-Stânca de pe Prut şi în lacul "Valea morilor" din Chişinău. Asemenea cazuri avem multe, însă care sunt factorii care contribuie la dezvoltarea exagerată a acestor specii este greu de identificat. Majoritatea speciilor depistate în bazinele acvatice din Moldova sunt alge larg răspândite, în cea mai mare parte cosmopolite. În acelaşi timp în algoflora Moldovei se întâlnesc multe alge rare, în total au fost depistate circa 140 specii din această categorie. Un deosebit interes prezintă speciale *Spirulina platensis, Anabenopsis raskibarskii, Gomontiella subtubulosa, Phacus lismorensis, Strombanonas gibberosa var. longicollis, Leptochaete stagnalis, Dinobryon cylindricum, Prymnesium parvum, Biddulfia laevis, Didymosphenia geminata, Surirella spiralis, Pseudostaurastrum hastatum, Istmochloron lobulatum, Pseudopolyedriopsis skiya, Pteromonas aculeata, Eudorina illinoisensis, E. cilindrica, Didymogenis palatina, Tetrachlorella coronata, Pachycladon umbricus, Scenedesmus fenestratum, S.lefevrii, S.sooii, S.anomalus, Copsopogon chalybeus* şi multe altele care se deosebesc prin aceea că au un areal restrâns şi se întâlnesc în exemplare solitare, cu excepţia *Spirulina platensis şi Anabaenopsis raciborskii,* pricina unei astfel de comportări ne fiind clară.

Distribuţia algelor după tipurile de bazine ne demonstrează că cea mai bogată taxonomic algofloră a fost depistată în râuri – 729 specii şi unităţi taxonomice intraspecifice (tabelul 2).

Tabelul 2

**Distribuţia algoflorei în diverse tipuri de bazine**

| *Încrengătura* | *Râuri* | *Bazine de acumulare* | *Iazuri* | *Lacuri* |
|---|---|---|---|---|
| Cyanophyta | 95 | 72 | 65 | 75 |
| Rhodophyta | 5 | 2 | 2 | - |
| Cryptophyta | - | 3 | 3 | 3 |
| Dinophyta | 2 | 17 | 12 | 7 |
| Crysophyta | 6 | 8 | 8 | 8 |
| Bacillariophyta | 230 | 242 | 157 | 125 |
| Xanhophyta | 14 | 12 | 16 | 17 |
| Euglenophyta | 90 | 85 | 31 | 158 |
| Chlorophyta | 287 | 245 | 180 | 210 |
| Charophyta | - | 1 | 5 | - |
| Total | 729 | 687 | 479 | 528 |

Pe locul doi se plasează bazinele de acumulare de pe râuri, după care urmează iazurile. Ultimul loc în privinţa varietăţii speciilor de alge revine lacurilor. Aceasta se lămureşte prin faptul că lacurile investigate atât cele din lunca Nistrului, cât şi cele din lunca Prutului, sunt concrescute cu plante acvatice vascolare, care prezintă un concurent trofic pentru toate tipurile de alge. Deosebit de sărac în aceste lacuri este fitoplanctonul. Majoritatea speciilor depistate în algoflora lacurilor sunt alge perifitone sau epifitone care trăiesc pe corpul plantelor acvatice vasculare cufundate în apă.

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# SOZOPHYTES IN THE MEDICINAL FLORA OF EASTERN CARPATHIANS

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**Summary.** *This paper includes species of vascular plants of medicinal value from the Eastern Carpathians (Romania), which are on both the Romanian Red Lists and Red Book for vascular plants. Sozophytes registered in various domestic and international documents and regulations are inventoried. Each taxon (species/subspecies) included in the paper is presented as follows: scientific name, author, most popular common name, international legal act of protection, its presence on the Romanian Red Lists/Red Book, its general spreading as well as its medicinal uses.*

## Introduction

The vascular Romanian flora amounts to a total of 3.136 species and 840 subspecies, grouped in 775 genera and 128 botanical families [2]. Among these, the Eastern Carpathian Mountains flora (Romania) includes, above the isohyps of 700 m altitude, more than 1.400 species of vascular plants (i.e. *Pteridophyta*, *Pinophyta* and *Magnoliophyta*). According to the consulted literature, among these species, in the cormoflora of the same mountain catena there are more than 300 species with various medicinal uses [6, 21]. Part of the medicinal species identified here are included in different categories of threat (=sozophytes) in our country [1, 5, 10]. For these species there are to be established monitoring and management measures, so that their gene pool be affected the least, collecting also having to respect the principles of sustainable exploitation.

## Materials and methods

The inventory of the Eastern Carpathians cormoflora was developed within a CNCSIS project, PN II – Project type Partnerships in priority areas, namely project 32-135 CARPATOBIODIV [22].

During the development of the project all cormophyte species found at above 700 m were registered, whether we geographically speak about hills, hillocks, low mountains or proper mountains. Thus, 1.409 species and subspecies were inventoried in the Eastern Carpathians flora [22].

Botanical Glossary in on par with the current works in the field [2, 11]. Threat categories are taken from papers published by the International Union for Conservation of Nature [18]. Medicinal uses of plants are taken from recent works [5, 6, 21].

## Results and discussions

In the Eastern Carpathians cormoflora there were identified 50 taxa with medicinal value, all of them included in one or several internal red lists or in the Red Book of Romanian vascular flora, some of them being subject of national or international legal regulations [1, 4-5, 10, 15-17, 19-20].

Families of plants that include the greatest number of taxa with medicinal value are: *Orchidaceae* (with 7 taxa), *Asteraceae* (with 4 taxa), *Pinaceae* (with 4 taxa), *Lycopodiaceae* (with 4 taxa), *Apiaceae* (with 4 taxa), *Violaceae* (with 4 taxa) etc. (Table 1, col. 2). As for the live's form, three species are trees (*Abies alba*, *Larix decidua* subsp. *carpatica*, *Pinus cembra*), six species are shrubs or undershrub (*Arctostaphylos uva-ursi*, *Juniperus sabina*, *Pinus mugo*, *Rhododendron myrtifolium*, *Taxus baccata*, *Thymus pulcherrimus*), a species is biannual - perennial (*Cochlearia borzaeana*), all others being herbaceous perennial species, even geophytes or hemicriptophytes [2].

The paper lists plant species with medicinal uses that can be found in the Eastern Carpathians flora (Table 1, col. 2 and 7) [6, 14, 21], included also in the main international documents on protection of plant species under various degrees of threat [9, 15–18] (Table 1, col. 4), as well as in the Red List of vascular plants in Romania [10], in the Red Book [5]), or in other thematic papers [1, 4, 7, 8, 12] (Table 1, col. 5). Protection of some of the species presented in this paper is enacted in domestic or international regulations issued in recent years [19, 20].

Among the categories of threats, the rare species prevail (R = 23), followed by the vulnerable and at the same time rare species (VU/R = 8); next category is represented by the vulnerable species (VU = 6), the critically endangered (CR = 4) and the endangered ones (EN = 2); the last categories include species with low threat risk (LR = 1), the poorly known in terms of belonging to one of the categories of the International Union for Conservation of Nature (K = 1) or the ones that are not at risk (nt = 1), but are likely to move into one of the above mentioned categories in the near future.

Some species of medicinal plants in the Eastern Carpathians (Romania) are endemic or near-endemic (6 taxa), some are glacial or tertiary relics (8) or are protected as natural monuments in Romania (7) (Table 1, col. 6) [3, 11, 13].

Taxa in various degrees of hazard that are present in the Eastern Carpathians have various uses in the treatment of medical conditions. Thus, many of them have anti-rheumatic, analgesic, anti-haemorrhagic, diuretic,

Table 1

**Medicinal plants and their sozologic categories in the Eastern Carpathians flora**

| *Crt. No.* | *Taxa* | *Vernacular name* | *International documents* | *Romanian Red List / Red Book* | *Floristic element* | *Pharmacodynamics action/therapeutic uses* |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | *Abies alba* L. (*A. pectinata* (Lam.) DC.) | brad | – | EN [10] | Centr. eur.–mont. | anti-rheumatic, blood circulation stimulator, breathing or bladder disorders, deodorant, expectorant, mild diuretic, anti-neuralgic |
| 2 | *Aconitum napellus* L. ssp. *firmum* (Rchb.) Gáyer | omag | Global Red List, 1997 | – | Carp.–Centr. East eur. | toxic / homeopathic remedy for treatment of flu, fever or tonsillitis, analgesic, anti-coughing, anti-sciatic, anti-bronchitis |
| 3 | *Allium victorialis* L. | ceapă de munte | – | R [10] | Alp. eur. | atherosclerosis, bactericide, bacteriostatic, anti-scorbutic, anti-haemorrhagic, melliferous |
| 4 | *Angelica archangelica* L. | angelică | – | VU [10] | Euras. bor. / Protected species as monument of nature | in indigestions, colic, blood circulation stimulator, appetite and digestion stimulator, tonic, cerebral stimulant, in anorexia, dyspepsia, flatulence, enteritis, antibiotics, in the liquor industry |
| 5 | *Angelica palustris* (Besser) Hoffm. | – | Habitat Directive 92/43/EEC, Annex IIb | CR [5]; VU/R [10] | Euro-Siberian | little known [5] |
| 6 | *Anthemis tinctoria* L. ssp. *fussii* (Griseb. et Schenk) Beldie | mușețel de vopsit | – | K [10] | Carp.–Balk. | colorant, little known medical importance |
| 7 | *Arctostaphylos uva-ursi* (L.) Spreng. | strugurii ursului | – | VU [5, 10] | Circ. bor. / Glacial relic species in the Romanian flora | kidney stones, pyelitis, hematuria, diarrhoea, coughing, prostate, gout, anti-rheumatic, diuretic, biliary diseases, natural colorant |
| 8 | *Arnica montana* L. | arnică | Habitat Directive 92/43/EEC, Annex Vb | VU [10] | Eur. (mont.) | anti-rheumatic, antiseptic, anti-arthritis, anti-inflammatory, sedative, in arterial spasms, in atherosclerosis / toxic and paralyzing |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9 | *Bupleurum falcatum* L. ssp. *dilatatum* Schur | urechea iepurelui | Global Red List, 1997 | – | Carp. | hepatic, anti-inflammatory, antipyretic |
| 10 | *Chimaphila umbellata* (L.) W. P. C. Barton | verdeața iernii | – | CR [5]; R [10] | Circ. bor. | hypoglycaemic, kidney stones removal |
| 11 | *Cimicifuga europaea* Schipcz. | – | – | R [10] | Euras. cont. | liver and gallbladder diseases (folk medicine) |
| 12 | *Cochlearia borzaeana* (Coman et Nyár.) Pobed. | lingurea | – | EN [5]; R [10] | Dacian endemics / Glacial relic species in the Romanian flora | antiscorbutic, antiseptic, anti-bronchitis, anti-asthmatic, in pulmonary catarrh, chronic skin diseases, diuretic, laxative, appetite and digestion stimulator, high contents of C vitamin, empirical in gingival problems, mouth soreness, nosebleeds |
| 13 | *Conioselinum tataricum* Hoffm. | schinduc | – | R [10] | Euras. bor. | appetite and digestion stimulator |
| 14 | *Cypripedium calceolus* L. | papucul doamnei | Habitat Directive 92/43/EEC, Annex IIb | VU/R [10] | Euras. / Protected species as monument of nature | antispasmodic, in menstrual pains, calming (at old Amerindians [21]) |
| 15 | *Dactylorhiza maculata* (L.) Soó | – | – | R [10] | Centr and North Eur. | Folk medicine in snake bites [21] |
| 16 | *Drosera rotundifolia* L. | roua cerului | – | R [10] | Circ. | anti-coughing, antispasmodic |
| 17 | *Drosera intermedia* Hayne | roua cerului | – | R [10] | Eur., North Amer. | anti-coughing, antispasmodic |
| 18 | *Filipendula ulmaria* (L.) Maxim ssp. *picbaueri* (Podp.) Smejkal | crețușca | – | VU [10] | Euras. | analgesic, anti-inflammatory, in strong gastritis, sweetening of mead / sacred plant for druid Celtic monks [21] |
| 19 | *Fritillaria meleagris* L. | lalea pestriță | – | VU/R [10] | Eur./ Protected species as monument of nature | melliferous, treatment of wounds (in Middle Ages [21]) |
| 20 | *Galanthus nivalis* L. | ghiocel | Habitat Directive 92/43/EEC, Annex Vb | nt [10] | Centr. eur.– submedit. | simulation of menstrual cycle (in Middle Ages [21]), paralysis and paresis of peripheral nerves, leucorrhoea, Candida, melliferous / toxic |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21 | *Gentiana lutea* L. | ghințură galbenă | Habitat Directive 92/43/EEC, Annex Vb | VU/R [10] | Alp.–eur. / Protected species as monument of nature | appetite and digestion stimulator, antipyretic, anti-flu, anti-malaria, anthelmintic, bitter tonic, eupeptic, choleretic - cholagogue |
| 22 | *Gentiana punctata* L. | ghințură pătată | – | R [10] | Alp.–eur. | idem |
| 23 | *Huperzia selago* (L.) Bernh. ex Schrank & Mart. (*Lycopodium selago* L.) | brădișor | Habitat Directive 92/43/EEC, Annex Vb | – | Cosm. | laxative, emetic, diuretic, in pulmonary disorders, nervous diseases, in nephritis, in pharyngo-tonsillitis, anti-rheumatic, melliferous |
| 24 | *Juniperus sabina* L. | cetină de negi | – | VU/R [10] | Eur. mont.–West Asia | toxic / abortive (in Antiquity [21]), treatment of warts |
| 25 | *Larix decidua* Mill. ssp. *carpatica* (Dom.) Šiman | larice, lariță | World Red List for Trees, 1998 | R [10] | Carpathian endemics | resin (venetian turpentine) – anti-coughing, in respiratory problems, expectorant, anti-bronchitis, astringent, in urinary infections |
| 26 | *Ligularia carpathica* (Schott) Pojark. (*L. glauca* (L.) O.Hoffm.) | varza iepurelui | – | LR [5]; R [10] | Carp.–Balk.–South Siberia | natural colorant, little known as medicinal uses |
| 27 | *Ligularia sibirica* (L.) Cass. | gălbinele, curechi de munte | – | R [10] | Euras. bor. / Glacial relic species in the Romanian flora | natural colorant |
| 28 | *Lilium jankae* A. Kern. | – | – | VU [5]; R [10] | Dacic–Balk. | melliferous (little known as medicinal uses) [5] |
| 29 | *Lycopodium annotinum* L. | cornișor | Habitat Directive 92/43/EEC, Annex Vb | – | Circ. | in eczema, dermatitis, alcoholism and chronic smoking |
| 30 | *Lycopodium clavatum* L. | pedicuță | Habitat Directive 92/43/EEC, Annex Vb | – | Cosm. | diuretic, anti-rheumatic, kidney and bladder stones, hair growth, in eczema, cosmetic, dermatology / toxic |

| | | | | | | |
|---|---|---|---|---|---|---|
| 31 | *Lycopodium inundatum* L. | brădişor | Habitat Directive 92/43/EEC, Annex Vb | – | Circ. / Glacial relic species in the Romanian flora | idem |
| 32 | *Menyanthes trifoliata* L. | trifoişte | – | R [10] | Circ. | appetite and digestion stimulator, liver stimulant, antipyretic, analgesic, homeopathic remedy in headaches, in dyspepsia of various nature |
| 33 | *Narcissus poeticus* L. ssp. *radiiflorus* (Salisb.) Baker | narcise | Bern Convention, Appendix I; Bern Convention, Appendix I, Annex I, 1998 | VU/R [10] | Centr. eur. (mont.) | Empirical treatment of chest and cardiac diseases |
| 34 | *Neottia nidus-avis* (L.) Rich. | cuibuşor, trânji | – | R [10] | Euras. | anti-hemorrhoids |
| 35 | *Orchis coriophora* L. ssp. *coriophora* | ploşniţoasă | – | R [10] | Centr. eur. | food reconstitute, in exhaustion, convalescence, digestive tract irritations, mucosal protection, reliving irritations, aphrodisiac |
| 36 | *Orchis militaris* L. | poroinic | – | R [10] | Euras. | idem |
| 37 | *Orchis morio* L. ssp. *morio* | poroinic | – | R [10] | Eur. | idem |
| 38 | *Orchis morio* L. ssp. *picta* (Lois.) Arcang. | poroinic | – | R [10] | Pont.–medit. | idem |
| 39 | *Pinus cembra* L. | zâmbru | – | R [10] | Euras.–arct.–alp. / Glacial relic species in the Romanian flora | melliferous |
| 40 | *Pinus mugo* Turra (*Pinus montana* Mill.) | jneapăn | – | R [10] | Centr. eur.–mont. | expectorant, diuretic, anti-inflammatory, antiseptic in respiratory and urinary, in lack of C vitamin, aromatic |
| 41 | *Polemonium caeruleum* L. | scara Domnului | – | R [10] | Circ. | expectorant, anti-bronchitis, anti-sclerotic |

| | | | | | | |
|---|---|---|---|---|---|---|
| 42 | *Primula elatior* (L.) Hill ssp. *leucophylla* (Pax) Hesl.–Harr. fil. ex W. W. Sm. et H. R. Fletcher | ciuboțica cucului | – | R [10] | Endemics of Eastern Carp. | diuretic, antispasmodic, sedative, homeopathic against headaches and circulatory problems |
| 43 | *Rhododendron myrtifolium* Sch. et Kot. | smirdar | – | VU [10] | Carp.–Balk / Protected species as monument of nature | anti-coughing, diuretic, kidney disorders, kidney disinfectant, in chest diseases, narcotic and aphrodisiac |
| 44 | *Taxus baccata* L. | tisă | – | VU/R [10] | Atl.–medit.–centr. eur. / Tertiary relic species in the Romanian flora / Protected species as monument of nature | toxic / anti-rheumatic, antispasmodic, anti-diabetic, vermifuge, in urological disorders, in tonsillitis, diphtheria, in typhoid fever (in folk medicine) |
| 45 | *Thymus pulcherrimus* Schur | cimbrişor | – | R [10] | Carpathian endemics | aromatic, antiseptic, tonic, mucus solvent, invigorating, digestion stimulant |
| 46 | *Trollius europaeus* L. ssp. *europaeus* | bulbuci de munte | – | R [10] | West and North Eur. / Protected species as monument of nature | toxic / empiric in treatment of viral hepathitis (in folk medicine [21]) |
| 47 | *Viola dacica* Borbás | unghia păsării | – | R [10] | Carp.–Balk. (Dacic), Altai Mts.**?** | in Antiquity for the treatment of coughs and stomach disorders [21] |
| 48 | *Viola epipsila* Ledeb. | – | – | CR [5]; VU/R [10] | Circumbor./ Glacial relic in the Romanian flora | little known [21] |
| 49 | *Viola palustris* L. | – | – | CR [5]; R [10] | Circumbor./ Glacial relic in the Romanian flora | little known [21] |
| 50 | *Viola jooi* Janka | tămâioară | – | R [10] | Near-endemics (Romania, Ukraine) | emetic, anti-coughing, diuretic, anti-bronchitis, colorant |

antiseptic, or expectorant action. Fewer are known for the antiscorbutic, anti-neuralgic, anti-asthmatic or mucus solvent action. Certain species are only used in folk medicine, as *Cimicifuga europaea* (in the empirical treatment of liver and gallbladder diseases) or *Dactylorhiza maculata* (in snake bites [21]). Some species were used in Antiquity, but their medicinal importance has significantly dropped nowadays (ex. *Juniperus sabina* for causing abortion, *Viola dacica* in treating coughs and stomach disorders [21] etc.). Interestingly, *Filipendula ulmaria* was regarded as a sacred plant to the Druid Celtic monks, being also used for sweetening the mead [21].

## Conclusions

Following our analysis it can be ascertained that the Eastern Carpathians flora contains 50 taxa of medicinal interest, included in one of the sozophyte categories of the International Union for Conservation of Nature (IUCN). Some of them are protected by international law (13 taxa), but the majority are on the red lists or in the Red book of spontaneous Romanian cormoflora (44 taxa). Some taxa with medicinal importance are categorized differently in terms of their sozological classification by various authors, which is the consequence of lack of population studies on vascular plant species in Romania.

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# GENURILE *SAMOLUS, HOTTONIA, LYSIMMACHIA* (*PRIMULACEAE*) ÎN FLORA BASARABIEI

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**Summary.** *In the paper the critic study results concerning the Hottonia, Samolus and Lysimmachia (Primulaceae) genera from Bessarabia's flora are carried out. Briefly characteristic of families, genera, bioecological and chorological characters of revealed species are given. The species of Hottonia, and Samolus genera only in South territory, but Lysimmachia punctata alone in the geobotanical district Hotin were identified.*

## Introducere

Familia *Primulaceae* (ord. *Primulales*, subclasa *Dilleniidae*) include 27-30 genuri şi circa 800(1000) specii răspândite aproape pe tot Globul pământesc, îndeosebi în regiunile temperate şi reci ale Emisferei de Nord.

Majoritatea reprezentanţilor primulaceelor sunt plante erbacee, perene, rar anuale (*Anagallis, Androsace*); terestre sau acvatice (*Hottonia*). Tulpini erecte, rar ascendente, uneori târâtoare (*Lysimmachia nummularia*). Frunze în rozetă bazală; opuse, alterne, uneori verticilate, foarte rar penat-sectate (*Hottonia*), cărnoase (*Primula, Glaux*), sesile, sau cu peţiol lung, păroase; lipsite de stipele. Flori solitare sau în umbele terminale, raceme, spice axilare sau capitule. Caliciu campanulat, 5-divizat. Corola după forma tubulară sau rotată, iar după colorit albă, galbenă, cărămiziu-roşietică, roză, albastră. Ovar superior, rar semiinferior (*Samolus*). Fruct capsulă globuloasă.

Pentru reprezentanţii familiei *Primulaceae* este frecventă heterostilia, care asigură polenizarea încrucişată.

Primulaceele includ specii care habitează prin liziere şi poiene, coline, prin locuri umede, pe lângă izvoare, în tufărişuri, în ape stagnante, pe terenuri sărate şi umede. Din punct de vedere filogenetic *Primulaceele* sunt foarte aproape de fam. *Theophrastaceae* şi *Myrsinaceae* şi au o provenienţa comună. (Takhtajan, 1987).

## Materiale şi metode

În calitate de materiale pentru cercetare au servit atât exsicatele din Herbarul Grădinii Botanice a AŞM, cât şi al Catedrei de Ecologie, Botanică şi Silvicultură a Universităţii de Stat din Moldova. În procesul de cercetare şi prelucrare critică a colecţiilor am folosit metoda clasică comparativ-morfologică (Коровина, 1986), cât şi unele izvoare fundamentale cu privire la nomenclatura şi bioecologia taxonilor (Черепанов, 1995; Ciocârlan V. 2009; Tutin, 2001).

Denumirile ştiinţifice româneşti sunt citate în conformitate cu cele elaborate şi publicate de academicianul A.Negru (2007). Pentru caracterizarea bioecologică a speciilor ne-am condus de lucrarea publicată de Popescu A., Sanda V. (1998).

## Rezultate şi discuţii

Prelucrarea critică a materialului prezent în herbarele Grădinii Botanice şi ale Universitătii de Stat ne permite să intervenim cu unele precizări taxonomice privitor la componenţa specifică a familiei Primulaceae din flora Basarabiei.

Pentru flora spontană a Republicii Moldova T. Gheideman (1986) şi A. Negru (2007) indică 9 specii: *Primula veris* L., *Androsace maxima* L., *A. elongata* L., *A. septentrionalis* L., *Lysimmachia nummularia* L., *L. vulgaris* L., *Glaux maritima* L., *Anagallis foemina* Mill., *A. arvensis* L. Analizând materialele herbarizate în legătură cu pregătirea ediţiei „Flora Basarabiei" am constatat prezenţa în familia Primulaceae încă a două genuri: *Hottonia, Samolus* şi a speciei *Lysimmachia punctata*, colectate în sudul şi nordul Basarabiei. A fost analizată reprezentativitatea tuturor speciilor din această familie. Rar se întâlnesc şi puţin sunt colectate speciile de *Glaux maritima* şi *Androsace septentrionalis*. Specie rară considerăm şi *Primula veris* cu toate că ea este bogat reprezentată în herbar, în natură se colectează de către populaţie, fiind medicinală, decorativă, alimentară. Defrişarea pădurilor tot joacă un rol negativ pentru plantă.

În continuare prezentăm pe scurt descrierea acestor genuri, caracterele bioecologice şi corologice ale speciilor înregistrate.

### Genul *Hottonia* L. – Hotonia

Linnaeus, 1753, Sp. Pl.: 145

Plante acvatice, submerse, perene. Frunze penat-sectate, verticilate. Flori pentamere, actinomorfe, heterostile, dispuse câte 3-6 în verticiliu, pedicelate. Inflorescenţa racemiformă, bractei liniare. Scapul lung, drept, ridicat deasupra apei. Caliciu 5-divizat. Corolă cu tub scurt, cu limb plat. Pedunculi florali reflecţi. Stamine 5, prinse de tubul corolei. Ovul anatrop. Gineceu ovoidal. Stil filiform. Stigmat obtuz. Fruct – capsulă globuloasă, dehiscentă prin 5 valve.

Genul include 2 specii: *H. palustris* L. răspândită în Europa şi Asia Mică;

*H. inflata* Ell. rar în partea atlantică a Americii de Nord.

În flora locală o singură specie.

T i p: *H. palustris* L.

*H. palustris* L. 1753, Sp. Pl.: 145; Смольян. 1952, Фл. СССР, 18:252; Карнаух 1957, Фл. УРСР, 8:102; Mor. 1960, Fl. RPR, 7:77; Ferguson, 1992, Fl. Europ. 3, ed.2:24, Ан. А. Фед. 1981, Фл. Европ. части СССР, 5:78; Доброчаева, Котов, Прокудин и др., 1999, Опред. высш. раст. Укр., изд. 2:140; Ciocârlan, 2000, Fl. ilustr. a Rom.: 595 – Hotonia palustră (Figura 1).

Plantă perenă, înfloreşte în lunile mai-iunie, acvatică. Helohidatofit, element euroasiatic, specie ultrahidrofilă, mezotermă, acido-neutrofilă. Plantă rară, habitează în ape stagnante sau lin curgătoare. Răspândită în districtul geobotanic Chilia. Arealul speciei cuprinde Europa, Asia Mică.

În herbarul Grădinii Botanice s-a păstrat un singur exsicat colectat în 1936 de Constantin Zahariadi în apropierea s. Necrasovca (în iaz).

**Genul *Samolus* L. – Samolus**

Linnaeus, 1753, Sp. Pl.: 171

Plante perene. Tulpini decumbente sau erecte. Frunze întregi, alterne, verticilate. Flori actinomorfe, axilare, pentamere, pedicelate, bracteolate, adunate în racem sau corimb terminal, rar solitare sau verticilate. Caliciul campanulat 5-divizat, persistent. Corola 5-partită cu tub scurt, limb rotat sau orizontal, lobi sinuați. Stamine 5. Staminodii 5, solziforme. Ovar semiinferior. Stil scurt cu stigmat capitat. Fruct capsulă globoasă, uniloculară, se deschide la vârf prin 5 valve.

Include cca 16 specii răspândite mai ales în America de Nord şi de Sud, Africa de Sud, Mexica, Australia. În Europa şi Asia, precum şi în flora locală 1 specie.

T i p.: *S. valerandi* L.

*S. valerandi* L. 1753, Sp. Pl.: 171; Смольян. 1952, Фл. СССР, 18:254; Карнаух 1957, Фл. УРСР, 8:104; Mor. 1960, Fl. RPR, 7:58; Ferguson, 1992, Fl. Europ. 3, ed.2:29, Ан. А. Фед. 1981, Фл. Европ. части СССР, 5:80; Доброчаева, Котов, Прокудин и др., 1999, Опред. высш. раст. Укр., изд. 2:140; Ciocârlan, 2000, Fl. ilustr. a Rom.: 598 – Samolus Valerand (Figura 2).

Plantă perenă, înfloreşte în lunile iunie-iulie. Hemicriptofită, mezohigrofită, mezotermă, eurionică; maritimă, cosmopolită. Staționează prin bălți şi mlaştini, pe lângă pâraie. Halofit facultativ. Se întâlneşte în districtul geobotanic Chilia. Specie răspândită pe tot globul pământesc.

În herbarul Grădinii Botanice se păstrează 11 exsicate colectate de Constantin Zahariadi în anii 1928, 1937, 1938 în localitățile Vâlcov, Jebrieni, Jebrieni – Ismail şi în regiunea Odesa, la nord de Şabo, limanul Nistrului, colectată de Pavel Pânzaru (1997).

## Genul *LYSIMACHIA* L. – Dreţe

Linnaeus, 1753, Sp. Pl.: 146

Plante perene. Tulpina erectă sau repentă. Frunze simple, întregi, opuse, verticilate sau alterne, scurt peţiolate. Flori galbene, pentamere, actinomorfe, axilare sau terminale, solitare sau adunate în inflorescenţă racem, panicul. Caliciu de regula 5-partit. Corola hipogină, 5-partită, lacinii întregi sau dinţaţi. Stamine 5 mai scurte decât corola. Gineceu lizicarp. Ovar superior. Stil filamentos. Stigmat capitat, obtuz. Fruct capsulă.

T i p: *L.vulgaris* L.

Include cca 60 specii răspândite, mai cu seamă, în zonele temperate a emisferei de Nord.

În flora Basarabiei genul este reprezentat prin 3 specii.

Cheia pentru determinarea speciilor

| | | |
|---|---|---|
| 1. | Plante mici, glabre. Tulpina repentă. Flori solitare, axilare.................................................. | *L. nummularia* L. |
| - | Plante mai mari, pubescente. Tulpina erectă...... | 2 |
| 2. | Laciniile caliciului înconjurate de o margine roşie. Laciniile corolei pe margini glabre. Frunze puţin păroase pe dos.......................................... | *L. vulgaris* L. |
| - | Laciniile caliciului fără margine roşie. Laciniile corolei pe margini glandulos-ciliate. Frunze pe dos pubescente, de obicei negru punctate.......... | *L. punctata* L. |

Primele 2 specii sunt bine cunoscute şi nu ne vom opri asupra lor.

*L. punctata* L. 1753, Sp. Pl.: 147; Штейнб. 1952, Фл. СССР, 18:260; Карнаух, 1957, Фл. УРСР, 8:110; Mor. 1960, Fl. RPR, 7:49; Ан. А. Фед. 1981, Фл. Европ. части СССР, 5:82; Ferguson, 1992, Fl. Europ. 3, ed. 2:27, Доброчаева, Котов, Прокудин и др., 1999, Опред. высш. раст. Укр., изд. 2:140; Ciocârlan, 2000, Fl. ilustr. a Rom. : 596; – D.punctată (Figura 3).

Plantă perenă, înfloreşte în iunie-iulie. Specie hemicriptofită, mezofilă, mezotermă, preferă soluri acido-neutrofile. Element pontic-mediteranean. Staţionează prin mlaştini, pe lângă izvoare şi pâraie, în păduri, depresiuni umede. Răspândită în districtul geobotanic Hotin. Plantă foarte rar întâlnită.

În herbarul Grădinii Botanice se păstrează 3 exsicate colectate la 26 iunie 1996 şi determinate de P. Pânzaru în regiunea Cernăuţi, raionul Hotin la nord-est de s. Grozinţî într-o poiană, în făget.

Figura 1. *Hottonia palustris L.*

Figura 2. *Samolus valerandi L.*

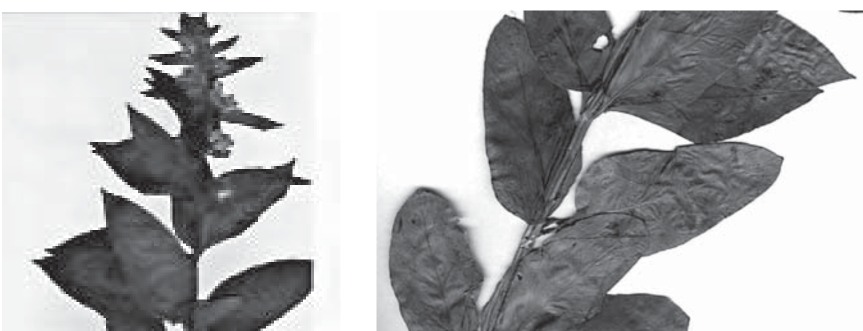

Figura 3. *Lysimmachia punctata L.*

Frunze tulpinale superioare

Frunze tulpinale bazale

Exprim sincere mulțumiri cercetătorului științific stagiar domnului V. Ababii pentru scanarea plantelor

Arealul speciei cuprinde Europa Centrală şi de Sud, regiunea Mediteraneană de Vest, Asia Mică.

## Concluzii

• În flora Basarabiei sunt răspândite 12 specii din familia *Primulaceae* dintre care: *Hottonia palustris L., Samolus valerandi L.* se întâlnesc numai în sudul teritoriului, iar *Lysimmachia punctata* numai în districtul geobotanic Hotin.

• Speciile *Androsace septentrionalis, Hottonia palustris, Samolus valerandi, Glaux maritima şi Lysimmachia puctata* sunt rare pentru flora în studiu.

• Se recomandă includerea în Cartea Roşie a Republicii Moldova a speciilor *Androsace septentrionalis* şi *Primula veris*.

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# REZERVAȚIA PEISAGISTICĂ „TEȚCANI”


***Lazu Şt., Postolache Gh., Ludmila Talmaci***



**Summary.** *Landscape Reserve "Teэcani" which occupies 164 ha, includes cherry with oak zonal forests (Querco(roboris)-Cerasietum Gheideman et al., 1964), and anthropogenic derivate of oak – maple forest extend on area of 80.7 ha or 64.2%, and of those azonal comprise willow stand (Salicetum albae Issler 1926) and willow with white aspen forests, (Saliceto-Populetum albae Meijer-Dress. 1936) extending over 4.8 hectares. The artificial acacia, pine, and ash forests occupy 37.5 hectares.*

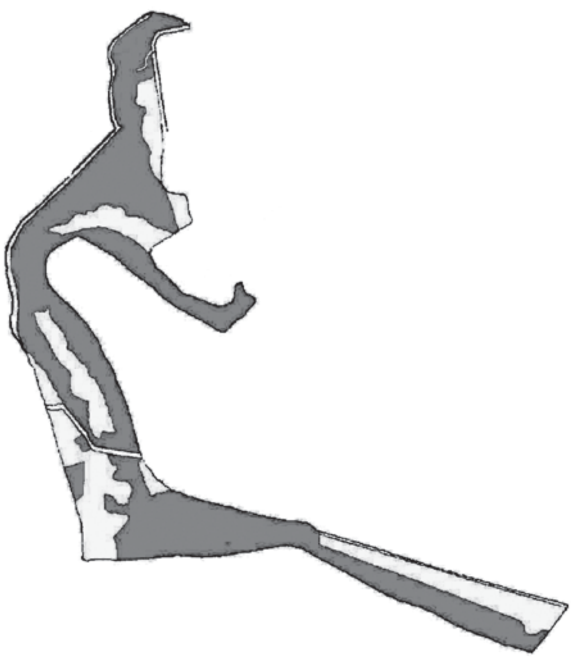
Rezervaţia peisagistică (de peisage geografice) „Teţcani” (R.P.T.) amplasată în raionul Briceni, com. Teţcani, se află sub protecţie de Stat prin Hotărârea Sovietului de Miniştri a R.S.S. Moldoveneşti de la 8 ianuarie 1975 N 5 (1). Deţinătorul funciar şi beneficiarul ariei (obiectului) protejate este  Întreprinderea silvică de stat Edineţ (Ocolul silvic Lipcani, parcelele 59 şi 60) cu suprafaţa de 114 ha pădure şi Primăria satului  - 50 ha terenuri libere de păduri. Aria protejată este cuprinsă între coordonatele cu longitudinea 27°57′630″; latitudinea 48°10′691″, altitudinea 120-200 m. Conform ultimului amenajament silvic (2005) R.T.P. deţine 133,2 ha păduri.

Rezervaţia peisagistică „Teţcani” se află pe cursul inferior al râuşorului Vilia, de la comuna Teţcani până la revărsarea lui în r. Prut, precum şi sectorul calcaros şi împădurit de pe malul r. Prut. Rezervaţia a fost concepută ca obiect geomorfologic - calcaruri a sarmaţianului inferior şi a tortonului desgolite în malul r.Vilia. Aici r.Vilia formează un canion priporos şi adânc de peste 100 m şi pe fundul acestuia şerpuieşte albia râului cu multe aluviuni şi grohotişuri (Кравчук Ю.П., Верина В.Н., Сухов И.М., 1976).

În analiza floristică şi fitocenotică din R.P.T. s-au utilizat investigaţiile proprii din anii 2004 şi 2011, precum şi cele din publicaţiile mai recente, care se referă la terenurile acestei arii protejate (Pânzaru P., 2006 şi Amenajamentul silvic din 2005).

R.P.T. cuprinde spaţii forestiere aflate în districtul geobotanic a pădurilor de stejar cu cireş, care predomină printre ariile împădurite a podişului Moldovei de nord. Aceste păduri sunt constituite din specii a plantelor vasculare cu indici superiori de abundenţă-dominanţă şi frecvenţă precum şi constituie grupul de plante caracteristice tipului de pădure stejăret cu cireş – stejar pedunculat (*Quercus robur*)*,* cireş (*Cerasus avium*)*,* mierea ursului (*Pulmonaria mollis*)*,* strigoaie (*Veratrum nigrum*)*,* firuţă (*Poa angustifolia, Poa nemoralis*)*,* iarba cu cinci degete (*Potentilla alba*) (Гейдеман Г.С. и др., 1964). Asemenea păduri zonale s-au păstrat pe mici suprafeţe în parcela 60 subparcela n (1,3 ha), răspândite pe platou cu altitudinea de 120 m. Arboretul are o compoziţie 9St1Ci cu vârsta 40-50 de ani, bonitatea 2 şi o regenerare naturală satisfăcătoare a stejarului şi cireşului. O mai mare răspândire au derivatele acestor păduri naturale spre stejărete cu jugastru, care au o compoziţie a arboretului - 8St2Ju întâlnite în parcela 59 subparcele a, k, l, şi m cu suprafaţa de 23 ha, iar în parcela 60 subparcelele c, f şi r pe o suprafaţă de 26,1 ha. Stejăretele cu cireş sub influenţa antropogenă au evoluat spre formarea celor actuale cu stejar şi jugastru (8St2Ju), iar ultimile duc spre formarea celor de jugastru (fără stejar pedunculat) - parcela 59 (subparcelele d, f şi j) 22,1 ha şi parcela 60 (subparcela h) 8,2 ha. Pe terenurile de luncă cu o altitudine de până la 100 m în valea râului Prut, parcela 60 subparcelele g şi l se răspândesc sălcişurile pe o suprafață de 3,4 ha, iar plopişurile în subparcela q cu suprafața 1,4 ha. Suprafața pădurilor naturale cu cele parţial derivate constituie 85,5 ha. În aceste condiții s-a evidențiat prezența speciilor rare - liana - vița de pădure (*Vitis sylvestris*) şi arbuştii - călin (*Viburnum opulus*), mălin (*Padus avium*).

Harta generală a Rezervației Peisagistice „Teţcani"



- Păduri naturale
- Păduri artificiale

În R.P.T. au fost identificate fitocenozele asociației cu vegetație silvică zonală de stejăret cu cireş *Querco(roboris)-Cerasietum* Gheideman et al., 1964) subasociația *poietosum (angustifoliae)*, iar din cea azonală sălcişuri (*Salicetum albae* Issler 1926), sălciş cu plop (*Saliceto-Populetum* Meijer-Drees 1936), subass. *rubietosum* şi *aegopodietosum*.

O largă răspândire au stejaretele artificiale cu o compoziție a arboretului cuprinsă în jurul la 10 St, răspândite în parcela 59 (subparcelele b, c, e, h, g, i, n, o, p, r) cu suprafață de 18,5 ha şi în parcela 60 (subparcelele j, k, o, s) pe o suprafața de 9,8 ha. Mai sunt prezente păltinişuri - 2,3 ha (parcela 59 subparcela q), frăsinete - 2,8 ha (parcela 60 subparcelele d şi m), salcâmete 9,8 ha (parcela 60 subparcelele a, b, p şi e) şi pinete - 0,3 ha (parcela 60 subparcela i). Pădurile artificiale în R.T.P. constituie 43 ha.

Pădurile naturale în rezervația peisagistică Tețcani (stejăretele naturale, sălcişurile, plopişurile), precum şi derivatele naturale - a acestora cu jugastru alcătuiesc 85,5 ha sau 64,2%.

În baza cercetărilor de campanie efectuate în vara anului 2004 şi 2011 precum şi a datelor publicate (Pânzaru P., 2006) s-a înregistrat prezența a 248 specii de plante vasculare din care: arbori 30 specii, arbuşti 23, liane - 2 şi ierburi 193 specii.

**Lista de plante vasculare înregistrate în Rezervația Peisagistică „Tețcani"**

**Arbori:** *Acer campestre L., Acer negundo L., Acer platanoides L., Acer pseudoplatanus L., Acer tataricum L., Carpinus betulus L., Cerasus avium (L.) Moench, Fraxinus excelsior L., Juglans regia L., Malus sylvestris L., Morus alba L., Morus nigra L., Padus avium Mill., Picia abiens (L.) Karst., Pinus sylvestris L., Populus alba L., Populus nigra L., Populus tremula L., Pyrus communis L.*[1*)]*, Pyrus pyraster Burgsd., Quercus petraea Liebl.*[*)]*, Quercus robur L., Rhamnus catharctica L., Robinia pseudacacia L., Salix alba L., Salix fragilis L., Ulmus carpinifolia Rupp. ex Suckow, Ulmus glabra Huds, Ulmus laevis Pall.* **Arbuşti:** *Amorpha fruticosa L., Caragana frutex (L.) C.Koch., Cornus mas L., Corylus avellana L., Cotinus caggygria Scop., Crataegus curvisepala Lindm., Crataegus monogina Jacq., Elaeagnus angustifolia L., Euonymus europaea L., Euonymus verrucosa Scop., Frangula alnus Mill.*[*)]*, Ligustrum vulgare L., Lonicera xylosteum L., Prunus spinosa L., Rhamnus tinctoria Waldst. et Kit., Rosa canina L., Rosa sp., Rubus caesius L., Sambucus nigra L., Staphylea pinnata L., Swida sanguinea (L.) Opiz, Viburnum lantana L., Viburnum opulus L.* **Liane:** *Hedera helix L.*[*)]*, Vitis sylvestris C.C.Gmel.* **Înveliş ierbos:** *Achillea millefolium, Aconitum anthora L., Actaea spicata L., Aegonichon purpureo-caeruleum (L.) Holub, Aegopodium podagraria L., Aethusa cynapium L.*[*)]*, Agelica sylvestris L., Agrimonia eupatoria L., Alliaria petiolata (Bieb.) Cavara et Grande, Anemonoides nemorosa (L.) Holub*[*)]*, Anemonoides ranunculoides (L.) Holub*[*)]*, Anthriscus sylvestris (L.) Hoffm.*[*)]*, Arabis turrita L.*[*)]*, Arctium lappa L., Aristolochia clematis L., Artemisia absinthium L., Artemisia annua L., Artemisia austriaca Jacq, Artemisia scoparia Waldst. et Kit, Artemisia vulgaris L., Asarum*

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[*)] - după Pânzaru P., 2006

europaeum L., Asparagus officinalis L., Asparagus tenuifolius Lam., Asplenium trichomanes L.*), Aster amellus L.*), Astragalus glycyphyllos L.*), Astragalus onobrychis L., Asyneuma canescens (Waldst. et Kit.) Griseb. et Schenk.*), Ballota nigra L., Betonica officinalis L., Bothriochloa ischaemum (L.) Keng, Brachipodium pinnatum (L.) Beauv., Brachypodium sylvaticum (Huds.) Beauv., Bromus arvensis L., Bupleurum falcatum L.*), Bupleurum rotundifolium L.*), Campanula bononiensis L., Campanula persicifolia L.*), Campanula rapunculoides L., Campanula trachelium L.*), Carex contigua Hope, Carex spicata Huds., Chaerophillum aromaticum L.*), Chaerophyllum temulum L., Chelidonium majus L., Cirsium arvense (L.) Scop.*), Clematis recta L.*), Clinopodium vulgare*), Convallaria majalis L., Conyza canadensis (L.) Cronq.*), Coronilla varia L., Corydalis cava (L.) Schweigg. et Körte, Corydalis marschalliana Pers., Corydalis solida (L.) Clairv., Cruciata glabra (L.) Ehrend.*), Cucubalus baccifer L., Cynoglossum officinale L.*), Dactylis glomerata L., Dentaria bulbifera L.*), Dipsacus pilosus L.*), Echinocystis lobata (Michx.) Torr. et Gray*), Elytrigia repens (L.) Nevski, Equisetum pratense L., Erigeron annus (L.) Pers.*), Eryngium campestre L., Euphorbia agraria Bieb., Euphorbia amygdaloides L.*), Euphorbia cyparissias L.*), Euphorbia esula L., Euphorbia platyphyllos L., Euphorbia villosa Waldst. et Kit.*), Festuca gigantea (L.) Vill., Festuca valesiaca Gaudin, Ficaria verna Huds., Filipendula vulgaris L., Fragaria vesca L., Fritillaria meleagroides Patrin ex Schult. et Schult.*), Gagea lutea (L.) Ker-Gawl., Gagea minima (L.) Ker-Gawl.*), Gagea pusilla (F.W.Schmidt) Schult. et Schult. fil., Galanthus nivalis L., Galeobdolon luteum Huds, Galium aparine L., Galium mollugo L., Galium odoratum (L.) Scop.*), Galium schultesii Vest*), Galium tinctorium (L.) Scop., Geranium robertianum L.*), Geum urbanum L., Glechoma hederacea L., Glechoma hirsuta Waldst. et Kit., Heliantus tuberosus L., Hepatica nobilis Mill.*), Heracleum sibiricum L.*), Hordelymus europaeus (L.) Harz., Humulus lupulus L., Hypericum hirsutum L.*), Hypericum perforatum L., Iris graminea L.*), Isopyrum thalictroides L., Knautia arvensis (L.) Coult., Lamium album L.*), Lamium maculatum (L.) L.*), Lamium purpureum L.*), Lapsana communis L., Lathyrus niger (L.) Bernh.*), Lathyrus nissolia L., Lathyrus vernus (L.) Bernh.*), Leonurus cardiaca L., Leopoldia comosa (L.) Parl.*), Lilium martagon L.*), Linum austriacum L., Linum hirsutum L., Lithospermum officinale L.*), Lysimachia nummularia L., Medicago falcata L., Melampyrum nemorosum L., Melica picta C.Koch., Melica uniflora Retz., Melilotus officinalis L., Mentha arvensis L., Mercurialis perennis

_L., Milium effusum L., Mycelis muralis (L.) Dumort.[*)], Nepeta cataria L., Nepeta pannonica L., Omphalodes scorpioides (Haenke) Schrank[*)], Origanum vulgare L.[*)], Peucedanum alsaticum L., Phlomis tuberosa L.[*)], Phragmites australis (Cav.) Trin. ex Steud., Physalis alkekengi L.[*)], Piptatherum virescens (Trin.) Boiss., Plantago lanceolata L., Plantago major L., Plantago media L., Poa angustifolia L., Poa bulbosa L., Poa compressa L., Poa nemoralis L., Poa palustris L., Polygonatum latifolium Desf., Polygonatum multiflorum (L.) All., Polygonatum odoratum (Mill.) Druce, Potentilla recta L.[*)], Potentilla reptans L., Primula veris L.[*)], Prunella vulgaris L.[*)], Pulmonaria obscura Dumort., Pulmonaria officinalis L., Ranunculus acris L., Ranunculus illyricus L., Rorippa sylvestris (L.) Bess., Rumex sanguineus L., Salvia nemorosa ssp. moldavica (Klok.) Soo, Sambucus ebulus L., Scilla bifolia L., Scrophularia nodosa L., Scutellaria altissima L., Sedum maximum (L.) Hoffm., Serratula tinctoria L.[*)], Silene chlorantha (Willd.) Ehrh., Silene nutans L., Sisymbrium strictissimum L.[*)], Solanium dulcamara L., Solidago virgaurea L.[*)], Sonchus arvensis L., Stachys sylvatica L., Stellaria holostea L., Stellaria media (L.) Vill., Tanacetum vulgare L., Taraxacum officinale Wigg., Teucrium chamaedrys L., Thalictrum minus L., Thymus marchallianus Willd., Trifolium arvense L., Trifolium pratense L., Tulipa biebersteiniana Schult. et Schult. fil.[*)], Urtica dioica L., Urtica urens L., Valeriana officinalis L., Veronica chamaedrys L.[*)], Veronica hederifolia L., Vicia pisiformis L., Vicia tenuifolia Roth, Vincetoxicum hirundinaria Medik., Viola hirta L., Viola mirabilis L.[*)], Viola odorata L.[*)], Viola reichenbachiana Jord. ex Boreau[*)], Viola tanaitica Grosset[*)], Viola tricolor L._

Din aceste plante rare în R.P.T. menționăm 16 specii - mălin (*Padus racemosum*), verigar (*Rhamnus tinctoria*), clocotiş (*Staphyllea pinnata*), caprifoi (*Lonicera xylosteum*), viță de pădure (*Vitis sylvestris*), sparanghel medicinal (*Asparagus officinalis*), sparanghel tenuifoliu (*Asparagus tenuifolius*), omag galben (*Aconitum anthora*), ghiocel alb (*Galantus nivalis*), călin (*Viburnum opulus*), floarea vântului (*Anemonoides nemorosa*), lalea de pădure (*Tulipa biebersteiniana*), crin de pădure (*Lilium martagon*), popâlnic (*Hepatica nobilis*), lalea pestriță (*Fritillaria meleagroides*), acul pământului (*Asplenium trichomanes*); plante invazive - 11 specii arțar american (*Acer negundo*), amorfa (*Amorfa fruticosa*), sălcioară (*Eleagnus angustifolia*), nuc (*Juglans regia*), napi, guli (*Helianthus tuberosus*), salcâm alb (*Robinia pseudacacia*), molid (*Picia abies*), pin obişnuit (*Pinus sylvestris*), dud (*Morus alba, Morus nigra*).

Tabelul 1

**Speciile de plante rare din R.P. Tețcani cu caracteristicile condițiilor de habitat**

| *Nr d/o* | *Denumirea speciei* | | *Arealul/ răspândirea* | *Habi-tatul* | *Statutul de protecție* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *Internațional* | | | *Național* | | |
| | *științifică* | *limba de stat* | | | *Berna Anexa II. rezol. 6* | *Bonn* | *CITES* | *Legea nr.1538-XIII feb. 25 1998* | *Categoria rarității* | *Cartea Roșie a R.Moldova* |
| 1. | *Aconitum anthora* | Omag galben | Eur(cont) | $U_2T_3R_5$ | - | - | - | + | IV | - |
| 2. | *Asparagus officinalis* | Spa-ranghel medici-nal | Eua(med) | $U_{1,5}T_{4,5}R_3$ | - | - | - | + | II | + |
| 3. | *Asparagus tenuifolius* | Spa-ranghel tenuifo-liu | Pont Med | $U_2T_5R_{3,5}$ | - | - | - | + | II | - |
| 4. | *Anemonoides nemorosa* | Floarea vântului | Eur | $U_{3,5}T_4R_0$ | - | - | - | + | III | + |
| 5. | *Galanthus nivalis* | Ghiocel alb | Eur(Med) | $U_{3,5}T_3R_4$ | - | - | - | + | III | + |
| 6. | *Lonicera xylosteum* | Caprifoi | Eua | $U_3T_3R_4$ | - | - | - | + | IV | - |
| 7. | *Padus avium* | Mălin comun | Eua | $U_{3,5}T_{3,5}R_3$ | - | - | - | + | III-IV | + |
| 8. | *Rhamnus tinctoria* | Verigar | Med. | $U_{1,5}T_4R_5$ | - | - | - | + | VIII | + |
| 9. | *Staphylea pinnata* | Cloco-tici | Eur(Med) | $U_{3,5}T_{3,5}R_4$ | - | - | - | + | IV | + |
| 10. | *Viburnum opulus* | Călin | Circ | $U_4T_3R_3$ | - | - | - | + | VIII | + |
| 11. | *Vitis sylves-tris* | Viță de pădure | Pont-Med. | $U_{3,5}T_{4,5}R_{4,5}$ | - | - | - | + | II-III | + |
| 12. | *Tulipa bie-bersteiniana* | Lalea de pădure | Pont-Cauc | $U_{3,4}T_3R_4$ | - | - | - | + | IV | - |
| 13. | *Lilium mar-tagon* | Crin de pădure | Eua | $U_3T_0R_4$ | + | - | - | + | VIII | - |
| 14. | *Hepatica nobilis* | Popâlnic | Eur | $U_3T_3R_4$ | - | - | - | + | III-IV | + |
| 15. | *Fritilaria meleagroides* | Lalea pestriță | E(Med) | $U_4T_{3,5}R_4$ | - | - | - | + | IV | + |
| 16. | *Asplenium trichomanes* | Acul pământului | Cosm | $U_3T_0R_4$ | - | - | - | + | VIII | + |

În Cartea Roşie a R.Moldova (ed. 2002) sunt cuprinse 11 specii - sparanghel medicinal (*Asparagus officinalis*), floarea vântului (*Anemonoides nemorosa*), ghiocel alb (*Galantus nivalis*), mălin comun (*Padus avium*), verigar (*Rhamnus tinctoria*), clocotici (*Staphyllea pinnata*), călin (*Viburnum opulus*), popâlnic (*Hepatica nobilis*), lalea pestriță (*Fritilaria meleagroides*), acul pământului (*Asplenium trichomanes*), iar crinul de pădure (*Lilium martagon*), este cuprins în Lista Roşie a Europei.

## Recomandări pentru îmbunătățirea condițiilor de habitat silvic în Rezervația Peisagistică Tețcani

1. De trecut sub gestionarea Gospodăriei silvice de stat Edineț 50 ha cele de terenuri libere de păduri aflate în posesia primăriei com.Tețcani r-nul Lipcani.

2. Pe toată aria pădurilor din rezervație de înfăptuit numai tăieri sanitare, iar pe sectoarele cu o regenerare naturală satisfăcătoare a esenței silvoformante (stejarul, plopul, salcia şi al.) de promovat tăieri succesive.

3. Prin amenajările silvice ulterioare de planificat substituirea arboreturilor artificiale (salcânete, păltinişuri, stejar roşu, frăsinete etc.) cu păduri naturale zonale adecvate habitatului (păduri cu cireş şi stejar).

4. De lărgit activitățile de educație ecologică a populației locale prin conştientizarea ei cu valoarea ştiințifică a obiectului ocrotit.

5. Periodic de petrecut reevaluarea stării tuturor componenților de floră şi faună precum şi de mediu din rezervația peisagistică Tețcani.

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# PAJIŞTILE DE LUNCĂ CU HABITAT CALCICOL DIN REPUBLICA MOLDOVA

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**Summary.** *The meadow grasslands, pertaining to syntaxonomic Molinio-Arrhenatheretea R. Tuxen 1937 and Phragmitio-magnocaricetea Klika 1941 classes are characterized by habitats with phreatic and surface waters of the calcium carbohydrate, and less than magnesium type was established.*

## Introducere

Vegetaţia pajiştilor de luncă se află în strânsă dependeţă nu numai de durata perioadei de inundaţie, dar şi de tipul de salinizare şi concentraţi ai sărurilor minerale din sol. Acestea din urmă sunt acumulate din apele freatice mineralizate, care frecvent scaldă solurile aluviale. În luncile râurilor din R.Moldova cu ape freatice şi de suprafaţă de o mineralizare slabă (până la 500 mg/l) (Взнуздаев О.Г., 1959; Сластихин В.В., 1978; Lozan R., 2002; Горячева Н.В., Дука Г.Г., 2004; Overcenco A. şi col., 2008), se stabileşte o componenţă floristică şi fitocenotică discretă. Este cunoscut faptul că pajiştile mezofile, mezohigrofile şi higrofile cu dominanţi din areal nordic se localizează în spaţiile unde apele freatice de origine sarmaţianului superior şi mijlociu sunt puţin sau nu sunt influenţate de apele puternic mineralizate a plasturilor acvatice de vârsta cretaceului şi silurului cu compuşi ai sodiului şi potasiului (Бобринский Н.В., 1988). Sau în Moldova avem pajişti de luncă cu habitat calcicol, scăldat de ape freatice de tipul hidrocarbonaţilor de calciu şi parţial magneziu, comunităţi a pajiştilor cu habitat sodic influenţat de apele arteziene saturate cu compuşi ai sodiului şi potasiului . Mai jos se va analiza pajiştele de luncă cu habitat calcicol, aflate sub influenţa permanentă a apelor freatice de vârstă sarmaţiană bogate în hidrocarbonaţi de calciu şi magneziu şi se află pe rocile argilonisipoase din terenurile cu o altitudine mare în relief (cursul începător al râurilor interne precum şi lunca fl. Nistru de la intrare pe teritoriul R.Moldova până la or. Dubăsari) (Друмя А.В., 1978).

## Materiale şi metodele

Pe parcursul anilor 1993-1996 s-au efectuat investigaţii floristice şi fitocenotice privind afinitatea speciilor de plante ierboase la conţinutul sărurilor în sol. În staţiunile cu dominarea principalelor pratoformanţi ai pajiştilor de luncă s-a colectat probe de sol la nivelurile 0-20 cm şi 20-40 cm şi fitomasă (partea aeriană), pentru analize chimice (Lazu, Sergentu, 1995 a, b). Efectuând cercetări floristice şi fitocenotice în diverse habitate ale luncilor râurilor din țara noastră s-au evidențiat deosebiri substanțiale în componența speciilor de plante şi formarea comunităților acestora în diverse regimuri de salinizare a solurilor. Prin compararea lor cu rezultatele analizelor chimice asupra conținutului de săruri minerale din apele freatice şi de suprafață (Lozan A., 2002; Горячева В.В., Дука Г.Г., 2004; Overcenco A. şi col., 2007), precum şi a componenței floristice şi fitocenotice (Пожарисская Л.П., 1956; Космодамианская М.М., 1967; Гейдеман Т.С., 1966) s-a evidențiat afinitățile pajiştilor de luncă către un anumit tip de mineralizare a apelor freatice şi de suprafața din stațiune. Mai jos se va analiza răspândirea vegetației pajiştelor de luncă şi din zonele umede cu habitat scăldat de ape cu un reziduu uscat de până la 1,0 g/l şi predomină hidrocarbonații de calciu şi magneziu.

## Rezultate şi discuții

Ecosistemele ierburilor de luncă din R. Moldova sunt puternic influențate de caracterul ascendant şi de acumulare a sărurilor în sol din apele freatice. Solurile din R.Moldova sunt scăldate de două tipuri de ape freatice deosebite după mineralizare şi componența chimică. Soluri scăldate de ape freatice de vârsta sarmațianului de mijloc şi superior, contribuind la stabilirea unei componențe floristice şi fitocenotice discrete, precum şi a raportului cantitativ a indivizilor. Cu creşterea concentrației sărurilor în sol se diminuează numărul speciilor componente din comunitățile de plante, formarea fonului de dominare a unei specii, mai rar, două sau mai multe. Pe lângă specia dominantă în aceste fitocenoze se mai prezintă şi cele asecatore sau codominante. Atât speciile dominante cât şi cele asecatore se află într-o disponibilitate directă față de condițiile de habitat, îndeosebi concentrația şi componența chimică a sărurilor din sol.

Apele freatice de pe văile râurilor din zona Codrilor Centrali de vârsta sarmațianului de mijloc se găsesc la o adâncime relativ mică (0,8-5 m), iar după componența chimică fac parte din grupul hidrocarbonaților de calciu $Ca(HCO_3)_2$, mai rar se întâlnesc cele cu cationi de sodiu şi magneziu. Sulfații apar în cantități neînsemnate. Ca regulă, aceste lunci au un regim inundabil de o durată variabilă 5-10 zile (primăvara, vara, iar uneori şi toamna-iarna), şi conținutul de săruri nu are tendințe evidente spre acumulare. Astfel se stabilesc condiții favorabile pentru dezvoltarea vegetației ierboase mezofile a pajiştilor propriu-zise (prata genuina). Apele freatice din luncile acestor râuri se caracterizează printr-o mineralizare redusă (156-949 mg/l, mai des până la 500 mg/l). Prin dereglarea regimului inundațional (construirea lacurilor de acumulare, barajelor) mineralizarea apelor freatice creşte.

Plantele eşantionate s-au colectat pe valea r. Bâc (or. Străşeni), unde apele freatice au un reziduu uscat cuprins în limitele de până la 960 mg/l, pH - 7,3 - 8,0, predomină hidrocarbonații ($HCO_3^{-1}$) şi cationii de calciu ($Ca^{+2}$), parțial magneziu ($Mg^{+2}$) (Взнуздаев, 1959; Overcenco A. şi col., 2007). Analizele chimice ale solurilor (0 – 20 cm), cu un reziduu uscat de la 0,100 până la 0,320 g/l sunt perzentate pentru diferite habitate a plantelor mezofite (Lazu, Sergentu, 1995). Din acestea au fost pratoformanții – ovăsciorul (*Arrhenatherum elatius*), colectat de pe sol cu sediment de 0,18 g/l şi predominarea calciului, iarba câmpului (*Agrostis stolonifera*) – 0,18, firuța (*Poa pratensis*) – 0,18, precum şi unele componente a pajiştilor mezofite - coada calului (*Equisetum ramosissimum*) – 0,2, sulfină medicinală (*Melilotus officinalis*) – 0,16*, sulfină albă* (*Melilotus albus*) - 0,14, ghizdei corniculat (*Lotus corniculatus*) - 0,14, linte praticolă (*Lathyrus pratensis*) – 0,2, lobodă tătărească (*Atriplex tatarica*) – 0,1, trifoi praticol (*Trifolium pratense*) – 0,32*,* trifoi fragifer (*Trifolium fragiferum*) – 0,22, săpunărița medicinală (*Saponaria officinalis*) – 0,1, tamariscă rămuroasă (*Tamarix ramosissima*) – 0,14, drețe repente (*Lysimachia nummularia*) – 0,16, rugină extinsă (*Juncus effusus*) - 0,3 g/l reziduu uscat.

În lunca r. Cula (s. Condrăteşti r-onul Ungheni) 7-16 iunie 1993 pe sol (0,20 cm) cu reziduu uscat de 243 mg/l de tip calcic s-a fixat habitatul pratoformantului coada vulpii (*Alopecurus pratensis*) şi a scvămăriței latifolie (*Lepidium latifolium*) pe sol cu sedimentul uscat 217 mg/l, iar în aceeaşi luncă pipirig maritim (*Bolboschoenus maritimus*), becmanie eruciformă (*Beckmannia eruciformis*), chirău intermediu (*Elytrigia intermedia*) pe sol cu habitat sodic şi cu reziduu uscat mult mai mare (395-961 mg/l).

Unele specii cu areal nordic sunt predispuse nu numai să accepte habitatul acidulat, dar şi să contribuie la formarea lui.

Bumbăcărița (*Eriophorum latifolium Hoppe*) – plantă rară cuprinsă în Cartea Roşie a țării noastre (ed. 1978, 2002) este răspândită din areal nordic, dar fragmentar se întâlneşte şi în țara noastră (Lozova şi Căpriana). Bumbăcărița – planta microtermofilă preferă habitat higrofil cu sol mlăştinos, troficitate redusă şi reacția chimică acidă. Prin dezagregarea anairobă a materiei vegetale de bumbăcăriță se formează turbă, acidulând solul. Formula ecologică a bumbăcăriței -$U_5Tr_1T_2R_2$. Ursu A. şi col (2007) au efectuat investigații morfologice, ecologice şi geografice în habitatul bumbăcăriței din Rezervația Ştiințifică ”Codrii”. S-a constatat că bumbăcărița se reproduce vegetativ prin fragmentarea rizomilor. Înmulțirea prin semințe lipseşte (Витко К.Р., 1978). Cercetările pedologice a substratului cu bumbăcăriță demonstrează că materia vegetală prin dezagregare chimică anairobă formează un mediu acidulat, care înaintează pe profilul solului calcaros până la 40-45 cm adâncime, formând un sol aluvial turbic cu o pronunțată acidulare. Habitatul natural al acestei specii sunt turbăriile din nordul Europei (acad. A.Ursu menționează că a vizitat turbăriile din Estonia unde bumbăcărița creştea de rând cu alte specii a acestui habitat). Puşcariu-Sorocianu E. şi col. (1963) atribuie bumbăcărița latifolie la comunitățile cu habitat de mlaştini oligotrofe a turbăriilor de munte. Tendința de a forma sol aluvial turbic în stațiunile cu bumbăcăriță de la noi a semnificat şi acad. Ursu A. Astfel, probabil, are loc modificarea habitatului calcaros sub influența produselor de descompunere anairobă a materiei vegetale ierburilor cu areal nordic - firuța, iarba câmpului, păiuş şi al. (Chifu, 1984).

Speciile de ierburi pratoformante cu habitat calcic sunt predispuse spre a avea în sol mediu acidulat prielnic pentru plantele cu areal nordic. Dar aşa specii pratoformante care se extind din arealul nordic în pajiştile de luncă a țării noastre ca – pipiriguța cespitoasă (*Deschampsia cespitosa, D.flexiosa*), şuvar albăstriu (*Molinia caerulea*), vițelar odorat (*Anthoxanthum odoratum*), răgoz leporin (*Carex leporina*), bucățel canin (*Agrostis canina*), bucățel subțire (*Agrostis tenuis*), ierbăluță arundinacee (*Phalaroides arundinacea*), bulbuc palustru (*Caltha palustris*), trestioară căruntă (*Calamagrostis canescens*), ecvisetă fluvială (*Equisetum fluviatile*), răgoz vesicariu (*Carex vesicaria*), raurică maximă (*Gliceria maxima*) şi al. sunt cotate că plante rare şi se întâlnesc preponderent la nordul R.Moldova.

În habitatele calcice de luncă mezofilă se regăsesc aşa pratoformanți a ordinului syntaxonomic *Arrhenatheretalia* ca ovăsciorul (*Arrhenatherum elatius*), zizania (*Lolium perenne*), golomăț (*Dactilis glomerata*), pir (*Elytrigia repens* şi *E.intermedia*), lucernă (*Medicago lupulina*). În habitatele calcicole mezohigrofile se întâlnesc pratoformanți ai ord. *Molinietalia* ca bulbuc sau calcia calului (*Caltha palustris*), țipirig silvatic (*Scirpus sylvaticus*), pipirig (*Juncus effusus*), aglică (*Filipendula ulmaria*), captalan (*Petasitis hybridus*), iarba câmpului (*Agrostis stolonifera, A.gigantea, A.tenuis*), răchitan (*Lythrum salicaria*), pălămidă (*Cirsium canum*), trestie de câmp (*Calamagrostis epigeios*), precum şi a pajiştilor mezohigrofile cu un regim inundațional mai îndelungat cu aşa ierburi al ord. *Deschampsietalia cespitosa* - coada vulpii (*Alopecurus pratensis*), păiuş (*Festuca pratensis*), firuță (*Poa pratensis, P.sylvicola, P.trivialis*).

Pajiştile cu vegetație de luncă mlăştinoasă cu ape freatice calcicole superficiale şi cu un regim inundațional diversificat sunt reprezentate de comunitățile ierboase a cl. *Phragmiteto-Magnocaricetea* Klika 1941. Pajiştile mlăştinoase cu regim inundațional de lungă durată sunt întrunite în ord. *Magnocaricetalia* Pignatti 1953 cu aşa pratoformanţi: *Carex acutiformis Ehrh., C.riparia Curt., C.vulpina L., C.vesicaria L., C.otrubae Podp., C.cespitosa L., Scirpus sylvaticus L.* Staţiunile mlăştinoase cu ape dulci în permanentă şi troficitate sporită sunt întrunite în formaţiuni higrofile a ord. *Oenanthetalia aquatica* cu pratoformanţii - crinul de baltă (*Butomus umbelatum*) şi firuţa de baltă (*Poa palustris*), precum şi din ord. *Nasturtio-Glycerietalia* cu aşa pratoformanţii ca buzduganul (*Sparganium erectum*), mlăştiniţă (*Eleocharis palustris*), erbăluţă (*Phalaroides arundinaceus*), trestie de câmp (*Calamagrostis pseudophragmitis*).

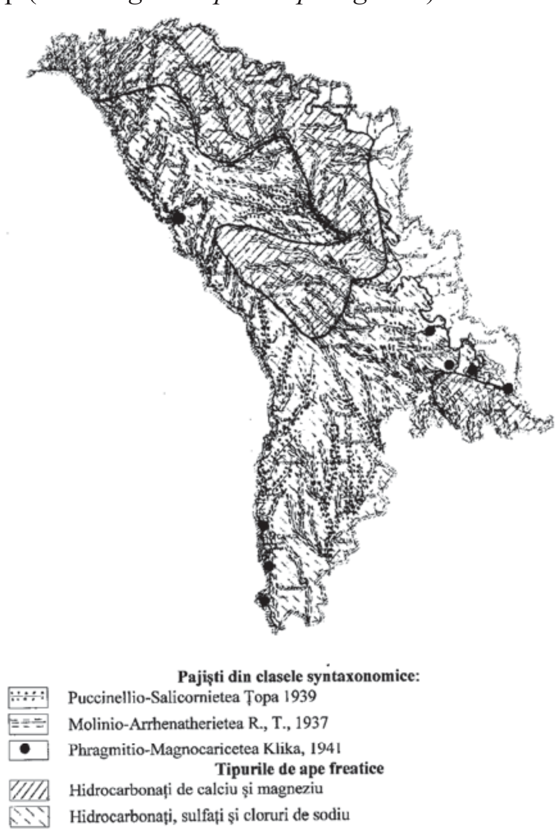


Figura 1. Vegetaţia pajiştilor de luncă a staţiunilor cu diverse tipuri de ape freate din R. Moldova

În luncile râurilor cu ape freatice şi de suprafaţă de tip calcic din R.S.S. Moldovenească au fost distinse aşa formaţiuni ierboase a pajiştilor mezohigrofile (Prata genuina) ca *Agrostideta stoloniferae, Calamagrostideta epigeios, Alopecureta pratensis, Festuceta pratensis, Agropyreta repentis,* *Poeta pratensis, Poeta silvicolae, Lolieta perenne* şi a staţiunilor mlăştinoase (Prata paludosa) – *Phragmiteta communis, Digraphideta arundinaceae, Cariceta melanostachyae, Cariceta ripariae, Glycerieta aquaticae* şi al., (Пожарисская Л.П., 1956; Гейдеман Т.С., 1966; Космодамианская М.М., 1967; Postolache Gh., 1995).

După nivelul de afinitate a speciilor de plante faţă de condiţiile de habitat din luncile râurilor (umiditatea, troficitatea, temperatura şi reacţia chimică a solurilor) precum şi gradul de mineralizare şi componenţa chimică a apelor freatice şi de suprafaţă s-a evidenţiat pajiştile mezofile cu un divertisment larg de plante indicatoare din pajiştile calcicole (Braun-Blanquet J., 1933; Chifu T., 1989; Lazu Şt., Sergentu E., 1995; Lazu Şt., Teleuţă Al., 2008; Lazu Şt., Izverschi T., Teleuţă Al., 2008) (Figura 1).

**Vegetaţia pajiştilor de lunca mlăştinoasă (Prata paludosa)**

I. CI. Phragmitio - Magnocaricetea-Klika 1941
1. ord. Phragmitetalia W. Koch 1926
1. AII. Phragmition communis W. Koch 1926
1. Ass. Phragmitietum communis (Gams 1927) Schmale 1939
2. Ass. Scirpeto-Phragmitietum W. Koch 1926
3. Ass. Schoenophetietum lacustris (Allorge 1922) Chonard 1924 Eggler 1933
2. ord. Oenanthetalia aquaticae Hejny 1948
2. AII Oenanthion aquaticae Hejny 1948
4. Ass. Butumietum umibelati (Konczak 1968) Philipii 1973
3. AII Poion palustris Sheliag, V. SI. et Sipailova 1985,
5. Ass. Poietum palustris Resmerita et Ratiu 1974
3. ord. Nosturtio - Glycerietalia Pignatti 1953
4. AII. Glycerio - Sparganion Br.-Bl. et Sissingh ex Baer 1942
6. Ass. Glycerietum maximae Heck 1931
7. Ass. Typhietum latifoliae Soó 1927
8. Ass. Typhietum angustifoliae Pignatii 1953
9. Ass. Acorietum calami Eggler 1993
10. Ass. Sparganio-Glycerietum fluitantis Br.-Bl. 1925
11. Ass. Eleocharietum palustrus Sennicov 1919, Soó 1933
5. All. Phalaroidion arundinaceae Kopecky 1961
12. Ass. Phalaroidietum arundinaceae Libb.1931
13. Ass. Calamagrostietum pseudophragmitis Kopecky 1968
4. ord. Magnocaricetalia Pignatti 1953
6. AII. Magnocaricion elatae W. Koch 1926

14. Ass. Caricietum acutiformis Sauer 1937
15. Ass. Caricietum ripariae Soó 1928
16. Ass. Caricietum vulpinae Nowinski 1927, Soó 1927, 1969
17. Ass. Caricietum vesicariae Br.-Bl. et Denis 1928
18. Ass. Caricietum otrubae n.n.
19. Ass. Scirpietum sylvatici Eggler 1933
20. Ass. Caricietum caspistosae Stellen 1931
21. Ass. Schoenoplectietum triqueter Zonneveld 1955

**Vegetația pajiştilor de lunci mezofite - (Prata Genuina)**

II. CI. Molinio-Arrhenatheretea Tx. 1937
5. Ord. Molinietalia W. Koch 1926
7. AII. Calthion palustris Tx. 1937
22. Ass. Juncietum effusi Soo (1931) 1949, Eggler 1933
8. AII. Filipendulo-Petasition Br.-Bl. 1947
23. Ass. Filipendulo-Geranietum palustrus W. Koch 1926
24. Ass. Petasitietum hybridi (Dostal 1933) Soó 1940
9. AII. Agrostion stoloniferae Soó 1933
25. Ass. Agrostietum giganteae n.n. M.Cosmodamianskaia; 1967
26. Ass. Agrostietum stoloniferae Ujvaroşi 1941
Subass. ranunculietosum repentis Soó 1944
Subass. agrostietosum Soó 1964
Subass. eleocharietosum Soó 1964
Subass. caricietosum vulpinae Soó 1957
Subass. tussilagietosum farfor
27. Ass. Agrostietum tenuis Sapegin 1986
28. Ass. Glycerietum aquaticae M.Cosmodamianskaia 1967
29. Ass. Lythro-Calamagrostidietum epigei I. Pop 1968
30. Ass. Lythro (salicariae)-Juncietum effusi-inflexi Todor et al.1967
31. Ass. Cirsietum cani Tx. 1951
32. Ass. Calamagrostietum epigeios Cosmodamianskaia MM., 1967 n.n.
6. Ord. Deschampsietalia cespitosae Harvatic 1930
10. AII. Alopecurion pratensis Soó 1938; Pass. 1964
33. Ass. Alopecurietum pratensis Regel 1925; Novinski 1928
Subass. poietosum pratensis Soó 1957
Subass. caricetosum melanostachyae Soó 1957
Subass. ranunculietosum acris Juhasz Nagy apud Soó 1957

Subass. puccinellietosum distantis n.n.

34. Ass. Festucietum pratensis Soó 1938

35. Ass. Poietum pratensis Rav., Cazac. et Turenschi 1956

Subass. puccinellietum distantis n.n.

36. Ass. Poietum sylvicolae Buia, Paun, Safta, Pop 1959

37. Ass. Poietum trivialis Soó 1940

38. Ass. Festucietum gigantaea n.n.

7. Ord. Arrhenatheretalia Pawl 1928

11. AII. Arrhenatherion elatioris (Br.-Bl. 1925) W. Koch 1926

39. Ass. Arrhenatherietum elatioris (Br.-Bl.1919 s.l.) Scherrer 1925, Soó 1969

Subass. tipicum Oberd 1952; Jeanplong 1960

Subass. poietosum sylvicola n.n.

40. Ass. Medicagini (lupulinae) - Agropyrietum repentis Popescu, Sanda, Doltu 1980

41. Ass. Lolietum perennis Safta 1943

42. Ass. Elytrigietum intermedium n.n.

43. Ass. Agropyrietum repentis Gors 1966

## Concluzii

Pajiştile calcicole se regăsesc în luncile râurilor, care pornesc din relieful deluros-muntos a Podişului Central Moldovenesc (r. Ichel, Bâc, Botna, Cogâlnic, Işnovăț, Lăpuşna, Nârnova), lanțul deluros Soroca-Rezina (râurile Camenca, Cernița, Cogâlnic) şi Platoul Moldovei de nord (râurile Răut, Cubolta, Căinari, Draghişte, Căldăruşa, Ciugur, Vilia, Racovăț). Aceste pajişti au habitat alimentat cu ape freatice şi de suprafața de tipul hidrocarbonaților de calciu şi magneziu de vârstă sarmațiană.

În pajiştile calcicole cu habitat mezofil şi mezohigrofil din luncile râurilor R.Moldova s-au evidențiat prezența 18 asociații, 5 alianțe, 3 ordine din cl. *Molinio-Arrhenatheretea* Tx. 1937, cu pratofornanți de arealul nordic. Pajiştile calcicole cu habitat higrofil cuprinde specii pratoformante termofile, s-au marcat cu prezența 24 asociații, 7 alianțe, 5 ordine din cl. *Phragmitio-Magnocaricetea* Klika 1941.

1. S-a constatat că pajiştile cl. *Molinio-Arrhenatherietea* se întâlnesc în luncile râurilor din Podişul Moldovei Centrale şi Platoul Moldovei de nord alimentate cu ape freatice şi de suprafețe bogate în hidrocarbonați de calciu.

2. Din plantele indicatoare caracteristice pajiştilor de luncă cu habitat calcicole menționăm: obsiga (*Brachypoodium pinnatum (L.) Beauv.*), firuță comprimată (*Poa compressa L.*), coşaci (*Astragalus onobrychis L.*),

sulițică (*Dorycnium herbaceum Willt.*), linărița (*Linaria genistifolia (L.) Mill.*), smeoaică (*Seseli libanotis (L.) Koch.*).

3. Pajiştile calcicole formează mediul acidulat în sol favorizând ierburile cu areal nordic. În condițiile impactului climateric al încălzirii globale vegetația pajiştilor de luncă este predispusă spre extinderea ariei solurilor alcaline, iar cele acidulate sunt în retragere.

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# 3. INTRODUCTION AND SUSTAINABLE USE OF THE PLANTS RESOURCES

## INTRODUCTION OF *SILPHIUM PERFOLIATUM* L. AND ITS UTILIZATION POSSIBILITIES


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***Summary.*** *Silphium perfoliatum L., an autochthonous cultivar "Vital" created and cultivated in Botanical Garden (Institute) of ASM., in the first year of vegetation, having a slow growth, but in subsequent years growth and development are intensive, beginning since early spring and ensuring the first natural forage production was established. The harvest of fresh mass reaches 128 t / ha where the leaves constitutes more than 55% of natural mass production fresh green forage for preparation of silage and vitaminous flour for livestock and poultry it was attested. Chemical composition of the natural forage is as follows: 78.90% water, 3.20% raw protein (composed of 17 amino acids, including lysine, leucine, valine and methionine), 0.51% raw fats, 7.15% raw fiber, 2.36% minerals, 7.87% of extractive free-nitrate substances; 1 kg of natural forage content: 0.16 nutrient units, 1.92 MJ exchange energy for cattle, 21.47 g digestible protein, 4.58 g calcium, 0.46 g phosphorus, 9.70 mg carotene; 1 nutritive unit is provided with 134.19 g digestible protein. On the same land can be cultivated more than 20 years. Plants are resistant to frost and cold but have an average resistance to drought. Due to longevity of exploitation, of productivity high and constant, as melliferous plants we can obtain approx. 170 - 200 kg/ha of honey, as energy plants for biogas production and pellets (16-17 MJ/kg) were utilized. Silphium perfoliatum L. plants which contributes to improve polluted, degraded and eroded soils, also physical and chemical soil properties was researched. The extracting capacity of salts or heavy metals from the soil and, transforming them into nontoxic neutral compounds, of sludge from wastewater, and of improving the state of municipal wastewater treatment plants and landfills was confirmed. The extracts from this plant can contribute to obtaining plants growth stimulants of vegetable origins, also as medicinal preparations.*


### Introduction

Mobilization and study, improvement and implementation of plants with multiple values are dictated by the supply and demand of the national economy. In Republic of Moldova about 400 thousand hectares of agricultural land are degraded that can't be used for cultivation the traditional plants. The insurance of animal and poultry with vegetable feed remains a stringent problem. Food consumption increased by 20-25%, because the food ration is unbalanced with vegetable protein. Plants with high energy potential for production of biofuels less are investigated and implemented. The planted area under herbaceous melliferous plants is considerably reduced. The perennial herbaceous plant species have an important role in solving the above-mentioned problems.

Scientific research performed in the Botanical Gardens over 60 years has tended to mobilization, improvement and implementation of new species; collection of fodder plants which enumerates near 260 species and varieties; new forms and varieties are created and technologies for cultivation of the new species of fodder plants, including for recovering of degraded soils was elaborated (Teleuta, 2010).

## Materials and methods

As biological material for researches served *Silphium perfoliatum* L., fam. *Asteraceae*, originated from North America was introduced and, the variety "Vital" in the Botanical Garden (Institute) of A.S.M. was created and cultivated. Scientific researches on growth and development of plants were performed according to the method Novoselov (1983), Ivanov (1985) meantime, chemical composition conform the recommendations of Ermakov (1987).

## Results and discussions

*Silphium perfoliatum* L., is a herbaceous plant, perennial, polycarpic, straight stem, four-cornered, with hairs; branched at the top, height of 250-370 cm and of 2-4 cm thickness at the base. The leaves are greenish, cordiform, with 25-35 cm length and of 16-22 cm width, embossed, asperous, dentate, and adverse, the inferior petiolate, those superior concrescent, poculiform, which permits efficient utilization of humidity and solar radiation. The palar root system penetrates up to 3.5 m depth. The plants, beginning with second year of vegetation, blooms in middle-July to August, has a compound inflorescence; on a raceme are disposed 20 to 30 yellow flowers, 3-5 cm in diameter.

The plant is propagated by generative and vegetative methods (seed, rhizomes, and seedling). For establishment of sylph plantation are necessary different measures as is follows: the weeding, applying organic fertilizers (manure or town-sludge) in dose of 25-35 t / ha, absolutely dry substance and processing at a depth of 32-35 cm, also leveling. The plant is sown in late autumn or early spring, with stratified seed, using about 10 kg/ha, the depth incorporation of the seed being 1.5 to 2.0 cm, then follows soil compaction. Plants generates after 10-15 days when soil temperature of 6-8 °C is established. Sylph forms a well-developed root system, consist from long and thin adventives roots and rhizomes was attested. At the end of first year of vegetation rhizomes reach to 3.0 - 3.5 cm in length from and 2.3 to 2.7 cm in thickness.

Figure 1. *Silphium perfoliatum* L. Vital variety of plants during of the stem formation achieves up to1,3 m height in the sixth year of vegetation

On the buds rhizomes appear the reproductive from that develop monocarpic shoots, whose development cycle is in function of the climate conditions, being 185-205 days. In the first year of development we distinguish two phases: formation of plantlets and juvenile phase. The length of cotyledons is 3.3 to 3.8 cm, greenish, after 20 days of the occurrence. Mature leaves appear during 8-12 days and the next leaf appears in 6-10 days. Primary factor in this period is the temperature. After the appearance of the 4th leaf, the cotyledons are dry.

The following leaves appear from the embryonic buds disposed between cotyledons. In the first year a plant can grow 12 to 14 leaves which make up the central rosette; and in August appear 1-3 shoots that can grow still 4-6 leaves. The central rosette grow and development up to the first autumn freeze. The plant reaches a height of 0.8 -1.0 m. In late summer on the rhizomes it forms generative buds which in spring of next year, when air temperature exceeds 5 °C, starts developing the new plants, when initiate all stages of ontogenetic development, finished with seed formation. In the early days of vegetation growth is slow, but after 25-30 days growth accelerates forming shoots which at the end of May can reach 1.3 to 1.6 m high, growth in this period is 5-9 cm/day. The generative organs start the development after14-16 leaves formation.

Figure 2. *Silphium perfoliatum* L. Plants during the flowering, height 3 m

In conditions of Moldova, the blooming begins in late July – early August which negatively affects the maturation homogeneity of the seeds and, also, mechanized harvesting. The fruit is an achene, which can be spread by wind. The seeds productivity reaches up to 2.9- 4.5 q/ha however, long flowering period ensure the bees with feed that helps to collect 150-200 kg/ha of honey.

In the second year of vegetation plants can form 3-5 shoots on a bush and after 5-7 years 10 to 14 shoots on square meter was confirmed. The plants of *Silphium perfoliatum* L. can be cultivated on the same land more than 20 years, but after 7 years of exploitation, operational works are necessary for optimizing of plants density. The plants have high resistance to frost and freeze, but moderate at heat and drought.

In the first year it can be harvested about 20-28 for t / ha fresh mass, but in subsequent years the annual harvesting of fresh mass varies from 72 t/ha to 128 t/ha, in function of weather conditions. The plants harvested at the first sew in buds phase, grow recovering and reach optimal harvesting stage again at the end of September.

The plants are used as green fodder, to the production of protein-vitamin flour, and silos for livestock and poultry (Vavilov, Kondratyev, 1975; Puia, 1985; Uteush, 1991; Abramov, 1992).

Chemical composition of green fodder, harvested in buds phase, when the leaves is more than 55%, it is as follows: 78.90% water, 3.20% raw protein (composed of 17 amino acids, including essential as lysine, leucine, valine and methionine), 0.51% raw fat, 7.15% raw fiber, 2.36% minerals, 7.87% nitrogen free substances. 1 kg of naturally feed contains: 0.16 nutritious units, 1.92 MJ metabolized energy for cattle , 21.47 g of digestible protein, 4.58 g calcium, 0.46 g phosphorus, 9.70 mg carotene; 1 nutritional unit is provided with 134.19 g digestible protein. The extracts of the plants are used at wheat seed treatment, thus increasing the crop (with 2.4 to 3.7q/ha), also, gluten content (with 1.3 to 1.4%) (Davidyants, 2006).

In Russia, Belarus this plants are used at the works for improving the soil with excess of humidity, due to the formation of a big biomass quantity and development of a vigorous root system, formed by the rhizomes and adventitious roots, help to regulate and improve of soil hydric regime (Zinkovskii, Zinkovskaya, 2010).

As a medicinal plant has antibacterial influence and is used in treating arthritis, bleeding and diarrhea (Kowalski, Kedzia, 2007; Kowalski, 2007, 2009).

Carpenter weed biomass is used in Germany, Czech Republic and Poland for producing biogas which allows getting from 1 tone of fresh mass 500 $m^3$ of gas containing 70% methane. Bricks have an energy capacity of near 16-17 MJ / kg (Majtkowski, 2009). The emplacement of plants on the mud deposits of SA “Apa Canal Chisinau” help to grassing land, strengthening "crown" and avoid slipping facilities, definitively binding sludge deposits and to reduce the proliferation of pathogens and undesirable odors.

## Conclusions

*Silphium perfoliatum* L., forming a central rosette with 12 to 14 leaves in the first year of vegetation; the next years due to intensive growth, all phases of ontogenetic development of the plant, was established. Plant vegetation begins early spring, providing fresh production of natural feed, thus ensuring the covering of vegetal forage until late autumn was confirmed. On the same land can be cultivated more than 20 years. Possess resistance to frost and cold, but shows average drought resistance. Thanks to its longevity, high and constant productivity are used to produce fodder for cattle and poultry, as melliferous plants and, as energy plants for biogas production and pellets. Carpenters weed possessing the peculiarities of improving polluted, degraded and eroded soil, beneficially influences physical and chemical soil properties (structure). These plants have the ability to neutralize heavy metals from soil also their transformation into nontoxic neutral compounds, can help to phytoremediation of polluted areas with radioactive elements, and protect the environment from treatment stations and waste deposits. Extracts of these herbs for obtaining means of plant protection, medicines preparations of vegetable origin are used.

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# PARTICULARITĂŢI FIZICO-CHIMICE ŞI BIOMORFOLOGICE COMPARATIVE ALE UNOR HIBRIZI DISTANŢI DE VIŢĂ DE VIE *(VITIS VINIFERA* L. X *MUSCADINIA ROTUNDIFOLIA* MICHX.*)*

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**Summary.** *Vine grapes, duet o the physical-chemical played high content of easily sugars (glucose, fructose), organic acids, mineral, amino acids, vitamins, etc., are required for large-scale consumption both fresh as well as various canned goods. A suitable culture technology may lead to expected results, even in less favorabile weather conditions recorded at certain times. As the object of study served vine distant hybrids (Vitis vinifera L. x Muscadinia rotundifolia Michx.) of $BC_3$: DRX-$M_4$-503; DRX-$M_4$-504; DRX-$M_4$-530; DRX-$M_4$-535; DRX-$M_4$-537; DRX-$M_4$-579; DRX-$M_4$-635; DRX-$M_4$-679. Hybrids distant vine with green-yellow berries contain phenolic substances in quantities much smaller in distant hybrids with blue-purple berries.*

## Introducere

Strugurii de viţă de vie, datorită particularităţilor fizico-chimice redate de conţinutul sporit de zaharuri uşor asimilabile (glucoză, fructoză), acizii organici, săruri minerale, aminoacizi, vitamine etc., sunt solicitaţi pentru consum la scară largă atât în stare proaspătă cât şi sub formă de diverse produse conservate. Calitatea strugurilor este primordială pentru obţinerea unui produs competitiv, capabil să facă faţă unei concurenţe tot mai acerbe de pe piaţa mondială din domeniu.

Valorificarea superioară şi eficientă a strugurilor de viţă de vie se datorează şi gradului de maturitate al bacelor. Aceasta se stabileşte în funcţie de soi şi condiţiile pedo-climatice ale zonei de producţie şi se realizează, în general, când strugurii ajung la maturitatea deplină.

O tehnologie de cultură adecvată poate duce la obţinerea unor rezultate scontate, chiar şi în condiţii climatice mai puţin favorabile înregistrate în anumite perioade.

## Materiale şi metode

În calitate de obiect de studiu au servit hibrizii distanţi de viţă de vie (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) de $BC_3$: DRX-$M_4$-503; DRX-$M_4$-504; DRX-$M_4$-530; DRX-$M_4$-535; DRX-$M_4$-537; DRX-$M_4$-579; DRX-$M_4$-635; DRX-$M_4$-679. Hibrizii respectivi sunt prezenţi în colecţia de hibrizi distanţi de viţă de vie din Grădina Botanică (Institut) a AŞM.

Particularităţile fizico-chimice au fost determinate în cadrul Institutului Ştiinţifico-Practic de Horticultură şi tehnologii alimentare, (Chişinău, str. Vieru 59).

Însuşirile bio-morfologice au fost efectuate în cadrul Grădinii Botanice (Institut) a AŞM (Chişinău, str. Pădurii, 18)

## Rezultate şi discuţii

Întru aprecierea proprietăţilor calitative şi cantitative ale strugurilor de viţă este necesar a se evalua la justa valoare însuşirile fizico-chimice şi bio-morfologice comparative ale hibrizilor distanţi de viţă de vie.

În studiul realizat au fost antrenaţi hibrizii distanţi de viţă de vie (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) de $BC_3$: (DRX-$M_4$-503; DRX-$M_4$-504; DRX-$M_4$-530; DRX-$M_4$-535; DRX-$M_4$-537; DRX-$M_4$-579; DRX-$M_4$-635; DRX-$M_4$-679).

Tabelul 1

**Particularităţile bio-morfologice a unor hibrizi distanţi de viţă de vie (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) $BC_3$**

| *Nr. d/o* | *Hibridul* | *Ciorchinul* | | *Baca* | | | | *Sămânţa* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Lungimea, (cm)* | *Forma* | *Culoarea pieliţei* | *Numărul bacelor pe ciorchin* | *Lungimea, (mm)* | *Greutatea, (g)* | *Prezenţa* | *Lungimea, (mm)* | *Greutatea, (g)* |
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* |
| 1. | DRX-M4-503 | 15 | Cilindro-conic | Verde-gălbuie | 70-80 | 18 | 3,2 | 1-2 | 6,0-7,0 | 0,042 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2. | DRX-M4-504 | 14 | Cilin-dro-co-nic | Verde-gălbuie | 180-200 | 16 | 3,1 | 2-3 | 6,0-7,0 | 0,040 |
| 3. | DRX-M4-530 | 14 | Cilin-dro-co-nic | Verde-gălbuie | 40-50 | 24 | 3,3 | 1-2 | 6,0-7,0 | 0,040 |
| 4. | DRX-M4-535 | 17 | Cilin-dro-co-nic | Verde-gălbuie | 80-90 | 20 | 3,3 | 1-2 | 6,0-7,0 | 0,050 |
| 5. | DRX-M4-537 | 18 | Cilin-dro-co-nic | Verde-gălbuie | 16-170 | 18 | 3,1 | 1-2 | 6,0-7,0 | 0,040 |
| 6. | DRX-M4-579 | 17 | Cilin-dro-co-nic | Verde-gălbuie | 160-170 | 22 | 3,3 | 1-2 | 7,0 | 0,040 |
| 7. | DRX-M4-635 | 17 | Cilin-dro-co-nic | Verde-gălbuie | 90-100 | 17 | 2,8 | 1-2 | 7,0 | 0,035 |
| 8. | DRX-M4-679 | 14 | Cilin-dro-co-nic | Albas-tru-vi-olet | 60-70 | 18 | 3,1 | 1-2 | 7,0 | 0,040 |

Lungimea medie a ciorchinului este de 15,75 cm, variind în limitele: minimal – 14 cm (DRX-M4-504) şi maximal 18 cm (DRX-M4-535). Predomină forma cilindro-conică a ciorchinului.

Bacele dețin o nuanță de un verde-gălbui şi numai un hibrid distant deține bace cu nuanță de un albastru-violet (DRX-M4-679).

Numărul bacelor pe un ciorchin variază în limitele de la 40-50 de bace (DRX-M4-530) şi maximal 180-200 de bace (DRX-M4-504).

Greutatea medie a unei bace este de 3,15 grame: minimal 2,8 g (DRX-M4-635) şi maximal 3,3 grame (DRX-M4-530).

În fiecare bacă este prezentă sământa, fiind prezente câte 1-2 (DRX-M4-503) şi 2-3 seminţe (DRX-M4-504). Greutatea medie a unei seminţe este de 40,8 mg.

Ţinând cont de greutatea totală a unei bace şi greutatea seminţelor din ea, constatăm faptul că greutatea seminţelor ocupă cca 1,3 % din masa totală a bacei. (Tabelul 1).

Comparând particularitățile fizico-chimice ale hibrizilor studiaţi se poate de menționat faptul, că din punct de vedere a aprecierii organoleptice (max. 10 puncte), hibrizii respectivi au fost apreciaţi minimal cu 8,1 puncte (DRX-M4-679) şi maximal cu 8,8 puncte (DRX-M4-504).

Conţinutul în substanţele fenolice de asemenea variază în limitele de 204 g/dm3 (DRX-M4-504) şi 793 g/dm3 (DRX-M4-679).

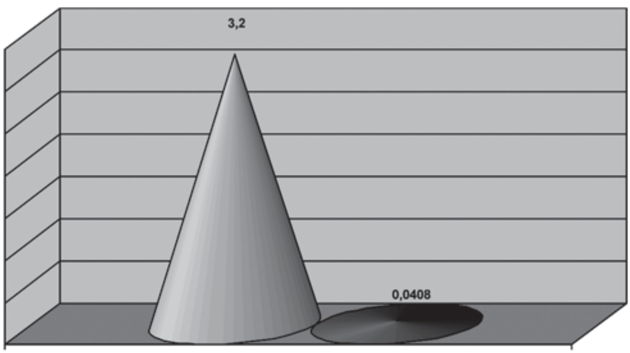
Tabelul 2

**Particularitățile fizico-chimice a unor hibrizi distanți de viță de vie *(Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) $BC_3$**

| *Nr. d/o* | *Hibridul* | *Pielița* | *Zahărul, g/dm³* | *Aciditatea, g/dm³* | *Acizi organici, g/dm³* | | | *pH* | *Potențialul OR, mV* | *Substanțe fenolice, g/dm³* | *Aprecierea organoleptică (max. 10)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *tartic* | *malic* | *citric* | | | | |
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *12* |
| 1. | DRX-M4-503 | medie | 16,8 | 6,6 | 3,6 | 2,4 | 0,30 | 3,21 | 209 | 242 | 8,6 |
| 2. | DRX-M4-504 | foarte tare | 17,2 | 5,5 | 3,2 | 2,1 | 0,21 | 3,09 | 193 | 204 | 8,8 |
| 3. | DRX-M4-530 | medie | 16,6 | 6,1 | 3,1 | 1,9 | 0,31 | 3,22 | 219 | 239 | 8,5 |
| 4. | DRX-M4-535 | medie | 15,9 | 6,8 | 3,7 | 2,3 | 0,31 | 3,11 | 203 | 223 | 8,4 |
| 5. | DRX-M4-537 | tare | 16,2 | 6,7 | 3,5 | 2,3 | 0,27 | 3,17 | 217 | 236 | 8,3 |
| 6. | DRX-M4-579 | medie | 17,0 | 5,7 | 3,3 | 2,0 | 0,17 | 3,27 | 201 | 217 | 8,6 |
| 7. | DRX-M4-635 | tare | 15,7 | 6,9 | 3,8 | 2,2 | 0,19 | 3,29 | 231 | 242 | 8,2 |
| 8. | DRX-M4-679 | tare | 15,9 | 5,9 | 3,7 | 2,1 | 0,17 | 3,05 | 227 | 793 | 8,1 |

Reieşind din analiza substanțelor fenolice putem menționa că hibrizii distanți de viță de vie cu bacele de nuanță verde-gălbuie dețin substanțe fenolice în limite cu mult mai mici ca hibrizii distanți cu bacele de o nuanță albastru-violet (Tabelul 2).

Raportul dintre greutatea totală a bacei şi seminței




□ *Greutatea totală a bacei (g)* ■ *Greutatea seminței (g)*

## Concluzii

1. Hibrizii distanți de viță de vie cu bacele de nuanță verde-gălbuie dețin substanțe fenolice în limite cu mult mai mici ca hibrizii distanți cu bacele de o nuanță albastru-violet.

2. Ținând cont de greutatea totală a unei bace şi greutatea semințelor din ea, constatăm faptul că greutatea semințelor ocupă cca 1,3% din masa totală a bacei.

3. Din punct de vedere a aprecierii organoleptice hibrizii respectivi au fost apreciați minimal cu 8,1 puncte (DRX-M4-679) şi maximal cu 8,8 puncte (DRX-M4-504) din grilajul maximum 10 puncte.

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# CONTRIBUTION TO THE STUDY OF THE BIOLOGY AND MULTIPLICATION OF *CYMBOPOGON FLEXUOSUS* (D.C.) STAPF

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**Summary.** *Spicy aromatic plants accompanied the man since ancient times, helping him to improve the taste and aroma of the food. Cymbopogon or lemon grass is popular in South-Eastern countries and now as well as in Europe. As an aromatic condiment flavor lemon grass has medicinal proprieties. Undoubtedly, useful proprieties, the fragrance and decorative appearance have contributed to the introduction and study of this astonishing species in collection of spicy aromatic plants.*

## Introduction

*Cymbopogon* or lemon grass is a perenial rapidly growing plant, originated from India and Sri Lanka. *Cymbopogon* Spreng genus refers to the division of angiosperms (*Magnoliophyta*), class of monocots (*Liliopsida*), order *Poales*, family *Gramineae* (*Poaceae*) including more than 55 species. The most extended are *Cymbopogon ambiguus*, *C. bambycinus*, *C. citratus* (lemon grass from Western India), *C. citriodora, C. flexuosus* (lemon grass from Eastern India), *C. martinii* (palmarosa), *C. nardus* (Citronella), *C. obtectus*, *C. procerus*, *C. schoenanthus*, *C. refractus*, *C. winterianus* Jowit.

*C. flexuosus* (DC) Stapf.

The above-mentioned species of plants, provided the foliage is nice – a refreshing lemon flavor with a hint of rose, thanks to essential oils. The main components of essential oil are citral and geraniol. The essential oil gives this plant sedatives, antidepressant [1], antioxidant, antiseptic, analgesic, antimicrobial, bactericidal, deodorant, insecticidal and antifungal properties [2]. In popular medicine, in native countries, lemon grass is used as a tonic for the skin and tissues, suppresses and soothes aching muscles, helps with indigestion, colitis, gastroenteritis, and some infectious diseases [3]. The Israelite scientists have discovered anti-cancer properties at this species [4]. Essential oil is also used in perfumes and cosmetics. Widely used in Asian food as a seasoning for soups, curries and various meat and fish dishes, as well as for flavoring sweets and soft drinks. Decorative plants can be used for planting beds, bordures, and parks.

## Materials and methods

The researches have been performed initiated in 2010, when a sample of seeds of *C. flexuosus* (DC) Stapf was received as a collegial donation. Studies on biological growth and development of plants, obtained from seeds (the first year of vegetation), was performed concomitantly in the same year, after the method of Ermakov (1972). The plants were obtained by sowing the seeds of lemon grass in special trays for seedling production. The planting substrate consisted of bio-humus - 60% (wormcompost obtained after rain), forest soil - 30% and sand - 10%. The harvests and analysis were made at the interval of each two weeks (10 plants) when plants have sprung in mass. For vegetative propagation lemon grass was used the plants kept in pots in the greenhouses in winter, at low temperature to $10^0$C and minimum humidity. Multiplication was performed in 2011 immediately before the planting in open ground. The applied method of division includes the cutting, in half, of roots or in four parts (at the more developed plants). After dividing of plants on the vegetative material the treatment for disinfection and growth stimulation with Glen extra by industrial product of algae and marine sediments was applied. In the spring of 2011 also seedlings from the rest of initial sample seeds according the same method were produced. Experience for the assessment the production of green mass was performed by the blocks method of 5 $m^2$ plots, in two repetitions (recalculation in h and q). Statistical data it means analysis of variation was done by the method of Dospehov (1978).

## Results and discussions

Seedlings of C. flexuosus (DC) Stapf, sown on 15 February the pallets have germinated in 12 days. During the vegetation period following plants ontogenetic developmental periods were found: plantlet, juvenile, immature, virginal, and generative. At the age of *seedlings* the specimens are represented by small plantlets with the dimensions of 0,5–1,7 cm, with coleoptiles and two small lanceolate leaflet. The root is fasciculate, formed up to 8–10 fascicles, with the length up to 3–5 cm and twinning, in forming, node. In age *juvenile* period the plants has up to 5–7 stems of 15–19 cm length with 4–5 leaves lanceolate (6–8 cm length and 0,1–0,2 width), the roots are well developed achieving 20–22 cm with 11–13 fascicles. The ring twinning is in forming, shining, whitish, but still quite thin. At the age immature stage go continuing the process of twinning, the plant forming up to10-12 stems with a height of 27-35 cm, well leafed (8–9 leaves). Ring twinning is well formed with multiple buds, which are well observed through leaf sheath tissues. When achieving the generative age the herbaceous plants represent a bush composed of 15–25 strains, with a height of 95–107 cm, well leafed, forming 12–17 leaves of length 29–37 cm and 1,5–2,0 cm width, of green–intense color. Leaf sheath is vigorous, even coarse, with the length of 33–40 cm. In this ontogenetic stage the plants have remained until the end of vegetation period (low environmental temperature is 3–5$^0$C) missing the phases of blossoming and earing.

Up to this phase the aerial part of plants (herba) was harvested and dried, but the roots with a stem segment of 25–30 cm were transplanted in pots for further winter conserved in greenhouse. Seedlings and roots kept, in the spring were planted in the open ground. Comparative tests were made on plants derived from seedlings and at those from the roots stored in the winter (Table 1).

Figure 1. Plants of the *Cymbopogon flexuosus* (DC) Stapf in the generative age

Table 1

**Productive potential of *C. flexuosus* plants reproduced by different methods, years 2010-2011**

| *Years* | *Production of green mass, q/ h* | | *Production of leaves, q / h* | | *Rate of the leaves in green mass, %* | | *Production of comestible shoots, q / h* | | *Rate of the shoots in green mass, %* | | *Volatile oil production, kg / h* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | a | b | a | b | a | b | a | b | a | b |
| 2010 | 17.0 | - | 7.8 | - | 45.9 | - | 9.2 | - | 54.1 | - | 17.1 | - |
| 2011 | 18.0 | 23.0 | 8.3 | 9.9 | 46.1 | 43.1 | 9.7 | 13.1 | 53.9 | 56.9 | 16.8 | 27.0 |
| x | 17.9 | 23.0 | 8.2 | 9.9 | 46.0 | 43.1 | 9.5 | 13.1 | 54.0 | 56.9 | 17.0 | 27.0 |

**a** – obtained from seedling plants, **b** – plants obtained from stored roots winter.

Despite the fact that the results within just two years of research, and the plants roots obtained from only one, have been observed trends of increasing production of raw materials to the latter. The plants obtained from the roots in winter kept is higher the production of green mass and the volatile oil. Comestible shoots which are also used fresh, prevail in these plants. This is explained as rooted plants held higher winter already fully formed at the time of planting. They quickly restore its growth is more easily adaptable than seedlings reproduced.

## Conclusions

Generative multiplication of *Cymbopogon flexuosus* (DC) Stapf species seedling propagated by seed is a very successful method that allows identification and selection of forms with high percentage of volatile oil and achieves mass production plant in the first year of vegetation. Plants multiplied generative reach ontogenetic stage. The vegetative multiplications of roots kept in the greenhouse in winter, and fragmented before planting, are also obtained plants *Cymbopogon flexuosus* (DC) Stapf, which are less vigorous, tending to increase the production of raw material and volatile oil. Curative qualities, seasoning, special ornamental, cultivation simplicity, requires introduction of the scope of use widely of this valuable species.

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# SOME MEDICINAL PLANTS USED IN LANDSCAPE-GARDENING

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**Summary.** *This article contains data on some herbs, ornamental plants and shrubs grown in BG ASM and their use for landscaping of parks, residential, commercial and private gardens were carried out. Investigations on reproduction, with the objective of landscaping by a good number of medicinal taxa in BG ASM collections were performed. Some suggestions for their use (borders, middle rows, decorative walls, ground cover, beds, floral compositions, high and medium hedges, rock gardens and, detection and prevention landslides) have been proposed.*

## Introduction

Actually there are active landscaping programs in our republic that promote use of many beneficial properties of herbaceous plants  for their using in the residential, commercial, public and private green spaces.

Gardening with flowering and evergreen medicinal plants is a simple way to bring more colour and interest into a garden, adding ornamental appeal. These days landscaping with medicinal plants is increasingly popular. They are a practical and ecologically valuable alternative for traditional landscaping. Medicinal plants are also used in landscaping because of their great benefits. They add colour and scent to the garden, help maintain temperatures, assist in reducing wind speed, prevent soil erosion and serve as barriers to distinguish different section of the garden. These plants like any other plants purify the atmosphere help to maintain an eco-balance, provide shade and help soil conservation. In addition to that, they offer a safe and gentle action on the body systems and can help us to acquire proper health, thus leading a healthy life style [2-6]. Medicinal shrubs are also useful plants for re-establishing woodlands and landslide prevention. Also they are very popular within the topiary industry because of their growth peculiarities.

Botanical Garden (Institute) of ASM possesses a medicinal and aromatic plant collection with over 400 species [1, 7]. In the last years we have begun a research program into identification the potential of the medicinal plants in interior sanation and for landscaping parks, home gardens and roadways, commercial and private places.

## Materials and methods

The present work is based on some therapeutically important plants used in landscape architecture due to their ornamental futures. The investigations regarding multiplication and cultivation of a good number of medicinal taxa were carried out at the experimental fields in the Botanical Garden (I) of ASM. Investigation included propagation aspects and research into cultivation techniques. The biological particularities and the phenological rhythm are also recorded. At the present time the majority of them are used for landscaping parks, home gardens in both urban and rural places.

## Results and discussions

A large number of medicinal plants cultivated in our collection can be used as landscape elements depending on growth habit, height, shape, texture and colour. Many of them serve as useful and fragrant ground cover (*Convallaria majalis* L., *Mentha pulegium* L., *Herniaria glabra* L., *Ceratostigma plumbaginoides* Bunge, *Bergenia crassifolia* (L.) Fritsch., *Fragaria vesca* L., *Viola odorata* L.). Thyme species (*Thymus comosus* Heuff. ex Griseb. (Figure 1) and, *Thymus marschallianus* Willd.) can be effective ground cover for weed control in landscaping. Their compact stature and aromatic quality make them a wonderful ground cover between garden stepping stones. The leaves offer a delicate texture for landscape design considerations. Many *Potentilla* L. species have a dense spreading habit and make a beautiful ground cover. Chamomile (*Matricaria chamomila* L.) with small, white flowers is legendary for its abilities to take root and cover an area as fragrant ground cover. *Ajuga reptans* L. is a good ground cover for a position in semi-shade, forming a nice carpet. *Asarum europaeum* L. is a useful ground cover for a shady position. *Vinca minor* L. is also a very good ground cover for toping steep banks and shady places.

Figure 1. *Thymus comosus* (flowering period)

*Table 1*

**List of the most popular medicinal and aromatic plants used for landscaping**

| *No* | *Scientific name* | *Family* | *Native / introduced* | *Comments* |
|---|---|---|---|---|
| 1 | *Lavandula vera* DC. | *Lamiaceae* | introduced | borders, middle rows |
| 2 | *Origanum vulgare* L. | *Lamiaceae* | native | edging plants, borders |
| 3 | *Centaurea cyanus* L. | *Asteraceae* | native | mixed with other plants, borders, floral arrangements |
| 4 | *Thymus marschallianus* Willd. | *Lamiaceae* | native | ground cover for sunny position |
| 5 | *Thymus vulgaris* L. | *Lamiaceae* | introduced | borders |
| 6 | *Echinacea purpurea* (L.) Moench | *Asteraceae* | introduced | borders, mixed with other perennials in urban gardens |
| 7 | *Vitex agnus-castus* L. | *Verbenaceae* | introduced | tall hedges, mixed borders |
| 8 | *Calendula officinalis* L. | *Asteraceae* | introduced | borders, containers |
| 9 | *Humulus lupulus* L. | *Cannabaceae* | native | decorative walls |
| 10 | *Hyssopus officinalis* L. | *Lamiaceae* | introduced | borders |
| 11 | *Ricinus communis* L. | *Euphorbiaceae* | introduced | hedges |
| 12 | *Asarum europaeum* L. | *Aristolochiaceae* | native | ground cover for shade positions |
| 13 | *Vinca minor* L. | *Apocynaceae* | native | ground cover in shady places |
| 14 | *Viola tricolor* L. | *Violaceae* | native | fragrant ground cover |
| 15 | *Sambucus nigra* L. | *Sambucaceae* | native | tall hedges and for re-establishing woodlands |
| 16 | *Coreopsis tinctoria* L. | *Asteraceae* | introduced | borders |
| 17 | *Oenothera biennis* L. | *Onagraceae* | native | beds, borders |
| 18 | *Adonis vernalis* L. | *Ranunculaceae* | native | beds, mixed with other plants |
| 19 | *Alcea rosea* (L.) Cav. | *Malvaceae* | introduced | back of borders |
| 20 | *Mentha piperita* L. | *Lamiaceae* | introduced | ground cover |
| 21 | *Convallaria majalis* L. | *Convallariaceae* | native | ground cover in woodland shade |
| 22 | *Viburnum opulus* L. | *Viburnaceae* | native | medium sized hedges, component of hedgerows |
| 23 | *Berberis vulgaris* L. | *Berberidaceae* | native | medium sized hedges |
| 24 | *Satureja subspicata* L. | *Lamiaceae* | introduced | decorative borders |
| 25 | *Salvia officinalis* L. | *Lamiaceae* | introduced | borders, edging plants |
| 26 | *Digitalis purpurea* L. | *Scrophulariaceae* | introduced | mixed borders, floral arrangements |

Figure 2. *Veronica chamaedrys* (flowering period)

Flowering medicinal plants (*Primula veris* L., *Monarda citriodora* Cerv. ex Lag., *Digitalis lanata* Ehrh., *Digitalis purpurea* L., *Veronica chamaedrys* L. (Figure 2), *Hypericum olympicum* L., *Adonis vernalis* L., *Gypsophila paniculata* L., *Coreopsis tinctoria* L., *Sanguisorba officinalis* L., *Scutellaria baicalensis* L., *Leucanthemum maximum* L.) can be a great addition to any garden.

Figure 3. *Satureja subspicata* (flowering period)

Purple coneflower (*Echinacea purpurea* (L.) Moench) known as an immune system booster is a superb long-blooming perennial that attracts butterflies and beetles. It can accent any flower garden or floral arrangement with incredible beauty. Some of the taller oreganos (*Origanum* L.) in addition to their medicinal and culinary value make great ornamental plants because of their beautiful flowers. It can be used as an edging plant and ground cover. The smaller varieties also do well in rock and alpine gardens. Marigold (*Calendula officinalis* L.) with bright yellow and orange flowers makes a beautiful border plant and look very well in containers.

Figure 4. *Penthaphylloides fruticosa* (flowering period)

Foliage is one of the most interesting aspects of medicinal plants for landscaping. Several species of *Salvia* L., *Artemisia* L., *Helichrysum* L. with silver, grey or golden foliage have a cooling effect in the garden, making other colours more vibrant. Sage (*Salvia* L.) is highly ornamental in rock gardens. Another use for ornamental sage would be to outline the garden stepping stone paths and to fill the gaps between them.

Another strong point for medicinal plants used for landscaping is that their strong flavour. Many plants with fragrant properties (*Melissa officinalis* L., *Mentha piperita* L., *Agastache foeniculum* L., *Hyssopus officinalis* L., *Satureja subspicata* Bartl. ex Vis. (Figure 3), *Thymus vulgaris* L., *Ocimum basilicum* L., *Rosmarinus officinalis* L.) can be used along walkways and pathways for their fragrance as you touch them. They are not only good to look at, but can also heal wounds, burns, cuts or irritations. Lavander *(Lavandula vera* DC.) is wonderful fragrant plant and its blue color has a calming effect. Their intermediate height makes them good for the middle row in a decorative border, comprised of shorter annual flowers in the front and taller shrubs in the back. Their grey-green foliage looks good all year round and attracts butterflies.

A large number of medicinal shrubs cultivated in our collection can be used as landscape elements. One of them can be used for creation medium size or tall hedges. For medium sized hedges the most suitable are: *Penthaphylloides fruticosa* (L.) Schwartz. (Figure 4), *Artemisia dracunculus* L., *Berberis vulgaris* L. *Sambucus nigra* L. can be grown as a tall hedge and it is an excellent species to use when re-establishing woodlands. *Rosa canina* L. is another shrub that grows quite bushy and can be hedged to a wide variety of shape and sizes. It makes a dense and stock proof hedge, especially when trimmed. The wild plant can be used as a stabilizing plant in specialized landscaping schemes. *Viburnum opulus* L. is an attractive element to the landscape due to its beautiful flowers and bright-red berries. It can be grown as a medium sized hedge or a component of hedgerows. *Vitex agnus-castus* L. can be grown as a tall hedge. It is highly tolerant of air pollution and can grow very well in urban environments. It is also useful plants for controlling soil erosion.

Some other medicinal shrubs cultivated in our collection can be recommended for landscaping: Japanese Quince (*Chaenomeles japonica* Thumb.), chokeberries (*Aronia melanocarpa* (Michx.) Elliott), common hawthorn (*Crataegus monogyna* Jacq.), common sea-buckthorn (*Hippophae rhamnoides* L.), hemp-leaved monks pepper (*Vitex cannabifolia* L.) etc.

## Conclusions

1. As a result of data was established flowering medicinal plants (*Primula veris* L., *Monarda citriodora* Cerv. ex Lag., *Digitalis lanata* Ehrh., *Digitalis purpurea* L., *Adonis vernalis* L., *Gypsophila paniculata* L., *Coreopsis tinctoria* L., *Sanguisorba officinalis* L., *Scutellaria baicalensis* L., *Echinacea purpurea* (L.) Moench) studied have great ornamental peculiarities and can be serve as a good addition to landscape-gardening.
2. Was attested the number of medicinal shrubs cultivated in our collection (*Penthaphylloides fruticosa* (L.) Schwartz., *Berberis vulgaris* L., *Viburnum opulus* L., *Vitex agnus-castus* L., *Chaenomeles japonica* Thumb., *Vitex cannabifolia* L., *Sambucus nigra* L.) which are useful in creation of tall hedges.
3. For decorative borders are suitable (*Satureja subspicata* Bartl. ex Vis., *Thymus vulgaris* L., *Lavandula vera* DC., *Satureja kitaibelii* Briq., *Hyssopus officinalis* L., *Origanum vulgare* L., *Salvia officinalis* L.) and, due to compact forms of some species (*Thymus comosus* Heuff. ex Griseb., *Thymus marschallianus* L.), dense spreading habit of *Asarum europaeum* L. and *Vinca minor* L. make them for ground cover decorativeness were confirmed.
4. The concept concerning landscape-gardening by means of herbs is realizable because of promoting esthetics, symmetry and form in

green spaces arrangements' in nature, we believe, thus contributing to conservation of many rare and threatened species.

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## SOME ASPECTS OF INTRODUCTION OF NEW MEDICINAL PLANTS IN THE BOTANICAL GARDEN OF ASM


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**Summary.** *This paper presents the preliminary results of introduction of five therapeutically important plants (Leonotis nepetifolia, Leonurus sibiricus, Basella alba, Basella rubra, Lycium chinense) in the Botanical Garden (Istitute) of ASM. The studied taxa were obtained from seeds received by international exchange. The study was preceded by an extensive literature survey of studied plants according to their therapeutic importance and utilization in popular and modern medicine. Investigations included propagation aspects and research into cultivation techniques in order to observe their reproductive behavior in our conditions and accumulate experience on their agro-technical peculiarities. Seasonal rhythm of development of these taxa was studied.*


### Introduction

Medicinal plants play a vital role in the maintenance of human health throughout the world. During the last two decades there has been a strong tendency to returning to plant therapy. At present a huge number of medicinal drugs, hundreds of herbal supplements, a lot of cosmetic products have in their composition many ingredients extracted from plants. They are considered to be less toxic and free from side effects than synthetic ones. The use of medicinal plants for the obtaining of food, pharmaceutical and cosmetic products is a topic of interest and a prospective for the development of the important industries. One of the major concerns of these relevant industries is to explore new sources of raw plant materials for the production of herbal drugs, cosmetic and food products. In this perspective identifying of new medicinal plants with great potential in therapeutic applications and their investigation in order to isolate new active biological substances is a very important and actual aspect.

The present paper gives information about some new therapeutically important species *(Leonotis nepetifolia, Leonurus sibiricus, Basella alba, Basella rubra, Lycium chinense)* cultivated in the plant collection of medicinal plants in the Botanical Garden (I) of ASM. These promising species are less known in our republic, but are used in composition of some modern drugs. Chinese boxthorn *(Lycium chinense),* native to southeastern Eurasia is a very rich source of vitamins and minerals. It reduces the hepatic cell intoxication [7] and is able to reverse the growth of cancer [4]. Lion's Ear *(Leonotis nepetifolia)* possesses anti-inflammatory, hypoglycemic [5], purgative and antispasmodic effects being excellent in fever, flu, cough, and externally in different skin diseases. Siberian motherwort (*Leonurus sibiricus*), native to Asia is used in traditional Chinese medicine to treat impotence and as a diuretic. Two common species of Malabar Spinach (*Basella alba* and *B. rubra*) are also included in this research. The plants are rich sources of chlorophyll that provide favorable intestinal flora and stimulate secretions of the stomach, liver and pancreas. Including these species in the collection we'll improve the assortment with new medicinal plants which through their pharmacological activity would be appropriate not only for research but also for food and pharmaceutical industries.

## Materials and methods

The investigations during 2007-2011 at the experimental fields in Botanical Garden of ASM (Laboratory Vegetal Resources) were carried out. Five medicinally important species in this research were used. The propagation of all taxa has been done through seeds that were obtained from the international seed exchange. An extensive literature survey of studied species was made according to their therapeutic importance and utilization in popular and modern medicine. The biomorphological peculiarities and the phenological observations were also registered using standard methods [11].

## Results and discussions

***Lycium chinense*** **Mill.**, (family *Solanaceae)* is a major tonic plant with a history of almost 2000 years of its medicinal use. The fruits are one of the most popular tonics used in Chinese herbal medicine. It is native to southeastern Eurasia.

Figure 1. *Lycium chinense* (pregenerative period)

Chinese boxthorn (*L. chinense*) is an erect or sprawling shrub, 0,5-1,5m tall. Stem is branched; branches pale gray, slender, with thorns 0,5-2cm. Leaves solitary or in clusters of 2-4, ovate or lanceolate (Figure 1). Inflorescences solitary with paired flowers on long stem 1-2cm in width. Calyx is campanulate 3-5-divided to halfway, lobes densely ciliate. The corolla is lavender or pale purple, 1-1,2cm. Stamens are somewhat shorter or longer than corolla with a villous ring slightly above filament base and adjacent corolla tube. Berry red, ovoid or oblong. Seeds yellow, 3 mm long.

The Chinese boxthorn's fruits are very rich source of vitamins and minerals, especially in vitamins A, C, and E, flavonoids, fatty acids, betaine. They content two antihepatotoxic cerebrosides that significantly reduce the hepatic cells intoxication. It is being also investigated that the fruits are able to reverse the growth of cancer tissue. The root is used in the treatment of pneumonia, febrile disease, cough, asthma, tuberculosis, hypertension and diabetes mellitus (Table 1). The root bark stimulates the parasympathetic nervous system, which controls involuntary body functions such as digestive secretions.

***Leonotis nepetifolia* (L.) R. Br.**, (family *Lamiaceae*) is an annual species native to tropical Africa and southern India [2, 6], now naturalized in North America.

Lion's ear (*L. nepetifolia*) is an erect, loosely branched plant that can grow up to 2,5 m tall in a single season. The plant has square stems with a distinct groove along each side. The leaves are membranous, oblong-ovate, opposite, 10-12cm long and 5-9,5cm wide with coarsely toothed margins. Flowers, very irregular are borne in rounded spiny clusters that encircle the stems (figure 2). They are up to 1-2,5cm long and curved downward. Round clusters of orange flowers nearly 5cm in diameter occur toward the tip of the stem. Seeds are dark, triangular shaped.

The herb contains alkaloids, flavonoids, essential oil, diterpenoids, polyphenols, iridoid glycosides, the mildly psychoactive alkaloid leonurine and other bioactive constituents.

Figure 2. *Leonotis nepetifolia* (flowering period)

This species has many traditional uses. The leaves and roots are used as a remedy for snakebites and other bites and stings. Extracts have been applied externally to treat boils, eczema, skin diseases and muscular cramps. Extracts are also used to treat fever, cold and flu, cough, bronchitis, hypertension and headache. Leaf infusion has been used to treat asthma and viral hepatitis. Recent scientific investigations [5] suggest that the leaf extract of this plant possesses anti-inflammatory, hypoglycemic, purgative, antispasmodic effects, and thus provide pharmacological credibility to the suggested folk uses of this plant.

***Leonurus sibiricus* L.** (family *Lamiaceae*) is an herbaceous annual or biannual with upright stems, 30-80 cm tall. The basal leaves are ovate-cordate in shape, early deciduous. The leaves have toothed margins and are incised with deeply cut lobes. The sessile flowers are produced in many verticilasters, 3-3,5cm in diameter. Calyx is tubular-campanulate, 8-9mm long, densely-pilose. The corolla is white or reddish to purple-red, glabrous, with an upper oblong lip longer than the lower one. Nutlets brown, oblong, 2,5mm long, with cuneate base. *L. sibiricus*, commonly known as Siberian motherwort is native to Asia, including Southern Siberia, China, Korea, Japan and Vietnam. Now the plant is naturalized in various parts of the world.

The aerial part of the plant contains alkaloids, organic acids, steroids, fatty acids. The roots of this plant are a rich source of cardenolids, alkaloid leonurine, tannins and flavonoids. Recently six new labdane diterpenoids were isolated from the leaves of *L. sibiricus* [3].

Both leaves and seeds of *L. sibiricus* are considered of important medicinal value. In traditional Chinese medicine the plant is used to treat impotence and as a diuretic. Also, it is a very good remedy for painful menstruation and other female reproductive system ailments. The tincture is used in the treatment of rheumatic fever and arthritis.

***Basella alba*** **L.** and ***Basella rubra*** **L.** (family *Basellaceae*) are two common species of Malabar spinach native to Africa and southeast of Asia. They are succulent herbaceous perennial plants (in temperate region – annual). The stem is twining, slender, smooth, green or purplish (Figure 3). Leaves are alternate, simple, fleshy, and usually cordate at base, acute and acuminate at apex, dark green or purplish. Inflorescence is an auxiliary spike, with long peduncle. Flowers are sessile, bisexual, regular, 5-merous, white, pink or purple. Fruit is a pseudo-berry, enveloped by the fleshy perianth, 1-seeded, purplish black. Seeds are globose, dark brown to black.

The leaves and succulent stems with mucilaginous texture contain important quantities of vitamins A and C, calcium and iron, proteins and fibers. Recently two antifungal peptides and two ribosomal proteins with antifungal activities were isolated from seeds [1, 8-10].

The plant represents a rich source of chlorophyll that provides favorable intestinal flora, digestive enzymes, and stimulation secretions of the stomach, liver and pancreas. The mucilaginous leaves are appreciated for removing toxins from the body and as diuretic. In some countries is one of the basic herbal drugs used for insomnia, headache and nervous breakdown. Boiled roots are very good remedy for diarrhea. The species *B. rubra* has been a folk medicine for cancer treatment. A paste of the leaves is applied externally to treat boils. Fruit juice is used as eye-drops in the treatment of conjunctivitis.

Table 1

**Some properties of the new medicinal plants cultivated in the Botanical Garden**

| *Scientific name* | *Provenience* | *Plant part used* | *Therapeutic effects* | *Medicinal applications* | *Edible uses* |
|---|---|---|---|---|---|
| *Lycium chinense* | Botanical Garden, Stuttgart, Germany | fruits<br>roots<br>bark<br>seeds | antibacterial<br>haemostatic<br>hepatic<br>tonic<br>hypoglycemic<br>ophthalmic<br>vasodilatator | kidney and liver disorders, diabetes mellitus, aching back and legs, cancer, pneumonia, fever, cough, tuberculosis, asthma, hypertension | ripe fruits raw in salads, cooked in soups or dried for later use; leaves fresh added to salads, dried – as a tea substitute |
| *Leonotis nepetifolia* | Museum National d'Histoire Naturelle Paris, France | leaves<br>stems<br>roots | antispasmodic<br>purgative<br>diuretic<br>haemostatic<br>hepatic<br>emmenagogue<br>hypoglycemic<br>anti-inflammatory | painful arthritic and other inflammatory conditions, diabetes mellitus, asthma, diarrhea, irregular heartbeats and other heart conditions associated with anxiety and tension | leaves are used as a tea substitute |
| *Leonurus sibiricus* | Botanical Garden "Al. Borza", Cluj-Napoca, Romania | aerial part<br>roots | antibacterial<br>cardiac, tonic<br>diuretic hypnotic<br>stimulant<br>antispasmodic<br>depurative | gynecologic ailments (painful and excessive menstruation), kidney complaints, kidney stones, rheumatic fever, arthritis, edema, eczema, abscesses | young shoots with sweetish flavor are cooked; roots are used as a flavoring |
| *Basella alba* | Botanical Garden, Stuttgart, Germany | leaves<br>shoots | demulcent emollient<br>diuretic astringent<br>laxative<br>febrifuge | digestive problems, constipation, urinary disorders, insomnia, headache and nervous breakdown, diarrhea, externally to treat boils, conjunctivitis, inflamed skin | Purple berries as a red dye to colour jellies, sweets and drinks. Leaves and stem tips raw as salads or boiled in soups and stews, tucked into sandwiches |
| *Basella rubra* | Poznan University of Medical Sciences, Poland | | | | |

Figure 3. *Basella rubra* (flowering period)

The propagation of all taxa has been done through seeds that were obtained from international seed exchange. In the second decade of February all the seeds have been sown in flower pots in green house conditions. The seedlings at the 2-6 true leaf stage were transplanted into the flower beds at the collection experimental fields. Most transplanted seedlings survived the first summer. It was also observed that the number of survived individuals decreased each following year and the critical point was the drought in summer period. In spite of this all seed grown plants bloomed and set seed for next season excluding *Lycium chinense*. In future studies, we plan to continue investigations regarding medicinal potential of these plants and their adaptation in our conditions.

## Conclusions

1. The new, for our collection, species have been obtained from seeds that were received from international seed exchange in 2007-2011. They are listed in the table 1 along with the information about vegetal material, provenience, and therapeutic activity, medicinal and edible uses. The study has shown that investigated species positively responded to climatic and soil conditions of our country, successfully attaining the generative period, except *Lycium chinense*. Most of them showed high cultivation aptitude with positive agronomic results.
2. The investigated species represent a valuable material for scientific

researchers and a potential vegetal material for medicinal drug production. Characteristics, characters


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# WHITE RUST QUARANTINE PESTS FOR CHRYSANTHEMUMS


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**Summary.** *The results of the symptomatic and biomorphological diagnostic of the chrysanthemum white rust agent (Puccinia horiana Henn.) are carried out.*


## Introduction

Autumn of last year in the laboratory of floriculture of Botanical Garden (Institute) of the ASM has received specimens of contaminated chrysanthemums, cultivated for the cut. Previously, similar symptoms on chrysanthemum in the Republic of Moldova has' not been observed. After a phytopathological analysis has established that in infectious patterns (samples) is revealed the white rust of chrysanthemums disease, which is the pathogene of fungus *Puccinia horiana* Henn. Name. *Puccinia horiana*, P. Hennings Taxonomic position. Fungi: Basidiomycetes: Uredinales. The disease is the subject of external quarantine [1, 2, and 3].

Chrysanthemums are the only host, especially the florists' cultivars, widely cultivated in glasshouses in the EPPO region. *P. horiana* originates in Japan and has spread to other Far Eastern countries, to South Africa, and from there to Europe. Africa, China, Cyprus (reported, but not established), Hong Kong, Japan, Korea Democratic People's Republic, Korea Republic, Malaysia, Taiwan, Thailand, USSR (Far East), South Africa, Tunisia. USA (was outbreak in New Jersey and Pennsylvania in late 1970s; also outbreaks in Oregon and Washington in 1990, declared eradicated).

Is widespread in France and Germany; since about 1964, locally established in Austria, Belgium, Denmark, Finland, Italy, Netherlands, Norway; but declared eradicated in 1988 in Poland Sweden, Switzerland, Tunisia, UK (accepted as established in Great Britain since 1988 and in Northern Ireland since 1990) and Yugoslavia. Reported but not established in Cyprus (1987, eradicated), Hungary (1989), Ireland (1977) and Luxembourg. Intercepted only in Czechoslovakia. Australia (declared absent despite interception reports, Walker, 1983; outbreak in Victoria in 1986), New Zealand (1965).

Epiphytotic development of the disease was noted in greenhouses in England, Denmark, and France.

Chrysanthemums white rust is an autoecious (aboriginal) species of pathogene for Japan and China, from where it was spread to Asia, South Africa, and Europe. As follows from the data in the literature, the white rust on chrysanthemums is wide spread in Poland, France, Italy, Israel, China, Japan, etc. Epiphytotic disease progression was noted in the greenhouses in England, Denmark, and France [1].

## Materials and methods

Infectious material was obtained from the greenhouses of the private farming, village of Yaloveni, engaged in cultivation of chrysanthemums. The initial planting material was imported from Poland. Investigations were carried out only in the conditions of mycological box and after finalization the work the specimens were totally destroyed, used tools and utensils were washed and sterilized. Determination of the fungal pathogene of the disease was performed by morphological characters of spores (shape, size, color) according to special methods [2, 3, and 4].

The intensity of development the rust disease was taken into account using the following scale (in points): 0 – there is no damage; the damage is absent; 1 – the pustules (telia) of the fungus are less visible, single, affected up to 10% of all the green surface of the plant; 2 – a considerable number of pustules on the lower and upper layers of the leaves, occasionally occur on the stem, affected up to 20% of the plant; 3 – pustules in large numbers, leaf epidermis breaks out, pustules dust and plagued, affected up to 30% of the surface; 4 – by the pustules of the fungus is covered with more than 50% of the green surface, the plant is depressed; 5 – affected from 80-100% of the surface, the plant dies.

## Results and discussions

The first symptoms appeared on young leaves. On the top of the leaf reveals small pale yellow spots. The symptoms at this stage remind signs of disturbance of mineral nutrition. However, in case of infection *Puccinia horiana*, occurs rapidly the modification of symptoms. The spots increase in size, they are visible from the upper and from the bottom of leaf, their color becomes more yellow tint on the old spots in the middle persist brown color. However, the most characteristic diagnostic feature of the disease is the appearance of spots on the underside of the rounded light-beige waxy pustules, in the form of whitish warts (Figure 1). Initially the pustules are light-beige or pink color, and then they are dirty-white, convex and powdered.

In the case of weak degree of affection on the spots are formed single pustules up to 5 mm, at a strong degree of affection are numbered hundreds of small pustules on the leaf.

The strongly affected leaves are twisted with the margins down, the leaves wilt and hang. General view of such plants as it were baked. The disease affects leaves, stems, but no flowers.

The agent of chrysanthemums white rust is the fungus *Puccinia horiana*, highly specialized haustoria and it has no intermediate host. Stage of uredospores is absent, the infection occurs from basidiospores. Basidiospores develop from teliospores.

The teliospores are varying between the sizes of 30-45 x 13-17 microns; the length of the transparent leg 42-58 microns, their general form is oblong-clavate, in place of walls slightly re-rounded on the top and compacted.

Figure 1. Pustules of white rust on the leaves of chrysanthemums

At the top of the cell membrane is in the form of a cap. Teliospores germinate without overwintering, producing basidia, outgoing in at hick part of the apical cell membrane with numerous dividing basidiospores. The disease can be dispersed by basidiospores through the air and can occur over distances of 700 m. Basidiospores remain alive only a few hours, but this is enough for the rapid dispersal of the disease.

On the surface of pustules a white coating (deposit) because of which the disease gets its name. Coating consists of the rounded basidiospores, nodular, measuring 8 x 11.5 microns.

The pathogene is active in a wide temperature range, practically from 0 to 36° can germinate teliospores. At a temperature of 17°C, the process of reproduction of the fungus is rapid, already after three hours starts the ejection of basidiospores. The spores propagate from the plant to plant by wind, with tools, clothing, and water droplets by watering chrysanthemums. Drops of water for the spread of infection are of particular importance, since the germination of spores needs high humidity and the presence of drop moisture. The incubation period for White Rust pathogene usually takes10 days.

## Conclusions

Planting material of chrysanthemums, imported from abroad, demands the strict quarantine inspection. It was established that the pathogene was introduced initially by planting varieties of chrysanthemums Reagan purchased in Poland. Then, from host to host with planting material the disease has spread to the villages Yaloveni, Nisporeni, Ghidighici. The most infected chrysanthemum sort Reagan, Anastasia, the Super-White.

In the early stages of disease development the disease is difficult to determine visually, so chrysanthemum imported from other countries must be quarantined in isolated areas or in greenhouses.

On such areas carried out systematic and decadal examination, beginning after 2-3 weeks from germination. The affected plants are removed from the greenhouse with a clod of earth and burn the soil, watering with 5% formalin solution (1 part 40% formalin for 8 parts water). The remaining plants are treated with fungicides, alternating with intervals of 7-10 days between treatments: tsineb 0.2-0.4%, 0.2%, kuprozan, topaz 0.1-0.15%, bayleton 0.2%.

Good results were obtained by using euparen 0.2-0.4%, which inhibits the development of the fungus even at a late stage of the disease.

Most of the drugs listed here have no systemic effects, so it is necessary treat the entire surface of the plant, including the lower part; submitting to the sprayer in the midst of plantations and in the intervals between the plants, ensuring their complete wetting.

Because many of the fungicides on the plant leaves traces of the filler, is more expedient to deal with rust is on the young grow back chrysanthemums and complete treatment cycle prior to flowering.

Especially favorable for the control with rust the time of summer heat, the period of natural damping epiphytotics.

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# ASPECTS FOR DOMESTICATION OF PEROVSKIA ATRIPLICIFOLIA BENTH SPECIES

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**Summary.** *From prehistoric times, guided by instinct and luck, people began to identify plants and herbs to eat, that could soothe or heal inflammations or wounds. Therefore, knowledge about the properties of medicinal plants, dating from ancient times through the evidence found in all civilizations. Moldova's climatic conditions are quite favorable for research, introduction and cultivation of many species of medicinal and aromatic plants. Of this, is testifying the plant collections created, including about 300 units. Previous researches have revealed precious species for drugs' production.*

## Introduction:

Nowadays, the special interest expressed worldwide for herbal medicine, in which the phytotherapy occupies a privileged role, can have negative repercussions for the conservation of plant species of wild flora; therefore, by introducing in production the medicinal plants, also the knowledge of suitable culture technologies, we hope to help save many species of medicinal and aromatic plants.

The importance and the identity of medicinal and aromatic plants find their echo in their chemical composition, in the active substance that is used to prevent and treat various diseases. Biosynthesis of these biologically active substances, which determine the characteristics of many medicinal and aromatic plants, depends on genetic factors and climatic factors. They can influence both the quality and the proportion to which biologically active substances are found in plants.

## Materials and methods

The initial seeds were received from Rusia. Plants were grown in open ground, in balanced ecological conditions, on the general agrotechnical background, without using fertilizers.

Phenological observations were made at 25 plants, once in three days to end flowering stage and once a week - until the end of vegetation, according to program developed by the Moscow Botanical Garden [1].

Of leaves and flowers, from the fresh plant, harvested at the stage of synthesis, the content of volatile oil was determined by using the hydro distillation method. Heating was done at direct fire, the system being continuously monitored to avoid the overheating of the distillation flask.

## Results and discussions

***Perovschia atriplicifolia Benth.*** The name of the plant is due to V.A. Perovscogo Russian general, who discovered it during an expedition in Central Asia. It is native and grows in rocky areas in Afghanistan and Pakistan and is known for its febrifuge properties, used in medicine to reduce fever, and having culinary uses, but also decorative, air purification. In Europe is grown as ornamental plants.

In the Botanical Garden, the plant was grown from seed received through international exchange of seeds in 2006, in order to highlight the development features and the volatile oil content, the propagation processes, some plant forms with superior productivity of herba and volatile oil, the elaboration of primary processes of growth and cultivation and the experimentation of herba samples and volatile oil in perfumes and cosmetics industry and in medicine in Moldova's climatic conditions.

The experimental results of study showed that species Perovskia atripicifolia act as perennial plant, herbaceous from the Lamiaceae family. In Republic of Moldova is not researched as medicinal herb. This one has a high ecological plasticity, no special requirements to climatic factors, develops a bush of 17-18 whitish stems and leaves lobed, deeply toothed, gray-silver with a length of 5 cm and a width of 2.5 cm. Mature stems are woody at the base and the young ones are gray-silver gear with a length of 6 cm and a width of 3.0 cm. Mature stems are woody at the base and the young are herbaceous, the stem is square in cross section. Stems and leaves exude, by crushing a flavor of sage. Its characteristic smell, in England is called "Russian sage". In late August the plant blooms, producing flowers with tubular flowers in blue or lilac. Flowers can reach a length of 30 cm and can last up to three months. The plant forms a bush, which in its natural conditions reach a height of 1.5 meters and a circumference of 60 cm, under our conditions reached 80-90 cm height.

It is a plant less capricious to the growth and development conditions. It does prefer the alkaline soils, not acidic and swampy. Better withstand to both low and high temperatures. It reacts favorably to a clime rich in precipitation. It is a light-loving species. In early spring, all branches from the last year are cut at the height of 5-10 cm from the ground. Perennial plants start growing in early April. The growth and developing of plants is intensive until the gemmation. Generative stems are growing 12-15 branches of II order. The first flowers, on the central axis, appear from the beginning of July. Flowering stage is long, sometimes until early October, which offers the possibility of including species of green land type curative - prophylactic and as a decorative plant. According to literature data, it is multiplied generative and vegetative. Vegetative: detached cuttings in summer from green branches or less lignified. Plants are resistant to diseases and pests.

Basic components of oil, according to data from the literature are: eucalyptone a-cimene, borneol, etc. total of about 35 chemical compounds. Due to the quality of essential oil, this one is used in medicine, wine flavoring, seasoning salads, various articles of confectionery. The literature mentions antibacterial effect [2].

*Perovschia atriplicifolia Benth* plant, accumulates during the entire growing season and in all above-ground organs. Volatile oil content varies according to the stage of plant development and their body [3].

In 2011,it was the first time determined the volatile oil content in plants in the collection, gathering all herba. It was found that the volatile oil content in flower mass is 0.54% in the first repetition (fresh herba) and 0.55% in the second repetition.

## Conclusions

Moldova's climatic conditions are favorable for plant growth and normal development of Perovschia atriplicifolia Benth, - species originating in Central Asia, arid and rocky areas of Afghanistan and Pakistan. They provide ontogenetic cycle. Plants are multiplying both by vegetative and generative way. Biomorphological features were described and researches were initiated on the determination of volatile oil depending on the organ, stage and plant age.

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# SOME ASPECTS OF PRODUCTION TECHNOLOGY FOR LAVENDER LAYERS FOR INDUSTRIAL PLANTATIONS FOUNDATION

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**Summary.** *The rational use of plant resources become an actual problem. Obviously, this is because the use of plants in various branches of national economy, in everyday life, opens up new possibilities for effective health training, treatment and disease prevention. Using aromatic species cultivated open quite important perspectives-source of biologically active substances with prophylactic properties.*

*One of the aromatic species, well known is lavender (Lavandula vera), which besides contains volatile oil(1.7%) used widely in the cosmetic industry, the perfuming soaps, bath sparkling wines, detergents, ceramic paints, and also has shown antimicrobial, antivirus, antimycotics properties. The flower active internals act as an antiseptic, antispasmodic, depurative and sedative. They are used in cardiac diseases with nervous substrate, for kidney disease, rheumatism, biliary dyskinesia, colds, flu, cough, asthma, intestinal parasites, hepatic and splenic disorders, migraine, and epilepsy. There is an internal use also for carminative action in digestive disorders, in headache, for general stimulant, as flavouring and corrective. Provide comfort and relief as nervous exhaustion and irritability. The volatile oil of lavender flowers are also used as flavouring in culinary preparation of various dishes and drinks.*

## Introduction

Today, after a period of stagnation, the products and natural essential oils used by the perfumery industry, food and traditional medicine returned on the market with a rate increase. They are seen on the world market by replacing synthetic products with natural ones. Such a trend is observed in our country. Famous perfume companies use natural essential oils of 60-90% in volume production.

Pharmaceutical and perfumery market in Moldova requires more and more demands on natural aromatic oils, less allergic and quality. Based on local market needs, we have decided to continue working towards producing high quality planting material foundation for industrial plantations of lavender. Using pure biological material allows us to guarantee the production of raw material to obtain a high quality, vigorous plants with longer life, applying technologies for using organic fertilizers without chemical fertilizers and herbicides.

## Materials and methods

Within several years, the Laboratory plant resources have been made a number of individual selections from the variety of lavender Chisinau

- 90. However, this variety is quite homogeneous, during the test results of various characters productive quantity and quality of volatile oil and chemical components, were selected the most vigorous and unharmed by diseases and pests, plants were subjected to layering Spring - 300 shrubs and autumn - 300 bushes. This process is dependent on weather conditions, especially on the amount of moisture in soil, temperature abuse, but can be directed to some extent by interfering with certain technological operations (irigation, fertilization, aeration etc…).

The method provides basal stems and roots party branches lignified without, as they are shortened. Initially selected lavender bushes covered easily, pulling soil between the rows below the lateral shoots, making a wave of 4-5 cm. After the bush splits from the centre outward radial strain by bending to the ground and put in the centre of bush land that tamp it down well with the feet, providing a soil layer of 10-12 cm and a good contact with the ground bent stems. The hilling of the must be done in this way: the leafy tops of stems bent (8-10 cm) must remain uncovered by soil. The covering of the bushes with soil for branching stems and roots will be in early spring and late autumn, when plants do not vegetate. For better rooting and obtaining an increased number of layers, it was applied the mulching before the layering of the intervals between rows of organic fertilizers (manure), plant remains, well-rotted, garden soil, peat mixed with biohumus etc.

The mulching of the space between rows increases rooting, also the number of layers that can be selected from a plant that is subject of layering, obtaining standard layers, vigorous with well-developed root system quality. The layering process was completed in early spring and late autumn at the end of vegetation, when the soil moisture level is increased and the temperature is marked by lower values. Moderate irrigation was applied to obtain smooth and uniform substrate mulch.

For posting layers obtained by experimental method was used sharp spade in a special way. By posting this method is quite fast, without great loss and damage to the parent plant. In industrial areas, the layers can be cut using special cultivator or pecker adjusted, but this operation is resulting in loss of both seedlings and parent plants.

## Results and discussions

After posting, the layers obtained are sorted, trimmed, counted and prepared for planting. To avoid drying of the root system, the layers are morassed, using the mixture from clay 50% + 50% manure on which pour the required amount of water until a consistent mass, uniform, able to stick to the root layers. Sorting the layers runs on the following criteria: the first category of layers - is considered that the main root reaches a length of 15 cm and bush diameter is 12 cm; the second-class roots have length of 12 cm and diameter of aerial part of 8 -12 cm. The other layers are classified as nonstandard and are planted in the nursery for further development in order to achieve satisfactory parameters for planting.

Planting lavender standard layers is carried out in autumn, the period when there are more precipitations. For draught, it proceeds at irrigation with 2 litres of water for each plant. Planting is carried out during September-October. This term allows for better rooting, seedlings become resistant to frost and form clumps in the first year already quite strong. Early spring planting is recommended but less inevitable if early frosts of autumn.

In the climate of Moldova, nutrition area is 100 x 50 cm, which allows prospective obtaining a large number of quality layers.

Before planting the layers, in accordance with the technology of land cultivation needs to be mapped and divided into strips separated by roads with width of 4 m and 8-10 m length to facilitate use of technology during the care and maintenance. Then the land is marked in two directions. Layers were planted in the holes made in the place of intersection of the marker.

Before planting select layers, keep them in optimal conditions severs the root of 15-20 cm, then soften the clay solution. Layers must be incorporated into the soil with 5-6 cm below the root ring, so that lower branches are well covered with soil. When planting, the roots layers are arranged well, being covered with soil, wet and again covered with a layer of soil, do not settle. For winter seedlings are hilled with soil layer with thickness of 3-5 cm.

During vegetation the plants are irrigated as necessary, creating good conditions for rooting. In June, it is made the removing of the inflorescence stems tips bent, then, tha sprouts rooted lose contact with the ground. In the second year of vegetation, to obtain layers, it is necessary to add the center shrub layer 3-4 cm soil compaction and to repeat it. Holding during the vegetation the soil from the center of bushes wet, the stems and branches covered with soil, form a well-developed roots fascicled,length of 10-20 cm. Towards the end of the growing season in October, stems and branches are dsiclosed and manually are remoed from bush , being cut at 2-3 cm above the package. The layers obtained are separated from the ground and splited by the degree of rooting and root development. The layers which meet the technical conditions of seedlings, must have the thickness in the zone of rooting greater than 3-4 cm and apical leafy branches. From every bush layered, we can obtain 80-100 of good layers used as planting material quality and as many layers with poorly developed roots, which will be transplanted in nurseries provide for better rooting. Before planting, the layers are treated with biologically active substances to achieve a better development of primary and secondary roots.For light soils, eroded or sandy, proposed for layering, it used  humic and fertil soil, brought out of plantation, given that light soils have a low moisture-holding capacity, which does not provide a satisfactory rooting layers.

The layering is carried out on mother plantation in the fourth year of vegetation, when the plants are already quite developed, have many branches. Before layering, a mulching is required for the interval between rows with biohumus or manure, plant debris, garden soil, mixed forest with peat soil. For one hectare of plantation are sufficient from 0.5 to 0.7 tons of mulching material. On each mother plant is applied soil, bending preventive side branches. All remaining gaps are well covered with soil. Spring, after vegetation starts, if it is necessary, additional soil mulching is done. Irrigation is done, in case of insufficient moisture. The additional organic fertilizers nutrition is beneficial. During the vegetation, if all the necessary technological operations are respected, plants grow well and are forming strong shoots and a well-developed root system. In autumn, from October to November, it is applied a detachment layers of mother bushes. Each mother plant can produce around 100 -150 standard layers.

## Conclusions

As a result of research, it was developed and implemented a special production of layers of lavender (C-90); it was obtained pure biologic seedlings, high quality, affordable, in terms warranted in order of foundation of a mother plantation and also the production of industrial plantations volatile oil; it has established a plantation – lavender pattern on the surface of 1 ha, it were applied some elements of organic cultivation, developed technology for producing sheet layers to use technology for seedlings production of lavender by layering.

The technology developed and implemented is recommended as a guide for farmers, farms and forestry enterprises specialized in the cultivation of individual species of medicinal and aromatic plants.

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## VIERMICOMPOSTUL – MIJLOC DE DIMINUARE A GRADULUI DE CONTAMINARE A PORUMBULUI CU TĂCIUNE

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**Summary.** *In this articlest is reflected influence of worm's compost on cultivation of maize and the level of smut's pollution (Ustilaginalis) of plants in the first, in the second and third year of use of fertilizer. As a result of researches it has been established, that inclusion of worm's compost in soil (4t/ha) has reduced in 2,5 times corn pollution of smut in the first year of use of fertilizer. The plants which have been grown up with use of worm's compost (for the second and third year of action of fertilizer), have not been infected of smut, and the cultures which have been grown up on a natural background, have been infected of smut, corresponding on 2,58 % and 1,15%. Harvest of cobs on lots worm's compost fund, increased by 21.05% -35.09% compared with the harvest from the control group. So, use of worm's compost diminished degree of contamination of maize of smut and increased harvest cobs.*

### Introducere

Bioconversia deşeurilor organice în calitate de direcție nouă a ştiinței şi practicii agrobiologice merită o atenție deosebită şi cercetări profunde [3]. Cercetările ştiințifice multiple mărturisesc, că produsul final al procesului bioconversiei deşeurilor organice prin viermicultivare este viermicompostul, care reprezintă fertilizant organic înalt efectiv ecologic, utilizarea căruia este un mijloc real de preîntâmpinare a poluării solurilor şi apelor [2].

Aprecierea calității viermicompostului are o importanță deosebită pentru sporirea cantității şi calității producției agricole inclusiv şi a plantelor furajere [1].

Viermicompostul este unul din remediile, care nemijlocit participă la dezvoltarea agriculturii durabile şi obținera producției ecologice [4].

De aceea spectrul de influență a viermicompostului asupra plantelor este larg şi soluționează un şir de probleme ale mediului:

- prelucrarea complexă a deşeurilor organice;
- reanimarea solurilor degradate;
- obținera fertilizantului organic cu acțiune îndelungată;
- sporirea producției culturilor agricole;
- obținerea producției agricole ecologice;
- protecția plantelor [3].

Obiectivul prezentei lucrări a constat în efectuarea cercetărilor privind influența viermicompostului asupra gradului de contaminare a porumbului cu tăciune (Ustilago maydis şi Sorosporium reilianum f. zeae*)*.

Este cunoscut, că tăciunea atacă culturile cerealiere, inclusiv porumbul. Tăciunea contaminează tulpinele, infloriscențele, spicul şi ştiuleții porumbului. Spicurile contaminate se transformă într-o masă de spori de culoare neagră, ştiuleții într-un conglomerat negru în formă de con alcătuit din mătase şi sporii ciupercii, care se păstrează până la coacerea porumbului. După coacere sporii de tăciune nimeresc în sol s-au pe semințe. Porumbul este contaminat de tăciunea Sorosporium reilianum f. Zeae [9].

Tăciunea menționată contaminează, în deosebi, regiunile de sud unde se practică intens cultivarea porumbului (inclusiv şi în R.Moldova). Prezența acestei maladii a fost depistată în regiunea Kubani, Osetia de Nord [5], şi în ținutul Stavponol [6]. S-a constatat că procesul contaminării porumbului cu tăciune înhibă dezvoltarea plantelor, provocând formarea intensă a pueților şi lipsa ştiuleților [8].

Gradul de contaminare a plantelor cu tăciune este influențată de mai mulți factori printre care un rol esențial revine timpului semănatului şi temperaturii aerului. Sporii de tăciune se păstrează în sol timp de 4 - 5 ani [6].

## Material şi metode

În calitate de material de studiu a fost folosit soiul de porumb M-425 şi fertilizantul organic (viermicompostul). În experiment a fost inclus porumbul cultivat cu fond de viermicompost şi cu fond natural. Cercetările au fost efectuate în condițiile de câmp a Stațiunii Tehnologico-Experimentală ”Maximovca”. În experiment au fost folosite 3 loturi (două experimentale şi un lot martor), cu suprafața de un ar. Pe loturile experimentale, înainte de semănat, a fost încorparat viermicompostul (din considerența 3-4 tone/ha), fertilizant organic, obținut în rezultatul bioconversiei deşeurilor organice prin viermicultivare (tabelul 1). Pe lotul-martor plantele au fost cultivate cu fond natural.

Pe parcursul experimentului au fost efectuate observări asupra dezvoltării porumbului, inclusiv şi asupra procesului de contaminare a plantelor cu tăciune.

Tabelul 1

**Schema experimentului**

| *Nr. crt.* | *Tipul culturii* | *Loturile* | *Condițiile experimentului* |
|---|---|---|---|
| 1 | Porumb | I- experimental | Viermicompost - 4 t/ha |
| 2 | Porumb | II- experimental | Viermicompost - 3 t/ha |
| 3 | Porumb | III – martor | Fond natural |

Cercetările s-au efectuat în primul, al doilea şi al treilea an de acțiune a viermicompostului. Pe parcursul experimentului şi la finele perioadei de vegetație a fost efectuată evidența plantelor contaminate cu tăciune. La sfârşitul perioadei de vegetație, prin cântărire, a fost determinată recolta ştiuleților colectată de pe fiecare lot.

## Rezultate şi discuții

În rezultatul cercetărilor efectuate s-a constatat, că utilizarea viermicompostului a influențat benefic asupra diminuării gradului de contaminare a porumbului cu tăciune. Este cunoscut că pentru protecția reuşită a cerealelor de contaminare cu tăciune este necesar de efectuat un şir de măsuri agrotehnice. Din ele cele mai efective sunt: practicarea permanentă a asolamentului, care împiedică acumularea în sol a sporilor de tăciune; folosirea soiurilor de hibrizi rezistente la contaminare; timpul semănatului; adâncimea la care sunt semănate plantele; deasimea culturilor; metodele de colectare ş.a. [6].

Pe parcursul perioadei experimentale, în primul an de acțiune a viermicompostului s-a constatat, că un număr mai mare de plante contaminate cu tăciune au fost depistate pe lotul-martor, în comparație cu loturile în care a fost încorporat viermicompostul (tabelul 2).

Tabelul 2

**Gradul de contaminare a porumbului cu tăciune**

| *Nr. crt.* | *Variantele experimentului* | *Contaminarea porumbului cu tăciune, %* | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Anul I* | | *Anul II* | | *Anul III* | |
| | | *Numărul de plante* | *%* | *Numărul de plante* | *%* | *Numărul de plante* | *%* |
| 1 | Cu fond de viermicompost (experimental I) | 7 | 1,51 | - | - | - | - |
| 2 | Cu fond de viermicompost (experimental II) | 7 | 1,51 | - | - | - | - |
| 3 | Cu fond natural (martor) | 18 | 3,87 | 12 | 2,58 | 5 | 1,15 |

Aşadar, pe loturile cu fond de viermicompost, au fost contaminate cu tăciune, doar 1,51% din plante, iar pe loturile-martor (cu fond natural ) – 3,87% din plantele cultivate pe lot.

Reieşind din cele expuse s-a constatat, că pe loturile cu fond natural contaminarea plantelor cu tăciune a fost de 2,57 ori mai sporită de cât pe loturile cu fond de viermicompost.

Analiza datelor expuse în tabel demonstrează, că în al doilea şi al treilea an de acțiune a fertilizantului, porumbul de pe loturile cu fond de viermicompost nu a fost contaminat cu tăciune.

Pe lotul cu fond natural cota-parte a plantelor contaminate cu tăciune a constituit 2,58% – în al doilea an şi 1,15% – în al treilea an de acțiune a fertilizantului organic. Analizînd rezultatele obținute, privind gradul de contaminare cu tăciune a plantelor de pe lotul-martor, s-a constatat că valoarea lui, în al doilea şi al treilea an al experimentului, a diminuat corespunzător, cu 33,3% şi 72,2%, în comparație cu anul întâi. În al treilea an valoarea gradului de contaminare a porumbului cu tăciune, a diminuat cu 58,3%, în comparație cu anul al doilea de vegetație.

Aşadar, în rezultatul cercetărilor s-a constatat că încorporarea fertilizantului organic în sol a diminuat gradul de contaminare a plantelor cu tăciune atât pe loturile cu fond de viermicompost cât şi pe lotul-martor.

Figura 1. Contaminarea porumbului cu tăciune, în diverse faze fenologice

Sunt cunoscute date, că în Ucraina, în anii 1980 ai secolului XX-lea, contaminarea cu tăciune a porumbului a constituit 21,60%, pierderea roadei de grăunțe constituind 2,80%. În Moldova, în anii 1980-1990 contaminarea semănăturilor de porumb cu tăciune a oscilat de la 1,60% până la 30,00%. Ca rezultat al acestei maladii pierderile recoltei de grăunțe au constituit

35,00%, [8]. Pe terenurile, unde porumbul se cultivă consecutiv mai mulţi ani (nu se aplică asolamentul), pierderile recoltei de seminţe oscilează de la 15,00% până la 20,00% [10].

Pe parcursul experimentului au fost efectuate observări asupra dezvoltării plantelor contaminate de tăciune. S-a constatat, că umflăturile cu spori de tăciune a porumbului se formează pe diverse părţi a plantei (spic, ştiuleţi, tulpină) provocând distrugerea spicului şi ştiuleţului, transformându-i în saci cu spori negri de tăciune (Figura 1).

Tabelul 3

**Influenţa gradului de contaminare a porumbului cu tăciune asupra recoltei de porumb**

| *Nr. crt.* | *Variantele experimentului* | *Recolta porumbului* | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Anul I* | | *Anul II* | | *Anul III* | |
| | | *kg* | *%* | *kg* | *%* | *kg* | *%* |
| 1 | Cu fond de viermicompost (experimental I) | 69,700 | 129,07 | 77,000 | 135, 09 | 114,600 | 132,02 |
| 2 | Cu fond de viermicompost (experimental II) | 66,500 | 123,15 | 69,000 | 121, 05 | 112,000 | 129,03 |
| 3 | Cu fond natural (martor) | 54,000 | 100,00 | 57,000 | 100, 00 | 86,800 | 100,00 |

În rezultatul observărilor s-a constatat, că porumbul contaminat cu tăciune a influenţat atât asupra dezvoltării întregii culturi furajere cât şi asupra recoltei de ştiuleţi. Aceasta a dus nemijlocit la scăderea recoltei de ştiuleţi pe unitate de suprafaţă. Analizând rezultatele expuse în tabelul 3 s-a constatat că recolta de ştiuleţi obţinută în anul întâi al experimentului, pe loturile cu fond de viermicompost, a fost cu 29,07% şi 23,15% mai sporită decât de pe lotul-martor. În anul al doilea şi al treilea de acţiune a fertilizantului, recolta porumbului de pe loturile cu fond de viermicompost, a depăşit-o pe cea de pe lotul cu fond natural corespunzător, cu 35,09%; 21,05% şi 29,03%; 32,02%.

Din cele expuse rezultă că viermicompostul, influenţând asupra diminuării gradului de contaminare a porumbului cu tăciune, a sporit recolta la unitate de suprafaţă.

## Concluzii

În rezultatul cercetărilor s-a constatat, că încorporarea viermicompostului în doza de 3-4 t/ha, în primul, al doilea şi al treilea an de acţiune a fertilizantului a contribuit la:

- diminuarea de 2,57 ori a gradului de contaminare a porumbului cu tăciune, în primul an de acţiune a fertilizantului;

- lichidarea contaminării cu tăciune a plantelor, în al doilea şi al treilea an de acțiune a viermicompostului;

- sporirea cu 21,05% – 35,09% a recoltei colectate de pe loturile cu fond de viermicompost, în comparație cu lotul-martor.


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# THE SELECTION OF CORNELIAN CHERRY (*CORNUS MAS* L.) IN UKRAINE


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**Summary.** *The genetic pool of Cornelian Cherry in Ukraine is formed mainly by the cultivars selected by the Hryshko National Botanical Gardens (NBG) of the Ukrainian National Academy of Sciences. These are 14 officially registered*

*(1987, 1999, 2001) cultivars of Cornelian Cherry, and substantial cross-bred fund, acquired as a result of selection. Our genetic pool possesses ore than 100 specimens collected from wild and cultivated plants in Ukraine, and the cultivars of Bulgarian, Slovak, English, Austrian, and Georgian selection. The genetic pool of Cornelian Cherry of the NBG presents rich variety of biological and economic properties.*

## Introduction

Cornelian Cherry has become an objective of the selection work in the world rather recently. The systematic work on formation of the collections, retrieval of the genetic pool and selection has been carried out lately in Ukraine, Bulgaria, Slovakia, Austria, Yugoslavia, France, Germany, Poland, and Turkey.

Cornelian Cherry is the culture meeting the standards of the time. It is valuable fruit, medicinal, ornamental plant [16]. Plants practically are not damaged by vermin and illnesses, and don't need pest-killers treatment [5].

Until recently natural resources of the cornelian cherry were the source of the fruits. As soon as their natural habitats, as well as productivity, were significantly reduced the demand in fruits are not met [1]. Besides, the forest forms of cornelian cherry don't bear fruits regularly enough, yield small dry fruits, especially in draughty years. The crop makes up 2.8 – 4.8 kg per bush; under sufficient light and moistening crop capacity grows considerably and makes 5 – 10 kg per bush [1, 8, 9].

According to literature data [18, 19, 21] and our research [6, 7] cornelian cherry yields abundant and stable crop in culture, and bares large juicy fruits, while not demanding thorough care, its cultivation is very paying.

## Materials and methods

Objectives of our research is to accumulate genetic pool of cornelian cherry and select winter resistant productive sorts baring high-quality fruits for industrial, farmers' and amateur gardens.

Inspection of natural resources, cultural plantations, collection of forms and their utilization in selection for creation of new cultivars of cornelian cherry. Forms of cornelian cherry (those of interest for genetic pool) were investigated in gardens of the test stations, horticultural research institutions, arboretums, private gardens, desolate parks of old mansions. Practically all regions of Ukraine have been studied, more than 350 forms have been described, out of which more than 100 have been selected and reproduced. The genetic pool we have collected is diverse by its biological and economic characteristics.

The first stage of work was analytic selection: the results of spontaneous selection were used for identifying of the most perspective forms, at the second stage – synthetic selection – were created cultivars with specific properties and features. Main method of synthetic selection we use in our work is hybridization. At the same time our cultivars Svitliachok and Exotic were obtained as a result of somatic mutations.

## Results and discussions

Crimea takes first place in the abundance of the cultural forms of the amateur selection [8]. Cornelian cherry is considered to be a southern plant. Many authors [4, 12, 14] have expressed an opinion concerning natural and ancient forests in this region with cornelian cherry participation; the above authors consider *Cornus mas* along with other tertiary elements of these forests to be relic of late Pliocene, i.e. the species, which survived the cold spell of the quaternary in situ.

Regular selection of the cornelian cherry has not been carried out for a while. Information concerning its cultivation abroad is rather scant [15, 17, 24, 25]. In recent decades in many European countries as well as in America much work has been done concerning investigation of the culture of cornelian cherry and creation of new cultivars [2, 13, 20, 23].

Among the first to be registered in 1985 were remarkable cultivars of Cornelian Cherry (Kazanlytsky pear-shaped and Pancharevsky cylindrical, selected by Tsolo Nagov in Bulgaria under Research-Production Company "Sortovi Semena i Posadchen Material". Two cultivars of Cornelian Cherry "Dvin" and "Titus" registered in 1989 have been selected by in Slovakian Institute of Horticulture. Dr. Helmut Pirk (Austria) has created new large-fruited cultivar "Joliko" with an average fruit weight 5.6 g, the stone is 10% of the fruit mass. The cultivar has been registered in 1991 in Arnold Arboretum (USA). It is being widely tested and reproduced by fruit-growers of Austria, Germany, and Switzerland. Another cultivar of Cornelian Cherry has been registered in 1992 in France. In Azerbaijan Institute of Genetics and Selection have been selected cultivars named "Armudi-Zogal" and "Ak-Zogal". Substantial investigation of natural genetic pool of Cornelian Cherry and breeding of cultivars are being carried out in the Central Institute of of Horticulture of Turkey in the city Yalovaya near Istanbul, and at the chair of horticulture of the Tbilisi Institute of Agriculture in Georgia. Big research of Cornelian Cherry's natural populations has been done by G. Leontyak in Moldova. Genetic multiplicity and ways of reproduction have been studied by G. Dudukal and I. Rudenko from Institute of Botany of Moldova.

Genetic pool of the cornelian cherry National Botanical Gardens possesses ore than 100 specimens collected from wild and cultivated plants in Ukraine, and the cultivars of Bulgarian, Slovak, English, Austrian, and Georgian selection. The genetic pool of Cornelian Cherry of the NBG presents rich variety of biological and economic properties.

Cornelian cherry has not been included in the State Register of Sorts of Ukraine until 1990. The blank has been filled up by the work of the National Botanical Gardens of Ukrainian Academy of Sciences.

The genetic pool of Cornelian Cherry in Ukraine is formed mainly by the cultivars selected by the Hryshko National Botanical Gardens (NBG) of the Ukrainian National Academy of Sciences.

These are 14 officially registered (1987, 1999, 2001) cultivars [10] of Cornelian Cherry, and substantial cross-bred fund, acquired as a result of selection. The first stage was the analytical selection, when we used the results of spontaneous selection. As a result of second stage - synthetic selection (cultivated forms of Cornelian Cherry of diversified origin were used) there have been developed cultivars characterized by steady annual fructification, high productivity, and frost resistance under the conditions of the forest-steppe.

Average mass of the fruit is 5.0–8.0 g, the mass of the stone – 7.5–11.0% of the fruit (table 1).

Table 1

**The characteristic of some cultivars of cornelian cherry**

| *Cultivar* | *Average weight of fruit, g* | *Mass stone from mass of fruit, %* | *Average crop from a tree, kg* | *The terms of ripening* |
|---|---|---|---|---|
| Exotichesky | 7.3 | 9.9 | 28.5 | 15.08–05.09 |
| Elegantny | 5.0 | 10.9 | 20.0 | 25.07–10.08 |
| Luk’anovsky | 6.0 | 10.2 | 40.0 | 10.08–25.08 |
| Coralovy Marka | 5.8 | 10.1 | 36.0 | 05.08–20.08 |
| Nezhny | 5.5 | 10.0 | 40 | 10.08–17.08 |
| Semen | 6.2 | 10.9 | 22.5 | 20.08–05.09 |

The fruits are bottle-shaped, pear-shaped, oval form; dark-red, cherry colored, pink, and yellow, contain 8.0 to 11.0% of sugars; 1.3–1.9% of organic acids; 101.0–193.0 mg% of the vitamin C; 670.0–850.0 mg% of anthocyan in the skin, and 36.0–121.3 mg% – in the pulp. Best cultivars of our selection cultivars are Evgenia, Semen, Coralovy Marka, Svetlyachok, Elena, Vydubetsky, Elegantny, Luk’anovsky (Figure 1), Exotichesky (Figure 4), Radost, Nikolka, Vavilovets, Vladimirsky, Grenader.

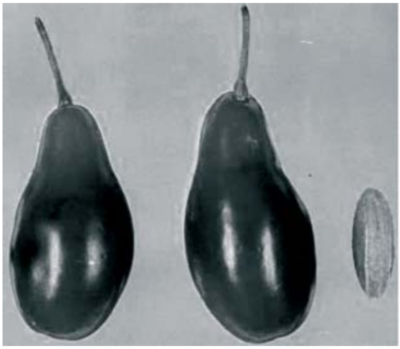

Figure 1. The cultivar 'Luk'anovsky'

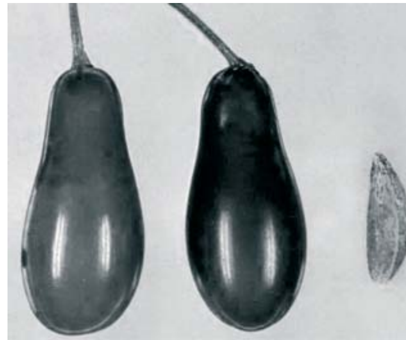

Figure 2. The cultivar 'Elegantny'

Cultivar Elegantly (Figure 2) is of dwarfish type, plants are 1.5–1.8 m high, with compact crown, cultivar Coralovy Marka (Figure.3) features big pik fruits, cultivar Semen – one of the most valuable in our selection features original pear-shaped fruits of late ripening (Figure 6).

Figure 3. The cultivar 'Coralovy Marka'

Now there are no genotypies with yellow fruits in nature. We have five the some (table 2), three of which are of particular interest – Alosha, Nezhny (Figure 5) and Yantarny and has been prepared to the State-cultivar-testing. Cultivars Svetlyachok and Exotichesky are result of somatic variability.

Industrial plantations of the cornelian cherry can function during tens of years. In calculating complex of arrangements aimed at establishing of the plantation we proceed from the following data: average number of plants per hectare – 400–625 pieces, average productivity of one plant –

30–80 kg, stones make 10% of the mass of the fruits, number of stones per one tree – 7.5–24.0 thousand, crop per 1 hectare – 200–250 centner.

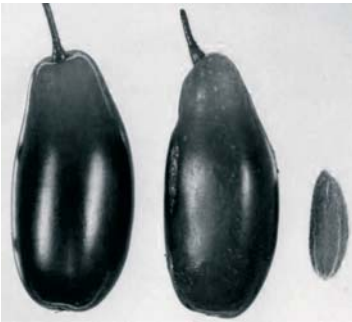

Figure 4. The cultivar ‘Exotichesky’’

Figure 5. The cultivar ‘Nezhny’

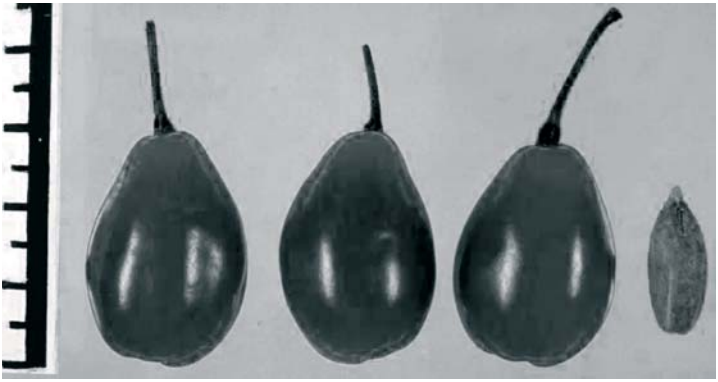

Figure 6. The cultivar ‘Semen’

Table 2

**Quantitative indications of morphological signs of genotypes of cornel with yellow fruits**

| *Cultivar* | *Fruits weight, g* | | | *Fruits length, mm* | | | *Fruits width, mm* | | | *Fruitstalk length, mm* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *min*/*max* | *M* | *V%* | *min*/*max* | *M* | *V%* | *min*/*max* | *M* | *V%* | *min*/*max* | *M* | *V%* |
| Alosha | 1.71/4.44 | 3.07 | 17.69 | 15.56/22.66 | 19.36 | 7.48 | 10.69/15.38 | 13.21 | 7.99 | 3.76/10.04 | 7.15 | 19.71 |
| Bukovinsky | 2.49/4.90 | 3.53 | 13.40 | 18.05/23.33 | 20.36 | 5.03 | 13.59/17.93 | 15.30 | 6.12 | 5.06/10.21 | 7.98 | 16.92 |
| Galitsky | 2.20/4.60 | 3.31 | 16.99 | 18.76/23.19 | 20.54 | 5.89 | 13.28/17.02 | 15.67 | 6.76 | 7.25/11.34 | 8.97 | 13.18 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nezhny | 3.32<br>5.87 | 4.32 | 13.45 | 24.43<br>32.57 | 29.09 | 6.44 | 13.40<br>17.99 | 15.32 | 5.64 | 9.71<br>21.46 | 14.87 | 17.74 |
| Jantarny | 3.09<br>5.80 | 4.36 | 13.19 | 17.02<br>24.43 | 22.04 | 7.73 | 14.23<br>18.53 | 16.35 | 5.50 | 3.98<br>18.59 | 8.70 | 29.15 |

The work on collection of genetic pool and selection of cornelian cherry heavily depends on effective methods of reproduction, which allow for extensive use of genetic pool, introduction of the cornelian cherry in the culture and creation of its cultured habitats.

The technology of vegetative reproduction of the cornelian cherry has been worked out. Main method is budding, resulting in 90–98% output; other methods also being effective: by offsets – with 85–90% output, by green grafts – with 75–78%. Seedlings serve as stock for inoculation.

## Conclusions

The genetic pool of Cornelian Cherry in Ukraine is formed mainly by the cultivars selected by the Hryshko National Botanical Gardens (NBG) of the Ukrainian National Academy of Sciences. These are 14 officially registered (1987, 1999, 2001) cultivars of Cornelian Cherry. The further selection within the *Cornus mas* L. species depends on replenishment and preservation of its genetic pool, which will always be needed for creation of new stable productive sorts in accordance with the demand of industrial production and amateur horticulture. It can be used in new selection programs as well.

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# NATURAL APPLE SEEDLINGS (*MALUS DOMESTICA* BORKH.) AS GENETIC RESOURCES FOR BREEDING NEW VARIETIES

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**Summary.** *The aim of study was to evaluate the basic characteristics variability of wild apple (Malus domestica Borkh.) seedlings selected collection. For this experimental study were applied 77 natural seedlings in different regions of Slovakia located during previous exploration. For the selection and evaluation purposes a health status was regarded as the most important criterion. Based on morphometric analysis was determined the average weight of fruits in range of 16.13 to 197.59 g, height of fruit from 29.55 to 74.04 mm, fruit width from 36.85 to 78.43 mm, depth of stalk cavity/calyx cavity 2.04- 16.1 mm / 1.22 – 11.69 mm, the fruit core height /width in ranges of 11.24 – 25.86 mm / 13.72 – 30.86 m, respectively. By correlation analysis were determined the correlation coefficients between the evaluated traits. Very strong degree of linear dependence was determined between the fruit weight and height (0.902) / width (0.959). A strong degree of dependence was found between the height and width of the fruits (0.861), depth of stalk and calyx cavity (0.722), fruit weight and depth of the stalk cavity (0.713). Among the other traits occurred only a moderate degree of dependence.. Significant differences were determined between the seedlings in the shape of fruit, color of fruit flesh and other features as well. The studied natural population of seedlings is suitable for selection of important and interesting genotypes in term promising genetic resources for breeding of new varieties as well as for direct use in practice.*

## Introduction

Apple is the most important fruit of species spread in temperate regions. It is able to adapt to different climatic regions, but the best conditions for this tree are between the 35 to 50º latitude (Kellerhals, 2009). Botanically the apple trees are classified in the family *Rosaceae*, subfamily *Pomoieae*. Within the genus *Malus* are recognized several individual species. Epidemiological studies suggest that the biochemical composition of apples and their food products have various phytotherapeutic effects. Eating of fruits can support reduction the risk of cardiovascular, asthmatic and other diseases (Ondrejovic et al 2009). Phytotherapeutic effects are conditioned mainly by the presence of polyphenolic components Aprikian et al. 2003, Enomoto et al. 2006). The process of breeding new varieties of apple trees requires a finding of suitable genetic resources (Miko 1999).

The basic characterization of individual traits must be done in order to evaluate the plant genetic resources. Langenfeld (1991) describes the apple tree (*Malus domestica* Borkh.) is of height mostly 3 – 6 m, and sometimes from 10-14 m. Leaves reach the length of 5 – 10 cm. The average weight of fruit is 150 to 160 grams moreover some varieties can reach 600 g weight (Antonovka) or even 900g. The size of fruit is most often measured by their weight (Murawski 1960, Smirnov 1966) or width (Bocek 1956, Burket 1882, Rejman – Zaliwsky et al. 1956). Some authors (Vavra 1955, Krumm 1956, Dvorak et al., 1969) evaluated the size of fruit at the same time according to the above two aspects.

Morphometric analysis is a part of the process of characterization and description of traits of apple genetic resources. The methodology of morphological assessment of apple (*Malus domestica* Borkh.) fruit was elaborated by many authors (Dvorak et al., 1976, Kohout 1960). Kohout (1960) where states that the shape of the apple fruit is very variable. The shape of the fruit is characterized mainly by the width and height. Krumm et al. (1956) defined the fruit shape index based on the width, shape of the calyx cavity and stalk cavity, placing the calyx, shape of stalk and crosswise cut. Morphological and agronomic characteristics are often used for basic description of genotypes, because this information is taking into account of high interest for users of the genetic diversity of plant genetic resources (Hammer et al., 2003).

## Materials and methods

The aim of study was to evaluate the variability of the basic features in the selected collection of wild apple seedlings. For this experimental study were located 77 natural seedlings in different regions of Slovakia. Seedlings were searched along the roads, in old orchards and gardens during flowering and fruit ripening. In the selection and inclusion to the evaluation a health status was regarded as the main criterion. For the evaluation were collected leaves, flowers and fruits of seedlings. In laboratory were evaluated the weight (g), height and width (mm), depth of stalk and calyx cavity (mm), length and width of the cores (mm). Alongside with these activities were evaluated the qualitative characteristics of fruits according to UPOV classifier for apple (*Malus domestica* Borkh.).

## Results and discussions

In the presented work the main attention was paid to the collection of wild apple seedlings. These are growing randomly from the vital seeds and usually after 5 – 8 years reach the fertile period. Seedlings may occur in fact as a consequence of self-fertilization or a foreign pollination, therefore is difficult to identify their genetic origin. This indicator is not so important than their economic value and possibility of being exploited in practice. Wild seedlings can be identified by the trees shape in the country. Seedlings often are having the shape of bushes. These bushes can reach quite different shape and size as documented in Figure 1. In our experiments was confirmed a significant variability in the shape and color of leaves (Figure 2).

The variability of fruits is presented in Table 1. Based on morphometric analysis, the determined average fruit weight range was 16.13 – 197.59 g, height of fruit 29.55 – 74.04 mm, fruit width from 36.85 to 78.43 mm, depth of stalk cavity/calyx cavity from 2.04 to 16.1 mm / 1.22 – 11.69 mm, height of fruit core/width of fruit core in range of 11.24 – 25.86 mm / 13.72 – 30.86 mm.

The values of variation coefficients were determined in range 12.43% – 39.98%. Moderate variability was determined for the height of fruit (14.85%), fruit width (12.43 %), height of the core (16.61 %) and width of the core (14.85 %). High degree of variability was determined for the weight of fruit (35.82 %), stalk cavity depth (31.09 %) and depth of calyx cavity (39.98 %).

Dvořák et al. (1976) classified fruits according to 3-year weight average as extremely small (less than 15 g), very small (16 – 48 g), small (41 – 70g), larger (71 – 110g), medium (111 – 150 g), big (151 – 200 g), very big (201 – 250 g), extremely big (over 351 g). According to this descriptor wild seedlings provide small and larger fruits.

Michálek (2003) divides the apple varieties according to fruit size, which is determined by the largest diameter of cross section. According to the descriptor, author recognizes the fruits as smaller with average diameter to 55 mm, medium 55 – 70 mm, large 71 – 85 mm and very large – above 85 mm. According to this descriptor fruit of apple seedlings can be characterized as small to large.

Kohout (1960) in his assessment of apple varieties grown in the 60´s, described as the smallest genotypes e.g Panenské České, Červené Tvrdé, Jadernička Moravská (diameter 55 mm). The largest width at that time was reached by Cár Alexander, Peasgoodovo, Pontoiské, Bláhovo Libovické (diameter 90 – 115) varieties. The evaluation and comparison shows, that it is possible to find genotypes with desired size of fruit in natural populations of seedlings.

In the fruit shape and coloring, the fleshes of fruits in collection of evaluated genotypes were determined significant differences as illustrated in Figure 3.

Figure 1. Comparison of selected genotypes from evaluated collection of wild apple seedlings (*Malus domestica* Borkh) in shape of a crown. Figure: M. Hulin, 2010

Table 1

**Variability of traits measured on the fruits of wild apple seedlings (*Malus domestica* Borkh).**

| *Traits* | *n* | *Min* | *Max* | *x* | *V%* |
|---|---|---|---|---|---|
| Weight of fruits (g) | 77 | 16.13 | 197.59 | 96.36 | 35.82 |
| Height of fruits (mm) | 77 | 29.55 | 74.04 | 52.82 | 14.17 |
| Width of fruits (mm) | 77 | 36.85 | 78.43 | 61.85 | 12.43 |
| Depth of stalk cavity (mm) | 77 | 2.04 | 16.11 | 9.23 | 31.09 |
| Depth of calyx cavity (mm) | 77 | 1.22 | 11.69 | 5.06 | 39.98 |
| Height of fruit core (mm) | 77 | 11.24 | 25.86 | 16.60 | 16.61 |
| Width of fruit core (mm) | 77 | 13.72 | 30.86 | 20.90 | 14.85 |

Figure 2. Comparison of selected genotypes from evaluated collection of wild apple seedlings (*Malus domestica* Borkh) in shape of leaves. Figure: M. Hulin, 2010

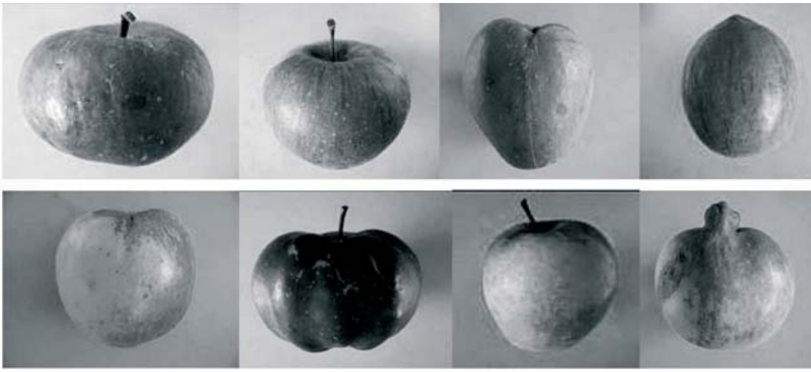

Figure 3. Comparison of selected genotypes from evaluated collection of wild apple seedlings (*Malus domestica* Borkh) in shape of fruits. Figure: M. Hulin, 2010

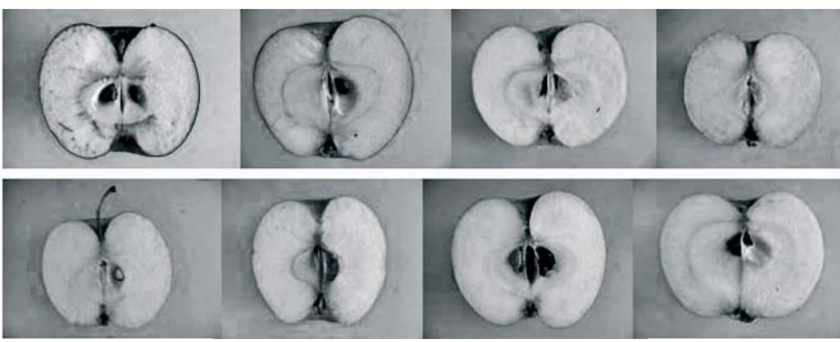

Figure 4. Comparison of selected genotypes from evaluated collection of wild apple seedlings (*Malus domestica* Borkh) height of core Figure: M. Hulin, 2010

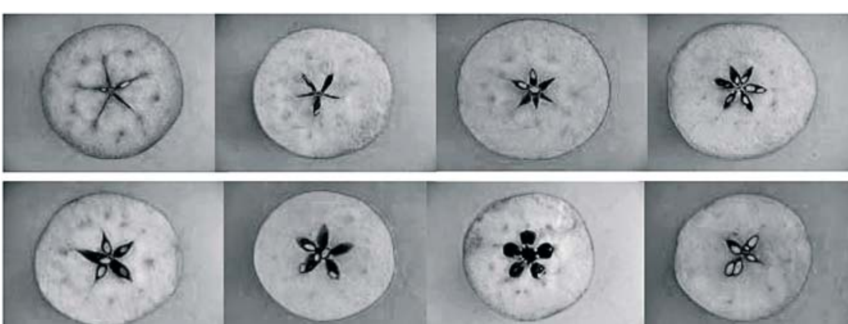

Figure 5. Comparison of selected genotypes from evaluated collection of wild apple seedlings (*Malus domestica* Borkh) width of core Figure: M. Hulin, 2010

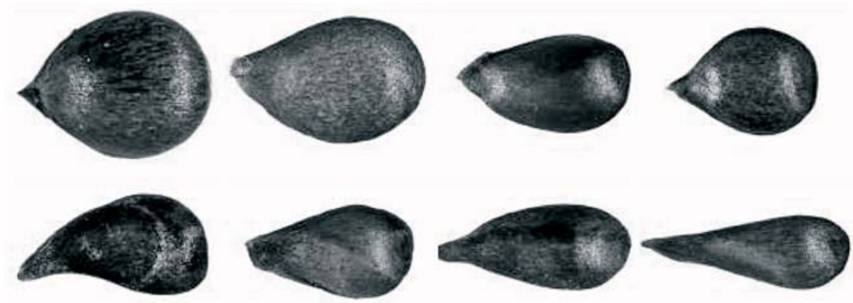

Figure 6. Comparison of selected genotypes from evaluated collection of wild apple seedlings (*Malus domestica* Borkh) shape of seeds. Figure: M. Hulin, 2010

For a more comprehensive evaluation of this issue were identified the correlation coefficient of linear correlation between the morphological traits. The results presented in Table 2, show that between the morphological traits of fruits were determined positive addictions. Very strong degree of linear dependence was determined between fruit weight and height (0.902), fruit weight and width (0.959), respectively. A strong degree of dependence was determined between the height and width of fruits (0.861), depth of stalk cavity and calyx cavity (0.722) and between fruit weight and depth of the stalk cavity (0.713). Among other traits was identified only a moderate degree of dependence.

Table 2

**Correlation coefficient of linear dependence between evaluated phenotypic traits of apple fruits (*Malus domestica* Borkh)**

| *r* | *Confidence interval* $r_{95\%}$ | $r^2$ | *t* | *Probability of t (p)* |
|---|---|---|---|---|
| **Weight of the fruits (g) and height of the fruits (mm)** | | | | |
| *0.902* | *0.8500<=r >= 0.9369* | *0.8140* | *18.1173* | *0.0000* |
| **Weight of the fruits (g) and width of the fruits (mm)** | | | | |
| *0.959* | *0.936<=r >=0.974* | *0.920* | *29.398* | *0.0000* |
| **Weight of the fruits (g) and depth of stalk cavity (mm)** | | | | |
| *0.713* | *0.5831<=r >=0.8086* | *0.5096* | *8.8280* | *0.0000* |
| **Weight of the fruits (g) and depth of calyx cavity (mm)** | | | | |
| *0.619* | *0.4591<=r >=0.7406* | *0.3836* | *6.8325* | *0.0000* |
| **Weight of the fruits (g) and height of core (mm)** | | | | |
| *0.593* | *0.4257<=r >=0.7213* | *0.3518* | *6.3802* | *0.0000* |
| **Weight of the fruits (g) and width of core (mm)** | | | | |
| *0.528* | *0.3453<=r >=0.6728* | *0.2792* | *5.3903* | *0.0000* |
| **Height of the fruits (mm) and width of the fruits (mm)** | | | | |

| | | | | |
|---|---|---|---|---|
| *0.861* | *0.7896<=r >=0.9098* | *0.7418* | *14.6785* | *0.0000* |
| **Height of core (mm) and width of core (mm)** | | | | |
| *0.376* | *0.1669<=r >=0.5540* | *0.1420* | *3.5231* | *0.0007* |
| **Depth of stalk cavity (mm) and depth of calyx cavity (mm)** | | | | |
| *0.722* | *0.5950<=r >=0.8148* | *0.5222* | *9.0544* | *0.0000* |

Among the important traits allowing distinguis individual genotypes of apple, belongs the stalk cavity depth as well. Michálek (2003) distinguishes the shapes of the stalk – narrow and shallow, wide and shallow, wide and deep and narrow and deep, respectively. Experimentally were confirmed all of these combinations among evaluated genotypes. Some genotypes were characterized by interesting fleshy formation which overgrowed the stalk cavity and attached stalk to one side (Figure 4).

Apple core is the true fruit (Kohout, 1960). This part is surrounded by vascular in term of pomology. It consists usually from five capsules. Sometimes there are fruits that have only four or three capsules. For each variety is not characteristic only shape but also its size and position relative to the stalk (Michálek, 2003). The different cores are presented on Picture 4. On cross-sectional view of the fruit are visible 10 vascular arranged in a circle. They appear as darker or lighter spots. There were observed 10 vascular in total, 5 of them are located directly opposite the top of capsules and other 5 between them. Vascular bundles are causing the roundness or angularity of the fruit. In case they are in a circle the fruit has a regular round shape. If there are two circles, externals are more developed and the fruit is therefore angular (Kohout 1960, Dvořák et al., 1976, Michalek 2003). These differences are presented on Figure 5.

Fruit core can be easily visible on cross-sectional cut of fruit. The core can be closed (capsules are closed), semi-opened, opened (capsules are opened) related to central axis of the fruit. If the capsules are large and open, then after shaking with fruit, seeds make sound. Differences between genotypes on longitudinal section of fruits are illustrated on Figure 6.

The important trait for characterization of apple (*Malus domestica* Borkh.) genotypes is also shape and size of calyx and calyx cavity. It is usually different and consists of the five calyx sepals and rest of dried stamens. It might be closed (Jonathan, Matkino), open (Blenheimská reneta, Albrechtovo), or semi-open (Parména zlatá, Boskopské červené). Calyx cavity can be small (Mc Intosh) or large (James Grieve) (Kohout 1960, Michálek 2003).

## Conclusions

It can be stated, that the results obtained constitute an important contribution for future conservation efforts and exploitation of *M. domestica*. Through the combination of different types of information we have been able to get new insights on the diversity inside of the apple (*Malus domestica* Borkh.) seedlings gene pool.

As shown below, the following knowledge was achieved:

a) Significant differences between genotypes of apple seedlings in all the morphological characteristics of fruits as well as shape and color of the pericarp and flesh were identified.

b) Many evaluated seedlings with traits suitable for use in practice were identified. Determination of the value of wild apple trees can expand the genetic base of apple gene pool.

c) It is concluded, that wild apple seedlings are an important genetic resource that can be used for breeding of new apple varieties. Some of them are suitable after further assessment and propagation to be used directly.

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## THE EXPERIENCE OF STUDYING AND USING GENUS *ECHINACEA MOENCH* IN UKRAINE

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**Summary.** *The main results of the study of cultivation, use and application of the genus Echinacea in Ukraine for 60 years are given in the article. It is reported that the most studied representative of this genus is Echinacea purpurea (L.) Moench, which occupies the largest acreage planted and is represented by several varieties. The accumulation of the main biologically active substances such as amino acids, lectins, polyphenols, polysaccharides and others was investigated. The basic directions use of Echinacea purpurea in the fight against many diseases in medicine, and also its used in veterinary science and zootechnics are considered. It has been established that Echinacea purpurea and Echinacea pallida are valuable honey plants. This honey distinguishes on physical-chemical quality and has expressed medicinal activity. Different forms (water, dry, alcohol extracts) that are used as biocorrectors are listed.*

The representatives of genus Echinacea Moench studied cultivated and used in Ukraine more then 60 years. For this period a great purposeful work has been done, results of which have following main direction:

***Introduction, Biology and Cultivation.*** From 9 species of genus 7 are introduced. From them only 3 species are being cultivated. Moreover Echinacea purpurea (L.) Moench occupies the largest sowing square (about 250-350 ha). Echinacea purpurea (L.) Moench is represented by varieties of home selection: "Princess", "Vitaverna", "Polisska Krasunya" and "Zirka Mykoly Vavilova" (*Star of Nikolai Vavilov*); Echinacea pallida (Nutt.) Nutt is cultivated by a new variety "Krasunya preriy" (*Prairie's Beauty*) is selected by the authors of this publication on squares that do not exceed 30-50 ha; Echinacea angustifolia D.C. (near 1 ha) is formed as a typical and homogeneous population. Other species: Echinacea atrorubens Nutt., Echinacea papadoxa Britton, Echinacea simulata McGregor, Echinacea tennessensis (Beadle) Small are grown in the collection of research establishments. Biological peculiarities of Echinacea purpurea (the questions of morphology, anatomy, cytology, morphogenesis, ontogenesis, physiology, microbiology and ecology) are studied best of all. With Echinacea pallida, Echinacea purpurea, Echinacea angustifolia the selection work is conducted. The main means of cultivation are worked out that include following: means of presowing seed preparation, sowing and seedling planting, fertilizer system, pest control, protection from diseases and weeds, terms of raw material harvest, drying and storage [1,2,3,5,6].

***Phytochemistry and Pharmacology.*** The main studied species is Echinacea purpurea. Research questions are accumulation of amino acids, lectins, polyphenols, polysaccharides, vitamins, macro-and microelements (including toxic), radionuclides and also criteria of raw materials and preparations standardization [1,5,7].

***Medical aspect of studying and usage***. This direction concerns only Echinacea purpurea. Mostly used are alcohol infusion and water-alcohol extract. Their immunomodulate and radioprotective qualities are proved. They are successfully used at the treatment of allergic, pulmonary, gastric, venereal, otolaryngological, stomatology diseases. Antioxidant, antimicrobial, anti-hypoxic, hepatoprotective, adaptogenic qualities are established by many times researches. Their usage at endocrine and cancer pathologies is being mastered by practice. Molecular mechanisms of influence on blood cells are worked out. Output of their different cosmetic and homeopathic preparations is adjusted [1,5].

***Veterinarian and zootechnical aspect of usage.*** The usage of Echinacea purpurea as medicinally-fodder plant in a fresh and dry state of above and under parts is grounded. Preparations of prolonged action for the treatment of suppurative wounds, pulmonary, gastric and parasitic diseases of animals are have been made. The usage of Echinacea purpurea for the treatment of sterility, increase of reproductive functions of bulls and boars and also introduction into piglets' sows, laying hens' ration is especially effective [1,5].

***Usage in beekeeping.*** It has been established that Echinacea purpurea and Echinacea pallida are valuable honey plants, their flowering lasts from May till August. Moreover they have a good nectar (from 23 to 60 kg/ha) and pollen productivity (from 40 to 130 kg/ha). Pure honey from Echinacea was received firstly. This honey distinguishes on physical-chemical quality and has expressed medicinal activity. On the base of beekeeping products with the adding of Echinacea purpurea extract medicinal honey and balsam with high adaptogenic qualities are made [2,3,4].

***Working out of functional products.*** These products are made on the base of Echinacea purpure. Water, alcohol, water-alcohol extracts are used as biocorrectors of mineral waters, fruit juices, liqueur-vodka, confectionery and dairy products and also tea and coffee. Moreover, immunostimulate and radioprotective qualities of received products are grounded [1,5].

Thus this material testifies that Echinacea purpurea is studied deeper and thoroughly in Ukraine. Research and usage of other introductive Echinacea species can be not less effective and promised.

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## STUDIUL PARTICULARITĂȚILOR DEZVOLTĂRII MAZĂRII, CULTIVATE CU FOND DE VIERMICOMPOST, ÎN DIVERSE FAZE FENOLOGICE

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**Summary.** *Investigations were performed to determine particularities of phenological development phases of peas groun with worm's compost fund during the three years of fertilizer action. As a result of observations made on phenological phases was found that the development of peas in the first, second and third year worm's compost action took place with 3-9 days earlier than that of the control group. So, it was found that the plants on lots of worm's compost fund had an early development in all phenological stages: mergence, early flowering, total flowering and early pod formation and full ripening.*

### Introducere

Ştiinţa şi practica mondială a efectuat cercetări direcţionate spre micşorarea influenţei negative a substanţelor nocive asupra organismelor, acordând o atenţie deosebită problemelor bioconversiei deşeurilor organice (din diverse ramuri ale economiei naţionale inclusiv şi din agricultură), prin viermicultivare [3]. Scopul acestei biotehnologii este obţinerea fertilizantului organic ecologic, viermicompostului, care este unul din produsele finale obţinute în rezultatul procesului bioconversiei deşeurilor organice. Produsul obţinut reprezintă un fertilizant organic natural, ecologic, acătuit din granule de diverse mărimi, de culoare cafenie închis, fără miros, higroscopic, cu acţiune îndelungată [1, 5, 6].

În rezultatul cercetărilor efectuate s-a constatat, că în viermicompost este bine echilibrat conţinutul de macro- şi microelemente, ceea ce permite micşorarea dozei de încorporare în sol, care este de 8-12 ori mai mică decât doza de compost obişnuit [4].

O particularitate deosebită a calităţii viermicompostului este corelaţia C:N. Dacă corelaţia este mai mică de 4 asigurarea cu azot este foarte înaltă; de la 4 până la 10 – înaltă; de la 10 până la 14 – medie; de la 14 – până la 17 – joasă şi mai mare de 17 – foarte joasă [7].

Conţinutul cantităţii de humus în sol este unul din indicii principali ai fertilităţii solului. Humusul are o influenţă asupra agrochimicii, activităţii higrofizice, termale, tehnologice şi biologice a solului. În humus sunt concentrate până la 98% rezerve de azot, 60% fosfor, 80% sulf, cantităţi esenţiale de alte micro- şi macroelemente.

În condiţiile naturale acumularea humusului în sol decurge foarte încet.

Pentru formarea unui strat de un centimetru de sol este necesar să treacă o perioadă de 100 de ani. Sub influența factorului antropogen acest proces poate să dureze doar 3-5 ani. Încorporarea în sol al compostului obişnuit este neefectivă şi costisitoare, deoarece dintr-o tonă de compost se formează doar 20 kg de humus. În schimb într-o tonă de viermicompost se conțin de la 270-300 kg de humus. De aceea utilizarea viermicompostului permite micşorarea esențială a perioadei de completare a dificitului de humus în sol, reanimarea fertilității solului sporind rezistența față de eroziunea aluvială şi eoliană [2, 7].

Conform cercetărilor efectuate s-a constatat că încorporarea viermicompostului în sol sporeşte nu numai cantitatea substanțelor nutritive dar şi activitatea biologică a solului. De asemenea viermicompostul micşorează densitatea solului (de la 2,70 până la 2,67g/cm$^3$), menține umiditatea în sol. Încorporarea viermicompostului în sol contribuie la reanimarea fertilității solului şi purificarea lui de substanțe toxice.

În rezultatul cercetărilor s-a constatat, că viermicompostul influențează benefic asupra dezvoltării fazelor fenologice a culturilor agricole. Dezvoltarea precoce a culturilor agricole, la diverse faze fenologice condiționează sporirea calității producției, recoltei, rezistenței la condițiile climatice nefavorabile şi la diferite maladii, permițând obținerea producției agricole ecologice [6].

## Materiale şi metode

Cercetările s-au efectuat cu scopul aprecierii influenței viermicompostului asupra dezvoltării mazării în diverse faze fenologice. În calitate de material pentru cercetare a fost folosit soiul de mazăre „Renata” şi fertilizantul organic – viermicompostul. Experimentul a fost organizat în condițiile de câmp a Stațiunii Tehnologico-Experimentală ”Maximovca”. În experiment au fost folosite 3 loturi (două experimentale şi unul – martor), cu suprafața de un ar. Pe loturile experimentale, înainte de semănat, a fost încorparat fertilizantul organic în doză de 4 t/ha (lotul experimental I) şi 3 t/ha (lotul experimental II). Fertilizantul a fost obținut în rezultatul utilizării tehnologiei bioconversiei deşeurilor organice prin viermicultivare. Pe lotul-martor plantele au fost cultivate cu fond natural (Tabelul 1).

Tabelul 1

**Schema experimentului**

| *Nr. crt.* | *Tipul culturii* | *Loturile* | *Condițiile experimentului* |
|---|---|---|---|
| 1 | Mazăre | I- experimental | Viermicompost - 4t/ha |
| 2 | Mazăre | II- experimental | Viermicompost - 3t/ha |
| 3 | Mazăre | III – martor | Fond natural |

Pe parcursul perioadei de vegetație a culturilor au fost efectuate observări fenologice asupra plantelor cultivate.

Cercetările s-au efectuat în primul, al doilea şi al treilea an de acțiune a viermicompostului. La finele experimentului s-a făcut evidența recoltei de mazăre prin cântărire.

## Rezultate şi discuții

În scopul aprecierii influenței viermicompostului asupra mazării, în diverse faze fenologice, cercetările au fost efectuate pe parcursul a trei ani. În fiecare an au fost efectuate cercetări asupra fazei de răsărire, începutul înfloririi, înfloririi totale şi formării păstăilor, coacerea totală. În perioada experimentului s-a observat, că în toate fazele fenologice plantele de pe loturile experimentale I şi II, cultivate cu fond de viermicompost, au fost mai precoce decât în lotul-martor cu fond natural. În rezultatul studiilor efectuate s-a constatat, că încorporarea viermicompostului în sol, în doza de 4 t/ha - 3 t/ha, a dus la dezvoltarea mai rapidă a culturilor, diminuând perioadele de răsărire, înflorire, formare a păstăilor şi de coacere a plantelor cultivate.

Analizând rezultatele observărilor efectuate, în primul an de acțiune a viermicompostului, (Tabelul 2) s-a constatat că semințele de mazăre semănate în solul loturilor experimentale I şi II au răsărit corespunzător, la 10-11 zile după semănat, iar pe lotul-martor plantele cultivate au răsărit după 16 zile. Aşadar, plantele de pe loturile cu viermicompost au răsărit cu 6 şi 5 zile mai devreme decât pe lotul-martor.

Tabelul 2

**Evaluarea influenței viermicompostului asupra fazelor fenologice ale mazării în primul an de vegetație**

| *Varianta experimentului* | *Perioada fazei fenolojice (după semănare) - zile* | | | |
|---|---|---|---|---|
| | *Răsărire* | *Începutul infloririi* | *Înflorirea totală şi formarea păstăilor* | *Coacerea definitivă* |
| Martor | 16 | 49 | 57 | 88 |
| Experimentul I | 10 | 40 | 48 | 80 |
| Experimentul II | 11 | 41 | 49 | 81 |

Inflorirea mazării, pe loturile experimentale I şi II (cu fond de viermicompost) a început corespunzător, la 40 şi 41 zile, iar pe lotul-martor la 49 zile de la semănat. Astfel, în rezultatul cercetărilor s-a constatat că această fază fenologică a plantelor de pe loturile experimentale s-a desfăşurat cu 9 şi 8 zile mai devreme decât pe lotul-martor. Inflorirea în masă şi începutul formării păstăilor pe loturile cu fond de viermicompost a avut loc după 48 şi 49 zile, iar pe lotul-martor după 57 zile de la semănat. Conform rezultatelor obținute în această fază fenologică mazărea de pe loturile experimentale s-a dezvoltat cu 9 şi 8 zile mai devreme decât cea de pe lotul-martor. Aceeaşi legitate a fost constatată şi în ultima fază de dezvoltare a mazării – coacerea totală. Mazărea de pe loturile experimentale au atins această fază fenologică cu 8 şi 7 zile mai deverme decât cea de pe lotul-martor.

Aşadar, în primul an de vegetație, viermicompostul a accelerat dezvoltarea mazării de pe loturile experimentale cu 5-9 zile, în comparație cu cea de pe lotul-martor.

În rezultatul cercetărilor efectuate privind influența viermicompostului asupra fazelor de vegetație a mazării, în al doilea an de acțiune a fertilizantului, s-a constatat că la toate fazele, plantele de pe lotul-martor au avut o dezvoltare tardivă, în comparație cu plantele de pe loturile experimentale (Tabelul 3).

Tabelul 3

**Evaluarea influenței viermicompostului asupra fazelor fenologice ale mazării în al doilea an de vegetație**

| *Varianta experimentului* | *Perioada fazei fenolojice (după semănare) - zile* | | | |
|---|---|---|---|---|
| | *Răsărire* | *Începutul inflioririi* | *Înflorirea totală şi formarea păstăilor* | *Coacerea definitivă* |
| Martor (fond natural) | 14 | 48 | 56 | 89 |
| Experimentul I | 10 | 40 | 48 | 81 |
| Experimentul II | 11 | 40 | 48 | 83 |

Rezultatele obținute demonstrează că influența viermicompostului în al doilea an de acțiune a fertilizantului, a contribuit la accelerarea cu 4 şi 3 zile a procesului de răsărire a mazării. Ulterior, în rezultatul observărilor efectuate s-a constatat, că plantele de pe loturile experimentale I şi II au început să înflorească cu 8 zile mai devreme decât cele de pe lotul martor. Înflorirea totală şi începutul formării păstăilor la plantele de pe loturile cu fond de viermicompost s-a desfăşurat cu 8 zile mai devreme decât la cele cultivate cu fond natural. Coacerea definitivă a mazării de pe loturile experimentale I şi II, în al doilea an de acțiune a viermicompostului, a fost corespunzător cu 8 şi 6 zile mai devreme decât culturile de pe lotul-martor.

Aşadar, influenţa viermicompostului asupra dezvoltării fazelor fenologice a mazării s-a constatat şi în al doilea an de acţiune a fertilizantului diminuând durata perioadelor de dezvoltare cu 3-8 zile.

În rezultatul observărilor efectuate asupra fazelor fenologice a mazării, în anul al treilea de acţiune a fertilizantului, (Tabelul 4) s-a constatat că plantele de pe loturile experimentale I şi II au răsărit la 8 zile, iar cele de pe lotul martor la 12 zile după semănat. Deci, atât plantele de pe lotul I, cât şi cele de pe lotul II experimental au răsărit cu 4 zile mai devreme decât cele de pe lotul-martor.

Tabelul 4

**Evaluarea influenţei viermicompostului asupra fazelor fenologice ale mazării în al treilea an de vegetaţie**

| *Varianta experimentului* | *Perioada fazei fenologice (după semănare) - zile* | | | |
|---|---|---|---|---|
| | *Răsărire* | *Începutul inflioririi* | *Înflorirea totală şi formarea păstăilor* | *Coacerea definitivă* |
| Martor | 12 | 44 | 51 | 85 |
| Experimentul I | 8 | 36 | 44 | 77 |
| Experimentul II | 8 | 36 | 44 | 77 |

Perioada începutului fazelor de înflorire, inflorire totală, apariţia păstăilor şi coacerea definitivă a mazărei pe loturile experimentale I şi II (cu fond de viermicompost) s-a desfăşurat corespunzător, cu 8; 7 şi 8 zile mai devreme decât pe lotul-martor.

Astfel, în al treilea an de influenţă a viermicompostului asupra dezvoltării fazelor fenologice a mazării, s-a constatat că durata perioadelor de dezvoltare a diminuat cu 4-8 zile.

Analizând rezultatele cercetărilor, pe parcursul perioadei experimentale, s-a constatat că diminuarea duratei fazelor fenologice a dezvoltării mazării de pe loturile experimentale, a constituit: în anul întâi – 5-9 zile; în anul al doilea 3-8 zile şi în anul al treilea 4-8 zile.

Aşadar, rezultatele cercetărilor efectuate pe parcursul a trei ani, au evidenţiat influenţa benefică a viermicompostului asupra dezvoltării fazelor fenologice a mazării.

## Concluzii

În rezultatul cercetărilor efectuate s-a constatat că:

- viermicompostul încorporat în sol, în doza de 3 t/ha - 4 t/ha, a accelerat cu 3-6 zile răsărirea, 8-9 zile – începutul înfloririi, 7-9 zile – inflorirea totală şi formarea păstăilor şi cu 6-8 zile – coacerea definitivă a mazării, în comparaţie cu plantele de pe loturile-martor;

- mazărea cultivată cu fond de viermicompost s-a dezvoltat cu 3-9 zile mai repede decât cea cultivată cu fond natural.

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## VEGETATIVE PROPAGATION OF THE ORNAMENTAL SHRUBS INTRODUCED IN THE REPUBLIC OF MOLDOVA


***A. Palancean, E. Onica***



**Summary**. *Peculiarities of the vegetative propagation of some species and cultivars of ornamental shrubs are described. It was determined that the rooting capacities of the saplings depends on the biological property characterized for every species, by the type of the saplings, the optimum date of layering, the length of saplings, the concentration of the risogenesis stimulators, the duration of exposure in the solution of stimulators, the type of substratum and the density of the saplings in the nursery.*


### Introduction

The economical changes of the last period from the Republic of Moldova, the population demand on ecological situation register, especially in big cities, the necessity of creation of the green areas at the highest level of landscaping, with the assortment of ornamental woody plants, resistant to the unfavorable ecological factors. The interest for the cultivation of the ornamental woody plants, in our country increases year to year. The market needs the new cultivars of woody plants with the high level of landscaping. The decorativeness of some species and cultivars of the trees and shrubs and their perspective of implementation for green area creation are described in the relevant publications [1, 2, 3].

The majority of the ornamental woody plants are propagated generative and vegetative. The advantage of the vegetative propagation is that the saplings are prepared from the selected plants (variety, race) with the high level of decorativeness.

## Materials and methods

The researches were made in the collection and experimental nursery of the Botanical Garden of the Academy of Sciences of the Republic of Moldova (ASM) between the years 2006-2010.

As a biological material for survey served 11 species and forma of ornamental shrubs from which the ligneous and semi-ligneous saplings were taken. The collecting of the sprouts and preparing of the saplings were made in two periods: February – March and June – July. The rooting of the saplings were made in common conditions with minim expenses. The saplings prepared in February – March were treated with the solution of 0,001 mg/l of $KMnO_4$ with further storage in a wet send in a cellar till spring. In the late spring, the saplings were planted in a cold nursery with the beforehand prepared substratum (treated with hot boiled water and the solution of $KMnO_4$) and covered with the frames for about 30 to 45 days.

The fresh prepared summer semi-ligneous saplings were treated with the risogenesis stimulator IAA of 0,01% and 0,05% with the exposition of 5, 8, 16 and 24 hours [4] and planted in the simple nurseries (the metal frames covered with the plastic foil) to maintain the optimum temperature and humidity. After the saplings rooting the frames are opened gradually for plants to become usual with the outside environment.

## Results and discussions

The peculiarities of the vegetative propagation of the 11 species and varieties of the ornamental shrubs introduced in Moldova were investigated. The described species and cultivars are introduced and investigated during the years in the laboratory of Dendrology [1, 2, 3].

Actinidia kolomikta (Rupr.) Maxim (fam. Actinidiaceae Hutchinson) originated from Far East, is rarely cultivated in Europe. In the Botanical

Garden (I) of the ASM it was introduced in 1975, from the saplings obtained from other Botanical Gardens from Ukraine (Kiev, Sofievca park, Uman'). The mentioned plant could be recommended for the assortment for the landscaping of green areas and as a medicinal plant with the multiple active and stimulating substances.

Actinidia is propagating with ligneous and semi-ligneous saplings. The highest percent of rooting of semi-ligneous saplings were obtained after their treatment with the solution of IAA of 0,01% during 24 hours. The percentage of rooting varies from 45% to 50%. With the similar methods are propagated varieties and species from the following families: Hydrangea, Hippophae, Buxus; the only thing that is different is the concentration and the duration of the risogenesis stimulators (Table 1).

Deutzia scabra Thunb. (fam. Hydrangeaceae Dumort.) is the ornamental shrub of about 1,5-2,0 m height. Originated from China and Japan Deutzia scabra is considered, together with rose, jasmine, syringe, hydrangea and other species from this genus, the "garden aristocrat" during the flowering period. This shrub differs from other species from this genus by color, flower form, as well as the longer flowering period (with 5-7 days). All species varieties are propagated using the same methods as for the species from Philadelphus genus.

Philadelphus L. (fam. Hydrangeaceae Dumort.) – Jasmin. The ornamental shrubs with the height of 2,0 – 4,0 m, with the strait trunk and ovoid crown. About 20 species and varieties are cultivated on the territory of Moldova and which differs from each other by leafs color (Ph. coronarius "Aureea"), habit (Ph. coronaries "Pyramidalis"), flower dimension, form and aroma (Ph. coronaries "Akademic Komarov" "Zoia Kosmodemianskaia", "Komsomoletz", "Snejnaia burea", "Karlik"; Ph Lemoinei "Albatre", "Mont Blanc" etc. Their propagation is made by saplings (February – March or June – July) or by marcotting. For cold nursery saplings a ligneous sprouts of 20-30 cm length and 10-20 mm thick at the superior end are used. For mass propagation the saplings are made, packed in November – December and stored in wet sand up till spring, when are planted directly into sand in cold nurseries. The nurseries are covered with frames for about 30-45 days and are irrigated 3-4 times/day. After 1,5 months the frames are opened gradually for plants to become usual with the outside environment. The percentage of rooting varies from 50% to 60%. The plantlets obtained from saplings are transferred into open field or into containers. The same methods are used to propagate the species and forms of Forsythia Vahl. genus.

Tamarix genus contains about 100 species spread all over Europe, Africa, Mediterranean region and arid areas of Asia. Tamarix ramosissima Ldb. (fam. Tamaricaceae Link) – tamarix, ornamental shrub with very fine characteristic foliage and abundant flowering, of about 1-3 (4) m height, naturally spread in south-east Europe, south-west Asia, China, Mongolia, Republic of Moldova. It could be found preponderantly in rivers valleys at the border of the poplars and willows forests. Hermaphroditic pentamer flowers, with the gentle smell light-rose or white. Has a light temperament. Is resistant and has a large usage in forestation and green areas creation.

The optimum method of propagation is by ligneous saplings in late fall or early spring. Saplings of about 20-25 cm are prepared from annual sprouts formed in current vegetative season, according to the possibilities with the butt end. It is planted in the well prepared soil (preferred before frost). If it is not possible to prepare in fall, they could be made in early spring (February – March), stored in wet send up till the danger of late freeze is passed, and then planted in loose ground disinfected with the solution of $KMnO_4$. After planting, the saplings are covered with the sawdust and are irrigated till rooting. Using this method the species and forms from the following genus are propagated: Salix, Ribes, Grossularia etc.

The ornamental forms of the species Deutzia scabra Thunb., Philadelphus coronaries L., Philadelphus lemoinei, Forsythia suspense (Thunb.) Vahl. have the same method of propagation. They are propagated by ligneous saplings early in the spring and by the semi-ligneous saplings in June-July, that are treated with the risogenesis stimulators. The length of the ligneous saplings varies from 15-25 cm at the Deutzia genus to 20-30 cm at the Philadelphus genus and the thickness of about 8-20 m at the superior end. The distance between the ligneous saplings in the nursery was 5x5 cm. The rooting coefficient varies between 50-80%. For other species and forms like Actinidia kolomikta (Rupr.) Maxim., Buxus sempervirens L., Hippophae rhamnoides L., Hydrangeea cinerea Small., the optimum method of propagation was with semi-ligneous saplings in June – July (Table 1). The distance between semi-ligneous saplings was 5x10 cm.

Generally the optimum growing substratum is the river sand which is washed up very good, disinfected with the hot boiled water and the solution of $KMnO_4$. The species like Ribes nigrum L., Grossularia reclinata Mill., Tamarix ramosissima Ledeb., genus Salix are well propagated with the ligneous saplings, planted in spring directly into wet and loose soil.

The good results were obtained when the sapling period was as shorter as possible. The period of sapling is in a direct correlation with the species biology when the annual sprouts, depending on meteorological conditions, start to lignify.

Table 1

**Peculiarities of the vegetative propagation of some species and forms of ornamental shrubs**

| *Nr.* | *Species, forms* | *The optimum period of sapling* | *The concentration of the stimulator, exposition, hours* | *The environment of rooting* | *The period of rooting, days* | *% of rooting* |
|---|---|---|---|---|---|---|
| 1 | Actinidia kolomikta (Rupr.) Maxim | VI-VII | IAA - 0,01%, 24 | fog 24% sand+peat (1:1) | 35-45 | 45-50 |
| 2 | Buxus sempervirens L., cultivars | VIII-IX | | sand | 45-60 | 80-90 |
| 3 | Deutzia sp., forms | IV-V | IAA - 0,01%, 24 | sand | 45-60 | 70-80 |
| 4 | Forsythia sp, forms | IV-V | IAA - 0,01%, 24 | sand | 30-35 | 80-90 |
| 5 | Grossularia reclinata Mill. | III-IV | | soil | 60-70 | 50 |
| | | VI-VII | | sand | 45-60 | 30-40 |
| 6 | Hippophae rhamnoides L., forms | III-IV | IAA - 0,01%, 16 | sand | 60-75 | 40 |
| | | VI-VII | IAA - 0,01%, 8 | | 45-60 | 50 |
| 7 | Hydrangea cinerea Sall. | VI-VII | IAA - 0,01%, 16 | sand+peat | 30-35 | 45-50 |
| 8 | Philadelphus sp. cultivars | III-IV | | sand | 45-60 | 50-60 |
| 9 | Ribes nigrum L. | IX-X | | soil | 60-75 | 60 |
| | | III-IV | | | | |
| | | VI-VII | | sand | 45-60 | 50 |
| 10 | Salix sp., forms | III-IV | | soil | 15-30 | 80-90 |
| 11 | Tamarix ramosissima LDB. | III-IV | | soil | 45-60 | 40 |
| | | VI-VII | | san | 60-75 | 40 |

Analyzing the data from the table 1 was established that the capacity of rooting depends on biological characteristic of each species, type of saplings, optimum period of saplings, length of saplings, the concentration of risogenesis stimulators, the time of exposition in the solution of stimulators, the type of substratum, the sapling density in the nursery and respecting the technology along the period of sapling.

The success of saplings culture depends on the quantum of the nutritive substances, especially of the minimum length of 10-20 cm and the thickness of 8-20 mm at the superior end, because before rooting the sapling consumes the nutritive substances from its reserve.

## Conclusions

The process of rooting of the saplings depends on many factors: the quality of sapling and substratum, the growing and development conditions of mature plants and the sprouts before sapling, keeping the optimum period of sapling and respecting the technology within the process of sapling, the density of the saplings in nursery.

It is necessary to select the sprouts from young plants which were initially obtained by vegetative propagation to obtain the highest percentage of saplings rooting. The major role is the correct sapling takeoff and strict respecting of the technology.

The risogenesis stimulator IAA-0,01% highly increases the percentage of rooting of the semi-ligneous saplings of the ornamental species.

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# CONTRIBUTIONS TO INTRODUCTION OF *THYMUS* L. SPECIES IN THE BOTANICAL GARDEN (I) OF ASM


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**Summary.** *This paper refers to Thymus L. taxa (Thymus comosus Heuff. ex Griseb., T. serpyllum L., T. striatus Vahl., T. vulgaris L., T. zygis ssp. sylvestrys Hoffm. et Link, T. marschallianus Willd., Thymus x citriodorus Schreb. and two cultivars: T. x citriodorus "Aureus" and T. x citriodorus "Argenteus") that are of great importance from decorative and medicinal point of view. The studies regarding their bio-morphological peculiarities and multiplication for landscape purposes were carried out at the experimental plots in the Botanical Garden (I) of ASM.*

## Introduction

The genus *Thymus* L. is one of the most important genera of the *Lamiaceae* family. The Antic Greek name of *Thymus*, used by Theophrastus and Deoscorides, comes probably from Antic Egypt and signifies "aromatic plant" [1].

*Thymus* L. species are small perennial shrubs or sub-shrubs, mostly hardy with erect or prostrate stem. Leaves are small, entire; floral leaves similar or changing in to bracts in the spike. Floral whorls are usually few-flowered. Calyx is ovoid, 10-13-nerved, 2-lipped, and 5-toothed. Corolla tube is included or exserted, naked inside, limb somewhat 2-lipped. Stamens – 4, arranged in pairs. Nutlets are smooth, ovoid or oblong.

Many *Thymus* L. species have decorative, culinary, medicinal and aromatic properties.

This is a polymorphous and very difficult taxonomically genus because the species hybridize freely between them and often integrates into each other. Some botanists recognize 300-400 species native to Africa, Europe and temperate Asia. Others consider many of these species as intraspecific taxa of *Thymus serpyllum* L. [4, 6]. According to Menitski the genus comprises about 150 species with area of distribution throughout Eurasia (except tropical regions) and in Africa (Mediterranean region and Ethiopia) [13]. In the European Flora the *Thymus* L. is represented by 66 species with a number of subspecies and varieties [5].

In the flora of the Republic of Moldova this genus is represented by 5 species (*Thymus ovatus* Mill., *T. moldavicus* Klok. et Schost., *T. marschallianus* Willd. (syn. *T. pannonicus* All.), *T. podolicus* Klok. et Schost. and *T. dimorfus* Klok. et Schost. [8].

In the Ornamental Plant Collection of Botanical Garden of ASM four *Thymus* L. taxa are cultivated and studied (*Thymus x citriodorus* Schreb., *T. striatus* Vahl., *T. serpyllum* L., *T. marschallianus* Willd.). Another five taxa (*Thymus comosus* Heuff. ex Griseb., *T. x citriodorus* hort. "Aureus", *T. x citriodorus* hort. "Argenteus", *T. vulgaris* L., *T. zygis* ssp. *sylvestrys* Hoffm. et Link) are cultivated in the Medicinal and Aromatic Plant Collection.

These species contain volatile oil with a variable content (thymol, cineol, borneol, linalool, cymene, geraniol etc), flavonoids, phenyl-propane derivates, polyphenols, and tannins [7, 9, 10]. They have a lot of applications in traditional medicine for treating cough, asthma, bronchitis, headache, and digestive problems. The thyme volatile oil is strongly antiseptic, expectorant and tonic. The thymol is the most effective antifungal. The tonic effect of the plants supports the normal function of the body. Besides their therapeutic properties they have an exceptional decorative aspect. They are attractive ornamental plants because of their habit, beautiful and fragrant flowers. For landscaping purposes the plants are often used as ground cover in planting beds, rock gardens, between stepping stone, and in containers [1, 11, 12].

## Materials and methods

The studies were carried out in 2007-2011 at the experimental fields in Botanical Garden of ASM (Laboratory of Ornamental Plant and Laboratory of Vegetal Resources). Seven decorative and medicinally important species and two cultivars were used in this research. The bio-morphological particularities and the phenologic observations were registered using standard methods [14]. The propagation of three species (*T. comosus*, *T. serpyllum* and *T. striatus*) has been done by spliting and by removing naturally formed layers in late autumn. Two cultivars (*T. x citriodorus* "Aureus" and *T. x citriodorus* "Argenteus") were obtained through seeds that were received from the international seed exchange. An extensive literature survey of studied species was made according to their decorative and therapeutic importance and utilization in landscape architecture.

## Results and discussions

***Thymus serpyllum* L.** commonly known as Mother of thyme or Creeping thyme is native to Europe and North Africa. It is a perennial plant with wiry, prostrate and rooting below, ascending – erect above, slightly puberulent stems 10-12cm long. Leaves are evergreen elliptic, oblong or ovate, 3-8mm long with short petiole. The nodes are short, making it a very leafy plant. Floral whorls sessile, congested into a head more or less distant and racemose. Flowers are lilac or rose 4-6mm long; calyx more or less hairy, 2-lipped to the middle, teeth of upper lip triangular, glabrous or ciliate.

It is a common plant in any garden, prized as an evergreen edging and as an aromatic ground cover throughout garden, stone pathways and waste places (Figure 1). Colorful and fragrant *T. serpyllum* is suitable for any dry well drained spots such as patios walks, rock gardens, or pond borders. The plants cascade, drapes, and mound in soft beautiful covers (Table 1).

The plant is used as an aphrodisiac in herbal medicine. It also treats cough. The leaves and the essential oil contained in them have antiseptic, antihelmintic, antispasmodic, carminative, expectorant, deodorant and disinfectant effects. The essential oil is also used in perfumery. As culinary herb it is used as a seasoning for many meat dishes and green salads. It is also an important nectar source plant.

Creeping thyme is easily and reliably to propagate by division. The small clumps from an established plant can be replanted into their permanent position without any difficulties.

Figure 1. Thymus serpyllum (flowering period)

***Thymus x citriodorus* Schreb.** is a garden hybrid of European origin between *T. pulegiodes* and *T. vulgaris*. Commonly known as Lemon Thyme, *T. x citriodorus* is an erect, evergreen sub – shrub with branching stems and dark green leaves.

*T. x citriodorus* and its cultivars are cultivated as ornamental, medicinal and culinary plants. The leaves and essential oil are used as antiseptics, for treating asthma, in respiratory aromatherapy and as deodorants and disinfectants [6].

Table 1

***Thymus* L. taxa cultivated in the collections of Botanical Garden (I) of ASM**

| *Scientific name* | *Area of distribution* | *Height, cm* | *Flower color* | *Flowering period* | *Uses* |
|---|---|---|---|---|---|
| *Thymus serpyllum* | Europe and North Africa | 2,5-8 | white, bright pink, purple | April-July | decorative (ground cover, dry and stone gardens), aromatic, medicinal, culinary |
| *Thymus x citriodorus* with two cultivars “Aureus” and “Argenteus” | hybrid between *Thymus pulegiodes* and *Thymus vulgaris* | 15-30 | lavender-pink, red, violet, blue | May-July | ornamental (dry and rock garden, ground cover, along paths, container), medicinal, culinary |

| | | | | | |
|---|---|---|---|---|---|
| *Thymus striatus* | Balkan peninsula to South Italy | 2-6 | purple, white | May- July | decorative (along pathways, mix beds), medicinal |
| *Thymus vulgaris* | Western Mediterranean area | 25-30 | white, pinkish, purple | May-July | decorative (rock garden, container), medicinal, culinary |
| *Thymus comosus* | Western and Central Romania | 10-15 | pink, purple | June - August | decorative (mix beds, ground cover), weed control, aromatic |
| *Thymus zygis ssp. sylvestris* | Spain and Portugal | 10-30 | white | June-July | medicinal, ornamental, culinary |
| *Thymus marschallianus* | Eastern Europe | 15-20 | pink, violet | May-July | decorative, medicinal |

For landscaping purposes the plant is often used as ground cover in planting beds, between stepping stone (Figure 2), and in containers.

Besides being an ornamental beauty, *T. x citriodorus* is an exceptional culinary herb. The leaves are used as a flavoring herb in cooking, raw in salads, and for an herbal tea. It is recommended for fish dishes, in marinades and fried vegetable.

Figure 2. Thymus x citriodorus (flowering period)

Two nice-looking cultivars *T. x citriodorus* “Aureus” and *T. x citriodorus* “Argenteus” are cultivated in the Botanical Garden. Commonly known as Lemon Golden Thyme, *T. x citriodorus* “Aureus” bears lemon scent and golden variegated leaves. Another cultivar *T. x citriodorus* “Argenteus”

(Silver Thyme) has lemon scented silver edged green leaves. They are an elegant addition to an ornamental or herb garden. These prostrate plants have creeping, cascading, and mounding habit, being very graceful for rock garden, stone walls, and pond edging.

It prefers full sun and well drained soil. The flowering period begins in the last decade of May and continues to the end of July (Figure 3).

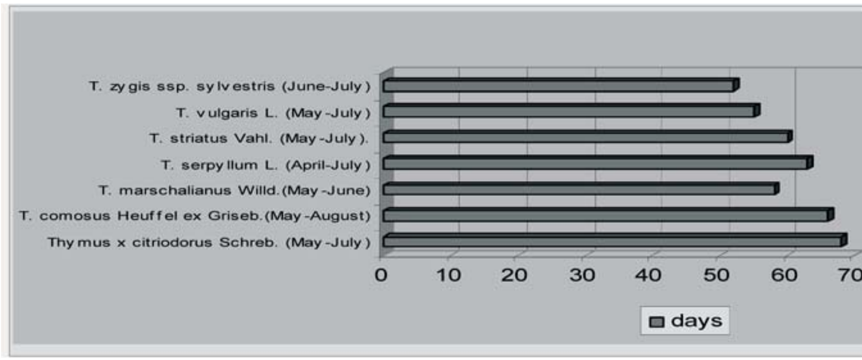


Figure 3. Duration of generative period of *Thymus* L. species

***Thymus striatus* Vahl.** is very polymorphous species, whose area of distribution extends from the Balkan peninsula to South and Central Italy. It is an evergreen sub-shrub with woody, procumbent branches. Flowering branchlets are erect, somewhat hirsute. Leaves are sessile, linear or subspatulate, glabrous, more or less ciliate. Floral leaves broadly cordate-ovate, striate and pubescent. Flowers congested in a dense, ovate head with the uppermost leaves forming white involucres. Calyx-teeth lanceolate, corolla-tube rather included.

This is another species of the genus that can be successfully implemented in the design of landscape spaces. It looks marvelous during the summer adding ornamental appeal to any garden. Fragrant and beautiful flowers of *T. striatus* are a pleasure in the garden, especially when they are planted along pathways.

Not less important is the fact that the essential oil composition obtained from *T. striatus* and its major component thymol has a strong antifungal activity against plant, animal and human pathogenic fungi [3]. That makes it very important not only for its decorative aspect but also from pharmacological viewpoint.

***Thymus comosus* Heuff. ex Griseb.** is native to mountains of Western and Central Romania and it is one of the most important endemic species from Carpathians [2, 5].

It is a fully hardy evergreen sub-shrub with sub-erect to procumbent branches, woody at base. Flowering stems are 5-15cm long, sometimes branched, hairy all round. Leaves are broadly ovate, petiolate, with distinct marginal veins, glabrous to slightly hairy, ciliate at base. Inflorescence is capituliform to cylindrical. Bracts are similar to the leaves. Calyx is sub-cylindrical; upper teeth up to 2mm, narrowly lanceolate. Corolla is 8-9mm long, pink-purple.

It can be effective ground cover for weed control in landscaping. Its compact stature and aromatic quality make it a wonderful ground cover between garden stepping stones. The leaves offer a delicate texture for landscape design considerations. It can be grown in thyme beds giving the impression of a magnificent patchwork quilt of many colors.

The flowering period lasts from the 3$^{rd}$ decade of May until the end of July.

## Conclusions

1. in the collections of the Botanical Garden (I) of ASM *Thymus* L. genus is represented by 7 species and two cultivars, all being perennial sub-shrubs.
2. In the table 1 are listed the *Thymus* L. taxa along with their area of distribution, dimensions, flower colour, flowering period and decorative, medicinal and culinary uses. Detailed information about four *Thymus* L. taxa is given in this paper.
3. One species (*T. marschallianus*) was collected from native populations, another eight have been obtained through national and international plant exchange. All these species are maintained in healthy conditions in the collections.
4. Beyond their therapeutic properties they have an admirable decorative aspect being exceptional plants in landscape architecture as fragrant ground covers, in rock gardens, between stepping stone, and in containers.

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# COLECȚIA DE PLANTE SUCULENTE A GRĂDINII BOTANICE (Institute) A AŞM

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**Summary***: Introduction of greenhousse succulents dates in 1975. In Botanical Garden (Institute) of ASM, over 40 years was created the collection (exceptl.fam. Cactaceae Juss.) of unique succulent plants.Currently the collection enumerates 608 taxons represented 18 fam. and 92 gen.(except fam. Cactaceae). Numerically, the most representative are fam. Crassulaceae. (195), Asphodelaceae. (119), Aizoaceae (111), Euphorbiaceae. (27). On the base of phonological observations was established that the generatibe phase, of which 321 (47,36%) are blooming and 63 (10,36%) forms seeds. Due to the great diversity of taxons, decorativity, plasticity in culture, we recommend the perspective succulents for the interiors abundantly illiminating and with low humidity.*

## Introducere

Suculentele sunt un grup de plante deosebit de interesante, ce aparțin la diferite familii botanice şi se bucură de mare popularitate la cercetătorii botanişti. Introducerea plantelor suculente de teren protejat în Grădina Botanicâ (I) a AŞM datează cu anul 1975 [2]. Actualmente, colecția de suculente enumără 608 taxoni, reprezentată de 18 familii şi 92 genuri (excepție, fam. *Cactaceae* ) Suculentele, în unele regiuni din America, Africa, insula Madagascar, se consideră plante endemice. În marea lor majoritate sunt suculente de frunze, în particular plantele din familiile: *Aizoaceae*, *Asclepiadaceae*, *Commelinaceae*, *Asphodelaceae, Crassulaceae* (cu unele excepții). Reprezentanții fam. *Euphorbiaceae*, (gen. *Euphorbia*), *Apocinaceae*, *Dracenaceae* (gen. Dracaena), Nolinaceae (gen. Nolina) etc. sunt suculente de tulpină. Datorită marii diversități de taxoni, decorativității, plasticității în cultură, recomandăm plantele suculente de perspectivă pentru amenajarea interioarelor abundent luminoase cu umiditate scăzută, cât şi pentru amenajarea stâncăriilor pe perioada caldă a anului.

## Materiale şi metode

Ca material de studiu a servit colecția de plante suculente creată pe parcursul a cca 40 de ani în Grădina Botanică (I) a AŞM. Completarea colecției se înfăptuieşte pe diferite căi: comenzi pe delectusuri, butaşi, plante din diferite Grădini Botanice, cât şi schimb cu floricultorii amatori. Observațiile fenologice asupra creşterii şi dezvoltării plantelor au fost efectuate conform "*Metodicii cercetărilor fenologice în grădinile botanice*" (1975). Înmulțirea se înfăptuieşte vegetativ prin butaşi plantați direct în substrat şi prin semințe la speciile, care fructifică. Prelucrarea critică a speciilor se efectuează după Jacobsen (1970).

## Rezultate şi discuții

În seră plantele suculente sunt aranjate după principiul sistematic (familie, gen, specie, cultivar). În centrul serei de-a lungul ei au fost create expoziții, începând cu aa.1985-1986. Pe parcursul anilor multe specii de plante au crescut până sub acoperişul serei (*Euphorbia, Iucca, Dracaena*) din care cauză la aceste plante li s-a tăiat vârful. Practic la fiecare 5-7 ani expozițiile se reînnoiesc. Pe lângă speciile care înfloresc anual (reprezentanții fam. *Crassulaceae, Asphodelaceae, Asteraceae, Aizoaceae, Asclepiadaceae)* pentru prima dată în serele GB(I) au atins faza generativă: *Furcraea gigantea* Vent., *Dracaena draco* L., *D. rumphii*, *Agava ferdinandi-regis* Bgr. , *A. Victoria-reginae* T. Moore, *A. albicans* Jacobi etc.

În rezultatul efectuării observațiilor fenologice asupra colecției de suculente pe parcursul aa. 2009-2011 a fost stabilit numărul de taxoni, care ating faza generativă (infloresc şi fructifică). Datele obținute sunt expuse în tabelul 1.

Tabelul 1

**Componența taxonomică și numerică a colecției de plante suculente**

| *Familia* | *N* | *Genul* | *Numărul total de taxoni* | *Înfloresc* | *Fructifică* |
|---|---|---|---|---|---|
| ***1.Agavaceae Endl.*** | 1 | *Agave L.* | 37 | 5 | 3 |
| | 2 | *Beschorneria Kunth.* | 1 | 1 | 1 |
| | 3 | *Dasylirion Zucc.* | 1 | | |
| | 4 | *Furcraea Vent.* | 3 | 1 | |
| | 5 | *Jucca L.* | 5 | 2 | |
| | 6 | *Hesperaloe Engelm.* | 1 | 1 | |
| ***2.Nolinaceae Nakai*** | 7 | *Calibanus Rose* | 1 | | |
| | 8 | *Nolina Mchx.* | 4 | 1 | |
| ***3.Asteliaceae Dumortier*** | 9 | *Cordiline Comm.ex Juss.* | 2 | | |
| ***4.Aizoaceae Martinov*** | 10 | *Aptenia N.E.Br.* | 1 | 1 | 1 |
| | 11 | *Astridia Dtr. et Schwant.* | 1 | | |
| | 12 | *Bergeranthus Schwant.* | 3 | 3 | 3 |
| | 13 | *Carpobrotus N.E.Br.* | 1 | | |
| | 14 | *Carruanthus Schwant.* | 1 | 1 | 1 |
| | 15 | *Chasmatophyllum Dtr. et Schwant.* | 1 | 1 | |
| | 16 | *Cheiridopsis N.E.Br.* | 5 | 5 | |
| | 17 | *Conophytum N.E.Br.* | 2 | 2 | |
| | 18 | *Delosperma N.E.Br.* | 4 | 2 | |
| | 19 | *Disphyma N.E.Br.* | 1 | 1 | |
| | 20 | *Faucaria Schwant.* | 18 | 16 | 10 |
| | 21 | *Gibbaeum Haw.* | 7 | 3 | 3 |
| | 22 | *Glottiphyllum N.E.Br.* | 22 | 10 | 6 |
| | 23 | *Hereroa Dtr. Et Schwant.* | 4 | | |
| | 24 | *Lithops N.E.Br.* | 13 | 4 | |
| | 25 | *Machairophyllum Scwant.* | 1 | 1 | 1 |
| | 26 | *Malephora N.E.Br.* | 2 | | |
| | 27 | *Mestoklema N.E.Br.* | 1 | 1 | 1 |
| | 28 | *Nananthus N.E.Br.* | 1 | 1 | |
| | 29 | *Orthopterum L.Bol.* | 1 | 1 | |

| | | | | | |
|---|---|---|---|---|---|
| | 30 | *Oscularia Schwant.* | 2 | 1 | |
| | 31 | *Pleiospilos N.E.Br.* | 11 | 5 | 3 |
| | 32 | *Rhombophyllum Schwant.* | 2 | 1 | |
| | 33 | *Semnanthe N.E.Br.* | 1 | 1 | |
| | 34 | *Sesuvium L.* | 1 | 1 | 1 |
| | 35 | *Sphalmanthus N.E.Br.* | 1 | | |
| | 36 | *Tischleria Schwant.* | 1 | 1 | |
| | 37 | *Trichodiadema Schwant.* | 2 | 2 | |
| ***5.Apocinaceae Juss.*** | 38 | *Adenium Roem.et Schult.* | 1 | | |
| | 39 | *Pachipodium Ldl.* | 1 | 1 | |
| ***6.Asclepidaceae*** | 40 | *Caraluma R.Br.* | 2 | | |
| ***Borkh.*** | 41 | *Ceropegia L.* | 6 | 4 | 4 |
| | 42 | *Dischidia R.Br.* | 1 | | |
| | 43 | *Echidnopsis Hook.f.* | 1 | 1 | |
| | 44 | *Huernia R.Br.* | 12 | 6 | 4 |
| | 45 | *Stapelia L.* | 6 | 5 | 2 |
| ***7.Asteraceae*** | 46 | *Othonna L.* | 1 | 1 | |
| ***Martinov*** | 47 | *Senecio L.* | 17 | 8 | |
| ***8.Asphodelaceae*** | 48 | *Aloe L.* | 48 | 20 | |
| ***Juss.*** | 49 | *Astroloba Uitew.* | 2 | 1 | |
| | 50 | *Gasteria Duval.* | 35 | 29 | 10 |
| | 51 | *x Gastrolea E.Walth.* | 1 | 1 | |
| | 52 | *X Gasterhawortia Guill.* | 1 | 1 | |
| | 53 | *Hawortia Duval* | 32 | 28 | |
| ***9.Commelinaceae Mirb.*** | 54 | *Cyanothis D.Don* | 1 | | |
| | 55 | *Tradescantia L.* | 1 | 1 | |
| ***10.Crassulaceae J/St.-Hil.*** | 56 | *Aichryson Webb et Berth.* | 1 | 1 | |
| | 57 | *Adromischus Lem.* | 3 | 2 | |
| | 58 | *Aeonium Vebb et Berth.* | 26 | 4 | |
| | 59 | *Bryophyllum Salisb.* | 8 | 5 | |
| | 60 | *Cotyledon L.* | 4 | 3 | |
| | 61 | *Crassula L.* | 44 | 19 | |
| | 62 | *Dudleya Br. et R.* | 2 | 1 | |
| | 63 | *Echeveria DC.* | 29 | 19 | |
| | 64 | *Graptopetalum Rose* | 1 | 1 | |
| | 65 | *x Graptoveria Gossot* | 1 | | |
| | 66 | *Kalanchoe Adans.* | 50 | 30 | 6 |

| | | | | | |
|---|---|---|---|---|---|
| | 67 | *Monanthes Haw.* | 3 | 3 | |
| | 68 | *Pachyphytum Link, Klotzch et Otto* | 4 | 1 | |
| | 69 | *Pachysedum Hybride* | 1 | 1 | |
| | 70 | *Rochea DC.* | 1 | 1 | |
| | 71 | *X Sedeveria E.Walth.* | 1 | 1 | |
| | 72 | *Sedum L.* | 24 | 9 | |
| | 73 | *Sempervivum L.* | 1 | 1 | |
| | 74 | *Sempervivella Stapf.* | 1 | 1 | |
| | 75 | *Tacitus* | 1 | | |
| | 76 | *Villadia Villadia Haw.* | 1 | 1 | |
| ***11.Didieraceae Drake*** | 77 | *Alluaudia Drake..* | 1 | | |
| | 78 | *Didierea H.Baill.* | 1 | | |
| ***12.Dracaenaceae Salysbury*** | 79 | *Dracaena Vand. ex. L.* | 3 | 2 | |
| | 80 | *Sanseviera Thunb.* | 21 | 10 | 2 |
| ***13.Hyacinthaceae*** | 81 | *Bowiea Harv. et Hook.f.* | 1 | 1 | 1 |
| ***Batsch ex Borkh*.** | 82 | *Drimiopsis Lindl.* | 1 | 1 | |
| | 83 | *Scilla L.* | 3 | 3 | |
| ***14.Euphorbiaceae*** | 84 | *Euphorbia L.* | 25 | 13 | |
| ***Juss.*** | 85 | *Synadenium Boiss.* | 1 | | |
| | 86 | *Pedilanthus Nesker.* | 1 | | |
| ***15.Geraniaceae Juss.*** | 87 | *Pelargonium L., Her* | 1 | 1 | |
| ***16.Oxalidaceae R.Br.*** | 88 | *Oxalis L.* | 1 | 1 | |
| ***17.Portulacaceae Juss.*** | 89 | *Anacampseros Sims.* | 1 | | |
| | 90 | *Portulacaria Jasq.* | 2 | | |
| ***18.Vitaceae Juss.*** | 91 | *Cisus L.* | 2 | 2 | |
| | 92 | *Vitis L.* | 1 | | |
| **Total** | | | 608 | 321 | 63 |

Conform clasificării elaborate de M.Gaidarzhy (2009) în cadrul colecției de plante suculente (excepție fam. *Cactaceae*) a GB(I) a AŞM se întâlnesc următoarele forme de viață: arbori, arbuşti, semiarbuşti, liane şi plante erbacee. În cadrul celor mai numeric prezentate familii întâlnim următoarele forme de viață după cum urmează: fam. *Apocinaceae* – arbori de talie mică cu tulpinile ortotrope (*Adenium, Pachypodium*); *Asteraceae* – arbuşti suculenți de tulpină; semiarbuşti suculenți de tulpină şi frunze, plante policarpice erbacee suculente de frunză. În cadrul fam. *Aizoace-*

*ae* se întâlnesc două forme de creştere: semiarbuşti suculenți de frunze şi plante policarpice erbacee (*Aptenia cordifolia* (L.f.)) Schwant. Majoritatea plantelor din această familie sunt semiarbuşti suculenți de frunze, aranjate în rozetă şi numai reprezentanții a 4 genuri au tulpinile acoperite cu frunze, fiind îndreptate heterotrop. Reprezentanții fam. *Asclepiadaceae* prezintă plante perene cu tulpini şi frunze suculente: grupul celor cu tulpini suculente heterotrope este reprezentat de *Caralluma*, *Huernia*, *Stapelia*. Grupul plantelor perene cu frunze suculente şi lăstarii plagiotropi este prezentat prin speciile de *Ceropegia*. Fam.*Crassulaceae* în colecția GB (I) este reprezentată prin 195 taxoni, majoritatea cărora au atins perioada generativă . Pentru reprezentanții acestei familii sunt caracteristice trei forme de viață: arbuşti suculenți de frunze, semiarbuşti suculenți de frunză şi plante erbacee policarpice suculente prin frunze. Majoritatea semiarbuştilor fac parte din grupul plantelor cu creştere heterotropă a lăstarilor şi predomină plantele, frunzele cărora sunt aranjate în rozete (gen.*Aeonium*, *Echeveria, Monanthes*, *Pachyphytum)*. La cea mai mare parte din grupul plantelor erbacee policarpice direcția creşterii lăstarilor este heterotropă. În genere cca 50% din reprezentanții acestei familii sunt plante erbacee perene. Fam. *Euphorbiaceae* este prezentată în colecție prin 27 taxoni: 25 din genul *Euphorbia*, şi câte unul din *Synadenium* şi *Pedilanthus*. Pentru reprezentanții acestei familii sunt caracteristice trei forme de viață: semiarbuşti, arbuşti şi arbori. Plantele din genul *Synadenium*, *Euphorbia tirucalli* L. cu frunze reduse, *E. grandidens* Haw., *E. stenoclada* H.Ball. se referă la arbori*; Pedilanthus* şi o parte din *Euphorbia* la arbuşti, iar restul speciilor din genul *Euphorbia* la semiarbuşti. În cadrul familiei întâlnim semiarbuşti, lăstari cu direcția ortotropă şi frunze reduse: *E. horrida* Boiss, şi cu lăstarii heterotropi: *E.caput-medusae* L., *E.franskiana* Bgr., *E. mamillaris* L., *E. meloformis* Ait. etc. Semiarbuştii cu frunzele parțial reduse sunt prezentați prin două grupuri: cu lăstarii ortotropi – *E.genoudiana* Ursch et Leandri, *Monadenium guentheri* Pax. şi heterotropi: *E. pteroneura* Bgr., *E. decaryi* A.Guill. etc. La plantele din fam. *Agavaceae* întâlnim 3 forme de viață: arbuşti, semiarbuşti suculenți de frunze, şi arbori. Ultimii sunt reprezentanți de plantele din genul *Yucca*: *Y. aloifolia* L., *Y.a. var. "Marginata*", *Y. elephantipes* Regel. Arbuştii suculenți de frunze sunt prezentați prin *Fourcraea selloa* C.Koch *var."Marginata*", *Beschorneria bracteata* Jacobi, iar speciile de *Agave* se referă la grupul semiarbuştilor suculenți de frunză, practic lipsiți de tulpină. În cadrul fam. *Asphodelaceae* în colecțiile GB(I) întâlnim practic 2 forme de viață: semiarbuşti suculenți de frunze cu majoritatea speciilor de *Aloe* şi plante suculente de frunze policarpice cu reprezentanții genurilor *Gasteria* şi *Haworthia.* Cercetările efectuate în cadrul colecției de suculente a GB(I) ne permit să afirmăm că o bună parte din plantele erbacee policarpice sunt suculente de frunză. Cea mai mare parte a plantelor suculente (80%) se referă la forma de viață semiarbust cu creştere ortotropă şi sunt suculenți de tulpină şi frunzâ.

Cl. *Liliopsida* în colecția de suculente este reprezentată de 6 familii şi 170 taxoni, dintre care înfloresc 86 (50,58%). Din această clasă numeric mai bine sunt prezentate fam.: *Asphodelaceae* – 119 taxoni; *Agavaceae* – 48.

Cl. *Magnoliopsida* esta prezentă prin 12 familii şi 438 taxoni, dintre care înfloresc 202 (46,12%). Numeric mai bine sunt prezentate familiile: *Crassulaceae* – 195 taxoni; *Aizoaceae* – 111; *Euphorbiaceae*- 27 etc.

În condiții de seră pentru reînnoirea colecției de suculente se aplică înmulțirea vegetativă (prin butaşi apicali şi divizare). Perioada optimală de multiplicare este primăvara-vara. Succesul înrădăcinării depinde de temperatura aerului (22-28$^{o}$C). Substratul optimal în care se plantează butaşii: pământ de țelină: mraniță: turbă roşie: nisip în raport de volum 2:0,5:0,5:0,5 părți. Butaşii sădiți în ghivece se amplasează la parapete în locuri luminoase, dar în lipsa razelor directe ale soarelui. Se udă şi se stropesc la început cu precauție. Iarna plantele suculente se udă moderat.

## Concluzii

Pe parcursul a cca 40 de în Grădina Botanică (I) a AŞM a fost creată o colecție cu valoare de unicat de plante suculente, care numără 608 taxoni ce aparțin la 18 familii şi 92 de genuri.

Observațiile fenologice efectuate în special pe parcursul aa. 2009-2011 ne permit să afirmăm că în marea lor majoritate (80-85%) plantele suculente au trecut etapele de adaptare şi sunt introduse în serele GB (I).

Plantele suculente în comparație cu cele tropicale şi subtropicale sunt mai puțin vulnerabile la temperaturile scăzute pe parcursul perioadei reci a anului.

Din cei 608 taxoni faza generativă (înfloresc) ating 321 (47,36%), fructifică 63 (10,36%).

Metoda de bază de înmulțire a plantelor suculente este cea vegetativă (butaşi apicali, de tulpină, de frunză, divizare). Pentru speciile de Agave care fructifică şi nu formează lăstari tineri – prin semințe.

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## UNELE ASPECTE ALE INTRODUCERII PLANTELOR DIN FAM. *CACTACEAE* JUSS ÎN SERELE GRĂDINII BOTANICE (Institut) A AŞM

***Ţîmbalî V., Guşanova V., Rogacico S.***

*Grădina Botanică (Institut) a AŞM*

**Summary.** *The Cactaceae Juss. family is represented by 737 taxons among which 435 are blossoming and 278 are fruitifying,in the collection of the Botanic Gardens (I) of the Academy of Sciense of Moldova. The plants of this family are multiplyng by seeds and vegetative. . Established collections play an important role in the ecological education of the population, in the teaching – educational process and in completing the assortment of plants used for greening of spaces with various destinations.*

### Introducere

Una din problemele de bază în valorificarea resurselor vegetale ale florei globului este introducerea plantelor de teren protejat, deoarece un număr mare din plantele de cultură folosite de omenire, cât şi cele de cameră sunt de origine din țările cu climă tropicală, subtropicală şi aridă.

Fam. *Cactaceae* este una din cele mai mari grupe de plante superioare ce numără peste 3000 de specii. Cactuşii sunt originari de pe continentul American, însă cei mai răspândiți sunt în Mexic, regiunile de pustiu din Peru, Chile, Argentina şi Bolivia. Arealul fitogeografic al familiei se întinde între 35$^{o}$ latitudine nordică, în Canada şi 54$^{o}$ latitudine sudică, în regiunea strâmtorii Magelan. Datorită acestui areal vast şi condițiile de mediu sunt extrem de variate, care la rândul lor au imprimat plantelor anumite particularități morfo-biologice specifice, fiind de fapt adaptări ale lor la condițiile de mediu mai mult sau mai puțin favorabile. Clima continentului american cuprinde toate formele, de la climatul polar la cel ecuatorial. Arealul de vegetație al cactuşilor se întinde pe mai mult de 12000 km, începând cu climatul ecuatorial, subecuatorial, tropical, temperat, deşertic şi chiar rece. Acest vast areal de răspândire al plantelor din fam.*Cactaceae* cuprinde aproape toate formele de relief începând cu spectaculoasele canioane din sudul SUA, platourile mexican, peruan, bolivian, argentinian, colinar până la munți ce depăşesc des 5000 m înălțime, stepe, pampasuri, deşerturi sau zona exuberiană a pădurilor tropicale. Datorită acestei varietăți mari de relief şi compoziția solului este la fel de diversificată. Unele specii de *Opunția* Mill. s-au aclimatizat foarte bine şi s-au răspândit în sudul Europei, nordul Africii, în India şi Australia.

În țările de origine o bună parte de cactuşi au constituit pentru popoarele conlocuitoare singurele resurse naturale, atât ca hrană pentru oameni şi animale cât şi în alte scopuri utilitare.

Cactuşii sunt plante xerofite cu tulpini suculente, cărnoase, de formă columnară sau sferică, de regulă muchiate. După locul lor de răspândire se împart în două grupe: 1 – cactuşii ce cresc în regiunile cu climâ aridâ (cactuşii tipici) şi 2 – plante din pădurile tropicale (*Epipyllum* Haw., *Rhipsalis* Gaertn., *Lipismium* Pfeiff., *Hateora* Br. et Rose, *Schlumbergera* Lem., *Selenicereus* Br. et Rose etc.).

Florile cactuşilor, de regulă, solitare numai la genul *Pereskia* şi *Rhodocactus* dispuse în inflorescență – racem, întotdeauna sesile, bisexuate (cu excepția *Mammillaria dioica* K.Brand.), de obicei actinomorfe, mai rar zigomorfe (*Aporocactus, Cleistocactus, Cochemeia, Schlimbergera*). În momentul înfloririi la reprezentanții unor genuri (Melocactus Link. et Otto) apare la vârful tulpinii un cefaliu – o formațiune densă, țepoasă, pe care apar florile. La unele specii de *Pilosocereus* Byles et Rowley în perioada înfloririi apare pe areole un număr mare de perişori țepi care au căpătat denumirea de pseudocefalii.

## Material şi metodă

Drept material pentru studiu a servit colecția de plante din fam. *Cactaceae* a GB (I) a AŞM. Anual se înfăptuieşte evidența plantelor în colecție. Prelucrarea critică a colecției s-a efectuat după C.Backeberg (1979), S.Copăcescu (2001) şi R. Udalova, M. Viughina (1983). Sistematic se duc observații fenologice asupra colecției în cauză.

## Rezultate şi discuții

Grădina Botanică (I) a AŞM dispune de o colecție de plante din fam *Cactaceae* Juss., cu valoare de unicat pentru Moldova, care la moment numără 737 taxoni, ce se referă la 3 subfamilii şi 132 de genuri. Aceasta este amplasată în serele GB(I) pe o suprafaţă de 360 m$^2$. Colecţia propriu-zisă este aranjată la parapete, ce se întind de-a lungul pereţilor laterali, iar în centru serei la sol au fost create pe parcursul aa.1985-1986 – 3 expoziţii cu plante suculente, predominante fiind speciile de cactuşi.

Printre primele specii de cactuşi (1963-1964), care au stat la baza creării colecţiei au fost: *Eriocactus leninghausii* Backbg. *Consolea rubescens* Lem., *Cylindropuntia leptocaulis* (DC) F.Knuth., *Cleistocactus strausii (Heese) Backeb.*

Colecţia de plante din fam. *Cactaceae* a GB(I) este reprezentată de cele 3 subfamilii: *Peiresckioideae* cu 4 genuri şi 6 specii; *Opuntioideae* cu 8 genuri şi 52 taxoni şi *Cereoideae* cu 120 de genuri şi 679 taxoni. Plantele din această familie sunt policarpice, durata de viaţă a tulpinii corespunde cu durata de viaţă a plantei. Pe măsura maturizării, tulpinile se lignifică putând depăşi usor venerabila vârstă de 200 de ani. În colecţia de cactuşi a GB(I) specia de *Echinicactus grusonii* Hilld. crescută din seminţe din 1965 a atins vârsta de 45 de ani, există specii în colecţie cu vârsta şi mai mare. Majoritatea genurilor de cactuşi (subfam.*Cereoideae*) sunt lipsite complet de frunze propriu-zise. Speciile de cactee din genurile *Peireskia* şi *Rhodocactus* Knuth. (subfam. *Peireskioideae*) prezintă frunze complete cu limbul de formă ovată, cu nervaţiuni penate, cu marginea întreagă, groasă, cu aspect ceros, de culoare verde-închis. Peţiolul este foarte scurt, cilindric, gros.Teaca se prezintă ca o dilataţie a extremităţii inferioare a peţiolului. La speciile din subfam. *Opuntioideae* (*Opuntia, Austrocilindropuntia, Tephrocactus*, *Cylindropuntia* etc.) apar frunze metamorfozate, de formă cilindrică, cu vârful ascuţit, numite frunze subulate, timpuriu caduce. Din punct de vedere al evoluţiei cea mai veche subfamilie este *Peiresckioideae*. În tabelul 1 sunt prezentate cele mai numerice genuri din cele 3 subfamilii. Din cele 132 de genuri cel mai numeric sunt prezentate: *Mammillaria* – 171; *Gymnocalicium* – 33; *Lobivia* – 33; *Opuntia* – 29; *Echinocereus* – 25; *Rhipsalis* – 22; *Notocactus* – 20 etc.

Tabelul I

**Componenţa sistematică a celor mai numeroase genuri a fam. *Cactaceae* din colecţia GB (I) a AŞ RM**

| *Nr.* | *Denumirea subfamiliei* | *Denumirea celor mai importante genuri* | *Nr.de specii în gen* | *Nr.de genuri în subfamilie* |
|---|---|---|---|---|
| 1 | *Peireskioideae* Schum. | *Peireskia* Mill. | 3 | 4 |

| | | | | |
|---|---|---|---|---|
| 2 | *Opuntioideae* Schum. | *Austrocylindropuntia* Back. | 5 | 8 |
| | | *Opuntia* Mill. | 29 | |
| | | *Tephrocactus* Lem. etc. | 10 | |
| 3 | *Cereoideae* Schum. | *Echinocereus* Engelm. | 25 | 120 |
| | | *Echinofasolocactus* Law. | 14 | |
| | | *Ferocactus* Britt et Rose | 17 | |
| | | *Gymnocalicium* Pfeiff | 33 | |
| | | *Lobivia* Britt et Rose | 33 | |
| | | *Mammillaria* Haw. | 171 | |
| | | *Neochilenia* Backeb. | 14 | |
| | | *Notocactus* Berger | 20 | |
| | | *Parodia* Speg. | 18 | |
| | | *Rebutia* Schum. | 11 | |
| | | *Rhipsalis* Gaerth. etc. | 22 | |
| Total | | | 737 | 132 |

Diversitatea condițiilor naturale precum şi a factorilor de mediu au creat o diversitate de forme cu dimensiuni ce pot varia de la 1 cm la 25 m. În colecție se întâlnesc plante ce ating în diametru până la 1 cm (*Aylostera sp*.) şi specii (*Austrocylindropuntia tunicata* Link et Otto, *Cereus peruvianus* (L.) Mill., *Consolea rubescens* Lem., *Myrtilocactus geometrizans* Juss., *Quabentia chacoensis* Backeb., *Brasiliopuntia brasiliensis* Berger, *Opuntia bergeriana* Web. *O.pilifera* Web. etc.) cu înălțimea de 4-6 m.

Din numărul total de cactuşi (737) faza generativă o trec 435 (59,02%) taxoni, dintre care fructifică numai 278 (37,72%).

Îndeosebi înfloresc speciile de *Mammillaria***,** *Astrophitum* Lem., *Parodia*, *Dolichotele* Br. et Rose, *Opuntia, Rhipsalis, Rebutia* etc.

În condițiile de seră ale Grădinii Botanice (I) a AŞM perioada optimală de înflorire a majorității speciilor de cactuşi sunt lunile martie (a doua jumătate) – mai. În această perioadă faza generativă o ating majoritatea speciilor de *Mammillaria, Opuntia* etc. În lunile noiembrie–februarie plantele de cactuşi se află în perioada de repaos.

Cactuşii se înmulțesc prin divizarea plantelor tinere de la planta-mamă, butaşi (cactuşii tropicali) şi semințe. Semințele cactuşilor (cu excepția celor de *Opuntia*) sunt înconjurate de o membrană subţire şi fragilă. Într-un fruct pot fi de la 1-3 seminţe la *Pelecyphora pseudopectinata* Backeb., până la 1500 la *Espostoa blossfeldiorum* (Werd.) F.Buxb. La majoritatea speciilor de cactuşi seminţele sunt mărunte cu l de 0,3-0,5 mm **(***Parodia, Blosfeldia, Strombocactus* etc.), iar la *Astrophytum, Opuntia şi Pereskia* ating lungimea de 3-5 mm.

Pentru păstrarea căpacităţii germinative pe o perioadă mai îndelungată se recomandă ca seminţele să fie menţinute la t de + 2 - + 5$^{o}$C.

În rezultatul cercetărilor s-a stabilit că seminţele proaspăt colectate la unele specii de *Mammillaria* au procentul germinării de 85- 98, pe când la cele păstrate pe parcursul a 7 ani în condiţii de laborator procentul s-a micşorat până la 20 – 30. La *Astrophytum senile* Fric. seminţele proaspăt colectate au procentul germinării 90-94, în timp ce la *A.ornatum* Web., după 3 ani de păstrare numai 3, iar la *A.senile var.aureum* Back., *A.myriostigma* Lem. seminţele practic nu au germinat.

Actualmente multe specii de cactuşi se folosesc pe larg în calitate de absorbanţi ai radiaţiilor electromagnetice, ce provin de la monitoarele calculatoarelor.

Colecţia de cactuşi din cadrul GB reprezintă o valoare de unicat incontestabilă, iar diversitatea bogată a fam. *Cactaceae* produce o impresie deosebită asupra tuturor vizitatorilor.

## Concluzii

Pe parcursul a cca 40 de ani în cadrul Grădinii Botanice (I) a AŞM a fost creată colecţia de plante din fam. *Cactaceae* cu valoare de unicat incontestabilă pentru Moldova, care la moment numără 737 de taxoni, aparţinând la cele 3 subfamilii şi 132 de genuri. Din numărul total de taxoni (737) faza generativă o trec 435 (52,09%), dintre care fructifică 278 (37,72%).

A fost stabilit procentul germinării seminţelor proaspăt colectate (85-95) şi a celor păstrate pe o perioadă mai îndelungată de timp (20-30) la unele specii şi numai 3 (*Astrophytum ornatum***).**

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# DEVELOPMENT RHYTHMS OF THE GENUS HAWORTHIA (NAWORTHIA NAW.) IN THE GREENHOUSE OF BOTANICAL GARDEN (INSTITUTE) OF ACADEMY OF SCIENCES OF MOLDOVA

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**Summary.** *In this article are presented the results of the systematical analysis of the representatives of Hawortia available in the collection of Botanical Garden of Republic of Moldova. All species of the collection are divided into sections according to classification criteria proposed by Jacobsen Are presented the phenology spectrum of Haworthia genus*

## Introduction

The main indicator of plant adaptation to new conditions of growth is the passage of all stages of development: normal vegetative growth and a successful transition to the generative development. Because fruit set and seed maturation tropical and subtropical plants often is associated with certain kind of insect pollinators, which are absent in the new environment, the main criterion for acclimatization of plants is the presence of the flowering phase. Regularity and stability and the appearance of flowering can serve as a criterion of successful introduction. In this regard, long-term phonological observations of exotic species are important for successful introduction.

## Materials and methods

Object our study were of the species of genus *Haworthia* Haw, represented in the greenhouse collection of the Botanical Garden.

*Haworthia* is a genus of flowering plants within the family *Xanthorrhoeaceae*, subfamily *Asphodeloideae* [1]. They have a small (usually 20 cm high) solitary or clump-forming. Some species have firm, tough leaves, usually dark green in color, whereas other are soft and semi-translucent. Their flowers are small, white and very similar between species. But their leaves show wide variations even within one species.

The classification of the flowering plant subfamily *Asphodeloideae* is weak and concepts of the genera are not well substantiated. *Haworthia* is similarly a weakly contrived genus consisting of three distinct groups: subgenera *Haworthia*, *Hexangularis*, and *Robustipedunculares*. Related genera are *Aloe*, *Gasteria* and *Astroloba* and intergeneric hybrids are known.

The genus *Haworthia* is named after the botanist Adrian Hardy Haworth. Bayer recognizes approximately 61 species whereas other taxonomists are very much less conservative (1999, Haworthia Revisited, Umdaus Press). The species are endemic to South Africa, Swaziland, Namibia and Maputoland. The plants are small, forming rosettes of leaves from 30mm to exceptionally 300mm in diameter. These rosettes are usually stemless but in some species stems reach up to 500mm.

Their flowers are small, white and very similar between species. There are differences in the flowers of the three sub-genera that botanists have curiously considered inconsequential although the differences between species in the same subgenus definitely are. The roots, leaves and rosettes do demonstrate some generic differences while wide variations occur even within one species. Because of their horticultural interest, the taxonomy has been dominated by amateur collectors and the literature is rife with misunderstanding of what the taxa actually are or should be.

A collection of *Haworthia* genus in the Botanical Garden contain of 31 species belonging to 12 sections in accordance with the classification of Jacobson (3), which divides Haworthias with 20 sections based on the structure of the stem and leaf. The most commonly (four species) in the collection is represented Section *Corctatae* Bgr.(II) - Haworthia cassutha Bak, Haworthia coarctata (Salm) Haw., Haworthia glauca Bak., Haworthia herrei v. Poelln.; VII Section Limpidae Bgr. (- Haworthia angustifolia Haw., Haworthia obtusa Haw., Haworthia vitata Bak., Haworthia obtusa Haw. v.variegata hort., IX (Margaritiferae Haw.) - Haworthia fasciata (Wild.) Haw., Haworthia glabrata (Salm.) Bak., Haworthia margaritifera (L.) Haw., Haworthia radula (Jacq.) Haw., XIV (Retusae Haw.) - Haworthia retusa (L) Haw., Haworthia mirabilis Haw., Haworthia nitidula v. Poelln., Haworthia ryderiana v.Poelln, Haworthia tuberculata v. Poelln. There are two *Haworthia* species from Section III Denticulatae Bak. Haworthia altilinea Haw., Haworthia mucronata Haw., Section XII - Obtusatae Bgr. - Haworthia cymbriformis (Haw.) Duv., Haworthia lepida GGSmit, Section XV- Rigidae Haw. - Haworthia rigida (Lam.) Haw., Haworthia rigida (Lam.) Haw. v. One species presented rigida Section I Arachnoideae Haw. -Haworthia pallida Haw.; VI Limifolia G.G. - Haworthia limifolia Marl.; XIII Planifoliae Bgr. - Haworthia aristata Haw.; XVIII-Tessellatae (Salm.) Bak.- Haworthia tessellate (Salm.) Haw.; XIX Tortuosae Haw- Haworthia tortuosa Haw.

To study the characteristics of the genus *Haworthia* were conducted phenological observations for plants collection. The study was conducted for three years. Every ten days, there were monitored phases of plant

Table 1

**The phenology spectrum of Haworthia genus**

| *N* | *Species* | *Year* | *Months* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *I* | *II* | *III* | *IV* | *V* | *VI* | *VII* | *VIII* | *1X* | *X* | *XI* | *XII* |
| 1 | Hawortia altilinea Haw | 1 | | | | | ■ | ■ | | | ■ | ■ | | |
| | | 2 | | ■ | | | | ■ | | | ■ | ■ | | |
| | | 3 | ■ | | | | ■ | ■ | | | ■ | ■ | | |
| 2 | Hawortia angustifolia Haw. | 1 | | | | | | ■ | ■ | ■ | ■ | | | |
| | | 2 | | | | | | ■ | ■ | ■ | | | | |
| | | 3 | | | | | | ■ | ■ | ■ | ■ | | | |
| 3 | Hawortia angustifulia var liliputana Uitew. | 1 | | | | | | | | | | | | |
| | | 2 | | | | | | | | | | | | |
| | | 3 | | | | | | ■ | ■ | | | | | |
| 4 | | 1 | | | | | | | | | ■ | | | |
| | Hawortia aristata Haw. | 2 | | | | | | | | | | | ■ | ■ |
| | | 3 | ■ | | | | | | | | | | | |
| 5 | | 1 | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Hawortia cassuta Bak. | 2 | | | | | ■ | ■ | ■ | ■ | ■ | | | |
| | | 3 | | | | | ■ | ■ | ■ | ■ | ■ | | | |
| 6 | | 1 | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | |
| | Hawortia coarctata (Salm) Haw. | 2 | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | |
| | | 3 | | | | | ■ | ■ | ■ | ■ | ■ | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | | | 1 | | | | | | | | | | | | |
| | Hawortia | cymbriformis (Haw.) Duv. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 8 | | | 1 | | | | | | | | | | | | |
| | Hawortia | fasciata (Willd.) Haw. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 9 | | | 1 | | | | | | | | | | | | |
| | Hawortia | glabrata (Salm) Bak. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 10 | | | 1 | | | | | | | | | | | | |
| | Hawortia | glauca Bak | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 11 | | | 1 | | | | | | | | | | | | |
| | Hawortia | Herrei v.Poelln | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 12 | | | 1 | | | | | | | | | | | | |
| | Hawortia | lemifolia Marl. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 13 | | | 1 | | | | | | | | | | | | |
| | Hawortia | lepida G.G.Smith | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | Hawortia margaritifera (L) Haw. | 1 | | | | | ■ | ■ | ■ | | | | | |
| | | 2 | | | | | ■ | ■ | ■ | | | | | |
| | | 3 | | | ■ | ■ | ■ | ■ | ■ | | | | | |
| 15 | Hawortia mucrocanta Haw. | 1 | | | | | | | | | | | | |
| | | 2 | | | | | ■ | ■ | | | | | | |
| | | 3 | ■ | ■ | ■ | | ■ | ■ | | | ■ | | | |
| 16 | Hawortia mirabilis Haw. | 1 | | | | | | | | | | | | |
| | | 2 | | | | | | | | ■ | ■ | | | |
| | | 3 | | | | | | | | | | | | |
| 17 | Hawortia nitidula v. Poelln | 1 | | | | | | | | ■ | ■ | | | |
| | | 2 | | | | | | | | | | | | |
| | | 3 | | | | | | | | ■ | ■ | | | |
| 18 | Hawortia obtusa Haw. | 1 | | | | | ■ | ■ | | | | | | |
| | | 2 | | ■ | ■ | ■ | ■ | | | | | | | |
| | | 3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | |
| 19 | Hawortia obtusa Haw. variegata | 1 | | | | | ■ | ■ | | | | | | |
| | | 2 | ■ | ■ | ■ | ■ | ■ | | | | | | | |
| | | 3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | |
| 20 | Hawortia palida Haw. | 1 | | | | | | | ■ | | | | | |
| | | 2 | ■ | ■ | | ■ | ■ | | ■ | | | | | |
| | | 3 | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | | | 1 | | | | | | | | | | | | |
| | Hawortia | planifolia Haw. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 22 | | | 1 | | | | | | | | | | | | |
| | Hawortia | radula (Jacq.) Haw. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 23 | | | 1 | | | | | | | | | | | | |
| | Hawortia | regida (Lam.) Haw. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 24 | | | 1 | | | | | | | | | | | | |
| | Hawortia | regida (Lam.) Haw. var regida | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 25 | | | 1 | | | | | | | | | | | | |
| | Hawortia | reinwardtii (S.D.) Haw. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 26 | | | 1 | | | | | | | | | | | | |
| | Hawortia | retusa (L.) Haw. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 27 | | | 1 | | | | | | | | | | | | |
| | Hawortia | ryderiana v. Poelln | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | | | 1 | | | | | | | | | | | | |
| | Hawortia | tesselata (Salm) Haw. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 29 | | | 1 | | | | | | | | | | | | |
| | Hawortia | tortuosa Haw. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 30 | | | 1 | | | | | | | | | | | | |
| | Hawortia | tuberculata v. Poelln | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |
| 31 | | | 1 | | | | | | | | | | | | |
| | Hawortia | vitata Bak. | 2 | | | | | | | | | | | | |
| | | | 3 | | | | | | | | | | | | |

development, namely the beginning of budding (inflorescence emergence), phase coated bud, beginning of flowering (first flower opening), the phase of mass flowering, late flowering (last flower wilting). The phase of development was marked even if it was observed in only one plant of the collection (2).

## Results and disscusions

The results are presented in Table 1.

As can be seen from the table in the Botanical Garden greenhouse bloom was observed in 30 of the 31 species of collection. During the experiments period only Haworthia retusa (L) Haw. (Section XIV) did not blossom The most stable bloom from May to September were observed at the following types of Haworthia cassutha Bak, Haworthia coarctata (Salm) Haw., Haworthia reinwardtii (SD) Haw. Haworthia glauca Bak. (Section II), Haworthia angustifolia Haw. (Section VIII) Haworthia tessellate (Salm.) (Section XVIII) Haworthia aristata Haw., Haworthia planifolia Haw. (Section XIII) Haworthia margaritifera (L.) Haw. (Section IX).Flowering not confined to the particular period during the year was observed on Hawortia vitata Bak. (Section VII) u Hawortia altilinea Haw. (Section III). Fruiting of the species within this genus conditions was not observed.

## Conclusions

Thus we can conclude that the species of the genus Hawortia successfully passed introduction and acclimatization in greenhouses of the Republic of Moldova and can be successfully used for landscaping interiors.

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# THE ACTION OF PHYSIOLOGICALLY ACTIVE SUBSTANCES OVER OF ROOTING CUTTINGS OF SOME SPECIES OF TROPICAL LIANAS

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**Summary.** *In the result of physiologically active substances on the process of cuttings rootedness of 3 species of tropical lianas, have established optimal concentrations of various stimulators of rooting for each species. For cuttings of: Jasminum polyanthum proved to be the AIA solutions – 0,01%, and the % of Virinil rooting during in June is – 80. For cuttings of Tetrastigma voinerianum the optimal concentration for AIA – 0,005%, the rooting – 100, in case of using the Virinil solution – 87,5. The cuttings of Philodendron scandens var. Oxycardium can be successfully rooted in water without using the PAS solutions.*

## Introduction

During in the last years the increasing attention is given of the greening problem and arrangement of close spaces with helping of the plants. For the enclosed greening are used the different species of plants. Special interests to solve the problems are lianas, because of some privileges compared with all species of plants. One of the most important fact is that they, lianas, occupies with as smaller area, but, they can green higher. For successful using of different species of tropical and subtropical lianas, form the collections of Botanical Garden (I) of the ASM, multiply only vegetative, but the % of rooting is small, therefore appear the necessity to resolve this problem through use of physiologically active substances (PAS), which play a particularly important role in regulating the essential processes of plants (Кулаева, 1995). PAS acts, both rooting for the purpose of shortening life and quantity of roots formed, thus ensuring a better gripping of the results of seedlings. (Калінін, 1989; Юскевич, Висящева, Краснова, 1990) A special interest for the vertical greening of interior is presented by: *Jasminum polyanthum Franch* – both decorative species with leaves, and by its inflorescences with white flowers, heavily scented; *Tetrastigma voinerianum Pierre ex Gagnep* şi *Phylodendron scandens ssp. oxicardium (Schott) Bunting* the species with rapid and decorative growing with their rich foliage.

## Materials and methods

Served as the study material cuttings of three species of tropical lianas from collections of Botanical Garden (I): *Jasminum polyanthum.,* *Tetrastigma voinerianum., Phylodendron scandens ssp. Oxicardium*. In the quality as stimulators for rooting of cuttings were used: Indolyl Acetic Acid (AIA – 0,01%), (AIA – 0,005%), Alpha-Naphthyl Acetic (ANA -0,01), (ANA – 0,005%) and Virinil with concentration $10^{-3}$. Were used apical and stem cuttings. After the processing with stimulators of rooting during of 30 min., the cuttings were places for rooting in the sand of river. Also the cuttings were places in water and after in the sand. During in the experience the mean of temperature and humidity of air in greenhouses was 22-26 °C and 70-80%. The peculiarities of the rhythm of development were studied according of the „Phonological Research Methodology in Botanical Gardens" (1972). The investigations were effected in greenhouses of Botanical Garden (I) of ASM during in the years 2008-2009, in June-July.

## Results and discussions

The results of research carried out has been established the affirmative action of studied physiologically active substances on rooting the cuttings of three species of lianas. The percentage of rooting is presented in the tables below:

Table 1

**The action of (pas) over % of rooting cuttings during the months of YI-YII**

| *Specia* | *AIA 0.01%* | *AIA 0.005%* | *ANA 0.005%* | *ANA 0.01%* | *Virinil $10^{-3}$* | *Witness* |
|---|---|---|---|---|---|---|
| Jasminum polyanthum | 80 | 20 | 75 | 60 | 80 | 0 |
| Tetrastigma voinierianum | 60 | 80 | 60 | 60 | 66,67 | 0 |
| Phylodendron scandens var. oxycardium | 57,14 | 66,67 | 60 | 80 | 100 | 100 |

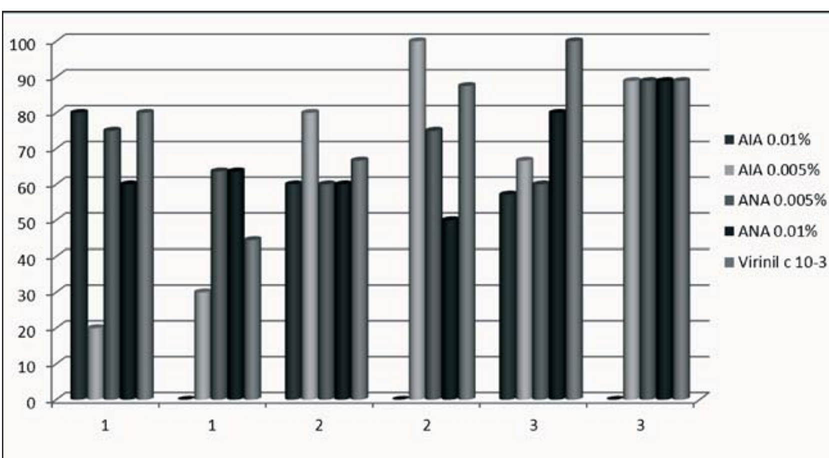
Table 2

**The action of (pas) over % of rooting cuttings during the months of YII-YIII**

| *Specia* | *AIA 0.01%* | *AIA. 0,005%* | *ANA 0.005%* | *ANA 0.01%* | *Virinil $10^{-3}$* | *Witness* |
|---|---|---|---|---|---|---|
| Jasminum polyanthum | 75,46 - | 30 | 63,64 | 63,64 | 44,44 | 0 |
| Tetrastigma voinierianum | 66,45 - | 100 | 75 | 50 | 87,5 | 0 |
| Philodendron scandens var. oxycardium | 60,25 - | 88,88 | 88,89 | 88,89 | 88,89 | 100 |

From the data of tables we see that cuttings of *Jasminum polyanthum* placed on rooting in June have a high percentage of rooting – 80, in case of using the AIA solution with concentration of 0,01%. In the same solution, but with concentration of 0,005%, the percentage of rooting was only – 20%. In case of using the solutions of: ANA – 0,01%, ANA – 0,005% and the percentage of Virinil rooting is 60-75, and respectively 80. If the experience made during the rooting of July the % is slightly lower compared with obtained data in the previous month.

During of planting of rooting cuttings the root system was well developed in all variants, and the roots reached a length of 7 to 13 cm. For the cuttings of *Tetrastigma voinierianum* the optimal period for rooting is July, and the % of rooting cuttings in the case of using the AIA solutions - 0,005% is 100 and Virinil – 87, 5. The roots when planting in substrate had the length about 5-9 cm. For these two species the % of rooting is 0. The cuttings of *Philodendron scandens var. Oxycardium* the % of rooting in case of using the Virinil solution is 100, but in case of using other solutions the % of rooting is 57-80 in June, while in Jule this % is fixed for each stimulator of growth. In case when the % of rooting in both periods (YI and YII) was 100. So the cuttings *Philodendron scandens var. Oxycardium* practical no need to use (PAS) for rooting, because adventitious roots, which in the conditions of increased humidity of the air is easily developed on the plant strains. Those exposed above are illustrated in the Figure nr. 1.




1 – Jasminum polyanthum Franch.
2 – Tetrastigma voinierianum Pierre ex Gagnep
3 - Philodendron scandens var. Oxycardium (Schott) Bunting

Figure 1. The action of PAS on the process of rootedness (% of rooting)

## Conclusions

Using the PAS solutions with different concentrations acted positively in the case of root system development at *Jasminum polyanthum* and *Tetrastigma voinerianum.* The optimal concentrations for the first species were found to be: AIA – 0,01%, and the % of Virinil rooting – 80, but the roots during of planting in the substrate had a legth of 7 to 13cm.

For *Tetrastigma voinerianum* the optimal concentration for AIA – 0,005%, the % of rooting is 100, in case of using the Virinil solution – 87,5.

The cuttings of *Philodendron scandens var. Oxycardium can* be successfully rooted in water without using the PAS solutions. The optimal temperature and humidity of the substrate and the air is 24-26 $^{o}$C and 70-90%.

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# INTRODUCEREA, PARTICULARITĂȚILE AGROBIOLOGICE ŞI TEHNOLOGICE A CULTIVĂRILOR DE TUTUN A VARIETĂȚII *BURLEY* ÎN CONDIȚIILE REPUBLICII MOLDOVA

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**Summary.** *The target of this study was to evaluating morphological characteristics, biological features, vegetative period, diseases and pests resistance, productivity, quality and chemical composition, technological and gustative characteristics of tobacco leaf of Burley variety, with follows cultivars: Burley 320 (Moldova), Burley 235 (Romania), Culinec and Podravec (Croatia), NC 5 and HB 40P (Rikcard Seeds, USA). The researches performed in Moldova's conditions, and high quality and productivity as well as the best technological and gustative characteristics of hybrid HB 40P were revealed.*

## Introducere

Tutunul (*Nicotiana )* face parte din familia *Solanaceae*, originar din Mexic a fost introdus în Europa de spanioli. Francezul Jean Nicot a contribuit la introducerea tutunului în Franța ca plantă medicinală şi folosită în afecțiunile oculare. Astăzi, tutunul se cultivă pentru frunzele sale utilizate în obținerea produselor de fumat şi prizat: țigarete, tutun de pipă, țigări de foi, tutun pentru prizat, tutun pentru mestecat etc., precum şi ca plantă decorativă.

În Moldova tutunul e cunoscut de aproape 400 de ani, provenind din Imperiul Otoman, populația băştinaşă producând tutun de gust şi scheletic a subspeciei *Orientalis* [3,6].

Astăzi, tutunurile cultivate în lume, aparțin în proporție de peste 90% la specia *Nicotiana tabacum* L., iar la fabricarea produselor de tutungerie cea mai mare pondere circa 72% o constituie tutunul subspeciei *Americana*, varietățile *Virginia* şi *Burley.* Un deosebit interes prezintă varietatea *Burley,* datorită structurii anatomice a parenchimului cu celule mari, ce dă posibilitate de a absorbi şi a reține sosuri şi aromatizatori, ce contribuie la înobilarea produselor de tutungerie. Recolta medie anuală a varietății *Burley* este de 770-780 mii de tone (asigurarea constituie circa 70% din necesar), ce constituie aproximativ 13% din producția globală de tutun. Cei mai mari producători ai acestei varietăți sunt Statele Unite ale Americii, Brazilia, China, India, Malawi şi Argentina, dar este considerat un producător semnificativ şi Uniunea Europeană. În secolul trecut cultivarea acestei varietăți a fost răspândit pe larg în România şi Bulgaria, dar la finele secolului suprafețele s-au redus considerabil, astăzi se întreprind măsuri de revitalizare producerii varietății *Burley* [1,5,7].

Din anul 1975 în Republica Moldova a demarat testarea, implementarea şi procesarea tutunurilor cu foaia mare de origine americană varietățile Virginia şi Burley. Conform investigațiilor efectuate de firmele transnaționale Philip Moris, BAT, Centrele ştiințifice din Moldova, Bulgaria şi Cruația condițiile pedoclimaterice a zonei de Nord, baza tehnico-materială, forța de muncă relativ ieftină ar permite anual producerea şi procesarea în Republica Moldova a circa 5 mii tone tutun a varietății Burley [2,3,4]. Soiul autohton Burley 320 creat la fostul Institut pentru tutun şi produse din tutun din Moldova, astăzi Institutul de Fitotehnie „Porumbeni”, omologat din anul 1993 nu satisface pe deplin cerințele de industrializare şi producere a produselor din tutun. SA „TUTUN – CTC” importă circa 70 - 90% din necesarul materiei prime de tutun a varietății *Burley.* Reieşind din cele menționate începând cu anul 1999 s-a revenit la cercetarea particularităților biologice, chimico-tehnologice şi gustative a cultivărilor (soiuri şi hibrizi) de tutun a varietății *Burley* creați atât la centrele ştiințifice din țară cât şi cele din străinătate: România, Cruația, SUA în scopul omologării acelor cultivări care ar satisface atât cerințele producătorilor agricoli, cât şi a procesorilor, consumatorilor autohtoni şi exportatorilor de materie primă şi produselor de tutungerie.

## Materiale şi metode

Investigaţiile ştiinţifice s-au efectuat pe teren neirigat la câmpurile de omologare a Comisei de Stat pentru Încercarea soiurilor de plante pe soluri cernoziomice, precum şi la sectoarele demonstrative SA „TUTUN – CTC"din Briceni şi Edineţ pe soluri cenuşii de pădure şi cernoziom levigat cu un conţinut de humus mai mare de 3%. Premărgător a servit culturile cerealiere. Răsadul a fost produs în solarii circa 500 fire/m$^2$. Lucrările de transplantare s-a efectuat pe parcursul primei jumătăţi a lunii mai. Schema de plantare 90x45cm. Obiect de studiu au servit cultivării de tutun a varietăţii *Burley:* martor – soiul autohton Burley 320, soiul Burley 235 creat în România, soiurile Culinec şi Podravec create la Institutul pentru tutun din Cruaţia, hibrizii NC 5 şi HB 40P de origine americană a firmei Ricard Seeds, SUA, renumită în lume în producerea şi comercializarea seminţelor de tutun. Cercetările în câmp s-au efectuat în conformitate cu indicaţiile metodice de încercare a culturilor agricole [10]. Determinarea calităţii, analizele chimico-tehnologice şi gustative a tutunului s-au efectuat conform metodelor standard acreditate în cadrul laboratorului de încercare a calităţii tutunului şi produselor din tutun SA „TUTUN –CTC".

## Rezultate şi discuţii

Datorită sensibilităţii mari a plantelor de tutun faţă de temperaturile scăzute, a perioadei sale lungi de vegetaţie, a seminţelor mici, tutunul nu se seamănă direct în câmp, dar se produce mai întâi răsadul, care după trecerea pericolului brumelor târzii din primăvară, se plantează în câmp. Pentru grăbirea şi uniformitatea răsăririi plantulelor, seminţele de tutun se supun în prealabil unui proces de încolţire în condiţii controlate de temperatură şi umiditate în dulapuri cu termostat [2,3,10]. În rezultatul cercetărilor efectuate s-a constatat că cultivării NC 5 şi HB 40P se evidenţiază printr-o energie de creştere a seminţelor mai înaltă şi dezvoltarea coltelui e mai uniformă, iar perioada de germinare a seminţelor în condiţii controlate de temperatură şi umiditatea fiind mai timpurie cu 18-34 de ore, comparativ cu martorul - Burley 320. După ce seminţele încolţite de tutun au fost semănate în răsadniţe s-a constatat că apariţia plantulelor la cultivării NC 5 şi HB 40P fiind mai uniformă şi mai timpurie cu 38 - 72 de ore faţă de martor. Cultivarul *Burley 235* manifestă o energie de creştere lentă şi apariţia plantulelor în răsadniţe se tărăgănează cu 2-7 zile în comparaţie cu ceilalţi cultivari. În perioada de dezvoltare a răsadului cultivării Culinec şi Podravec reacţionează mai puternic la fluctuaţiile de temperatură şi iluminare, sunt mai predispuşi la boli şi dăunători. S-a stabilit că perioada de formare a răsadului standard la cultivarii studiați e diferită. Astfel, la cultivarii NC 5 şi HB 40P perioada de formare a răsadului standard constituie 38 zile, Podravec şi Burley 320 constituie 44 de zile, iar la Burley 235 şi Culinec depăşeşte 50 de zile. Printr-un răsad viguros cu un sistem radicular bine dezvoltat disponibil şi pentru plantarea mecanizată s-au evidențiat cultivării NC 5 şi HB 40P, colectarea răsadului fiind executată într-o singură repriză, iar la cultivarii Podravec şi Burley 320 în două reprize, pe când la cultivarii Burley 235 şi Culinec în trei reprize din motivul dezvoltării neuniforme a plantelor, prelungindu-se cu 6 - 8 zile perioada de plantare în câmp în comparație cu martorul.

În prima lună după plantare nu s-au constatat deosebiri esențiale privitor la ritmul de creştere şi dezvoltare între cultivarii studiați. Am putea s-ă menționăm, că după 45-50 de zile de la plantare o creştere mai intensivă a tulpinii s-a observat la cultivarii Culinec şi Podravec, iar cea mai mică fiind la NC 5 şi HB 40P, totodată la aceşti din urmă numărul de frunze fiind cu 2-3 mai mare, dezvoltând şi un sistem radicular cu o pătrundere mai adâncă.

Tabelul1

**Particularitățile agrobiologice a cultivarilor de tutun a varietății *Burley* în condițiile Moldovei**

| | *Burley 320* | *Burley 235* | *Culinec* | *Podravec* | *NC 5* | *HB 40P* |
|---|---|---|---|---|---|---|
| Perioada de vegetație, zile | 137 | 135 | 134 | 139 | 123 | 125 |
| Înalțimea plantelor, cm | 183 | 171 | 183 | 171 | 133 | 138 |
| Frunze recoltate | 24 | 25 | 24 | 27 | 31 | 31 |
| Lungimea limbului, cm | 58 | 48 | 53 | 59 | 67 | 74 |
| Lațimea limbului, cm | 37 | 29 | 36 | 39 | 39 | 38 |
| Plante vătămate, %, inclusiv de | 1,8 | 15,0 | 6,9 | 6,9 | 13,9 | 5,7 |
| boli, % | 1,0 | 13,0 | 4,0 | 4,0 | 4,0 | 1,0 |
| lupoaie, % | 0,0 | 0,0 | 0,0 | 1,0 | 7,0 | 3,0 |
| dăunători, % | 0,8 | 2,0 | 2,9 | 1,9 | 2,9 | 1,7 |
| Masa proaspata recoltată, q/ha | 165,4 | 149,0 | 187,7 | 185,5 | 218,7 | 212,5 |
| Roada de frunze uscate, q/ha | 23,3 | 21,6 | 27,6 | 26,5 | 30,8 | 30,8 |
| Coeficientul la uscare | 7,1 | 6,9 | 6,8 | 7,0 | 7,1 | 6,9 |
| Calitatea 1 comercială, % | 80,1 | 62,3 | 80,2 | 88,1 | 78,7 | 90,7 |

În perioada creşterii şi dezvoltării plantelor în câmp s-a observat că cultivarii studiați, tabelul 1, manifestă o rezistență diferită la boli şi dăunători, cedând cu mult martorului. Astfel, cel mai multe plante vatămate fiind la cultivarii Burley 235 şi NC 5. Începând cu faza butonizării cultivarii NC 5, HB 40P, Culinec şi Podravec au fost atacați de planta parazită Lupoaia (*Orobanche ramosa* L.), cel mai puternic fiind atacat cultivarul NC 5.

Cultivarii NC 5, HB 40P, Culinec şi Podravec necesită efectuarea lucrărilor de cârnire (înlăturarea infloriscenței) şi copilire chimică (înlăturarea copililor) mai precoce, reținerea acestor lucrări se răsfrânge negativ asupra lucrărilor de recoltare, productivității cât şi a calității materiei prime. Cultivarii Culinec şi Podravec comparativ cu alți cultivari necesită efectuarea repetată a copilitului. Recoltarea frunzelor s-a efectuat pe etaje la atingerea maturității tehnice. Cel mai devreme s-au maturizat frunzele de poală la cultivarii Burley 235 şi Podravec, iar cel mai târziu la cultivarii Burley 320 şi Culinec. Printr-o creştere, dezvoltare şi maturizare mai precoce şi uniformă a frunzelor de mijloc şi submijloc s-au evidențiat cultivarii NC 5 şi HB 40P, iar cea mai tardivă înregistrându-se la cultivarii Culinec şi Podravec. Cel mai dificil a fost recoltarea frunzelor de mijloc şi subvârf la Burley 235 şi Culinec, datorită faptului că plantele au avut o creştere şi dezvoltare neuniformă.

Efectuarea lucrărilor de cârnire şi copilire s-a răsfrânt benefic asupra dezvoltării şi maturizării frunzelor. Astfel, la cultivarii NC 5 şi HB 40P recoltarea frunzelor de submijloc, mijloc şi subvârf efectuându-se concomitent, perioada de finalizare a recoltării depline a frunzelor acestor cultivari fiind mai precoce cu 9-16 zile.

Cultivarii studiați se deosebesc după talie, forma limbului foliar, numărul de frunze şi recolta de frunze proaspăte. Cel mai mare număr de frunze recoltate 31 fiind atestată la cultivarii NC 5 şi HB 40P, totodată aceşti cultivari s-au evidențiat şi prin lungimea limbului foliar, depăşind martorul cu 9-16 cm, iar lățimea limbului foliar deosebindu-se nesemnificativ, ceea ce s-a răsfrânt pozitiv asupra productivității şi eficienței lucrărilor de recoltare şi manipulare ulterioară a materiei prime de tutun.

Prin cea mai înaltă recoltă de frunze proaspăte 218,7 q/ha se evidențiază plantele cultivarul NC 5 fiind cu 32% mai înaltă față de martor, iar cea mai diminuată recoltă de frunze proaspete 149,0 q/ha fiind atestată la cultivarul Burley 235.

Pentru uscarea tutunului varietății Burley sunt necesare instalații de uscare naturală cu reglarea temperaturii şi umidității cu ajutorul curenților de aer, ce are un rol esențial la obținerea produsului solicitat, menținerea structurii anatomice a parenhimului cu celule mari, colorației roșcate - cărămizii a limbului foliar, compoziția chimică necesară pentr-o mai bună absorbiție și reținere a sosurilor și aromatizatorilor, care contribuie la înobilarea produselor de tutungerie. În instalațiile de uscare naturală perioada de uscare a frunzelor diferă semificativ în dependență de condițiile climaterice, cultivar și etajul de recoltare. O reducere mai intensivă a umidității frunzelor recoltate în primele zile de uscare s-a constatat la cultivarii NC 5 și HB 40P, de aceea e strict necesar respectarea tehnologiei de uscare prin menținerea umidității aerului în instalațiile de uscare naturală în perioada de dospire, care contribuie la formarea culorii omogene și elasticității țesuturilor foliare.

Valoarea comercială a tutunului e bazată atât pe producția de frunze uscate cât și calitatea acestora [5,7,9]. Cea mai înaltă productivitate de frunze uscate 30,8 q/ha fiind înregistrată la cultivari NC 5 și HB 40P, depășind martorul cu 32,1%. Cultivarul Culinec depășește cu 18,5% martorul după productivitate, calitatea fiind la același nivel, iar cultivarul Podravec - cu 13,7% totodată calitatea comercială fiind cu mult mai inaltă. Datorită faptului că cultivarul NC 5 a fost puternic atacat de *Orobanche ramosa* L. calitatea 1 comercială de frunze uscate s-a diminuat considerabil. Cultivarul Burley 235 a avut cea mai mică roadă de frunze uscate fiind și de o calitate inferioară, ce s-a răsfrânt negativ eficienței economice.

La cultivarul HB 40P datorită optimizării perioadei de creștere a răsadului, dezvoltării omogene a plantelor în câmp, reducerii cheltuielilor la recoltare și prelucrare postrecoltare, productivității și calității înalte a materiei prime eficiența economică e mai ridicată cu circa 49,7% față de Burley 320.

Tabelul 2

**Proprietățile chimico-tehnologice și gustative a materiei prime la cultivarii de tutun a varietății Burley în condițiile Moldovei**

| | *Burley 320* | *Burley 235* | *Culinec* | *Podravec* | *NC 5* | *HB 40P* |
|---|---|---|---|---|---|---|
| Nicotina,% | 1,7 | 1,5 | 1,4 | 1,9 | 1,3 | 1,5 |
| Hidrați de carbon,% | 3,8 | 3,4 | 2,8 | 1,7 | 3,4 | 2.5 |
| Albumine,% | 8,2 | 8,5 | 10,7 | 8,5 | 11,2 | 11,7 |
| Clor,% | 0,17 | 0,14 | 0,31 | 0,16 | 0,12 | 0,20 |
| Nervură, % | 29,9 | 28,7 | 33,0 | 26,4 | 30,1 | 26,2 |
| Groisimea nervurii, mm | 4,2 | 4,0 | 2,9 | 3,2 | 2,6 | 2,8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Tutun-marfă denervurat % | 67 | 63 | 68 | 71 | 67 | 73 |
| Capacitatea de umplere, $cm^3/g$ | 4,0 | 3,9 | 4,1 | 4,1 | 5,0 | 5,3 |
| Porozitatea, % | 77,1 | 72,8 | 81,4 | 82,8 | 75,5 | 78,3 |
| Materilitatea $g/m^2$ | 35,2 | 45,0 | 34,0 | 38,0 | 31,9 | 31,9 |
| Gust, puncte | 15,5 | 15,3 | 17,0 | 17,8 | 17,0 | 17,3 |
| Aroma, puncte | 16,7 | 16,8 | 18,2 | 18,2 | 18,4 | 19,1 |
| Tarie | înaltă | înaltă | medie | înaltă | medie | medie |

Analizând indicii tehnologici tabelul 2, putem menționa că cel mai înalt randament la prepararea tutunului industrializat denervurat a fost la cultivarii HB 40P şi Podravec, iar cel mai diminuat la Burley 235, datorită formei limbului foliar, conținutului ridicat şi grosimea nervurii, gradului de vătămare a frunzelor de boli şi dăunători.

La fabricarea produselor de tutungerie o importanță colosală o are elasticitatea, materialitatea, capacitatea de umplere şi porozitatea tutunului denervurat de care depinde eficiența economică la confecționarea produselor de tutungerie [5,7,8,9]. O capacitate de umplere mai înaltă o manifestă cultivarul HB 40P, iar cultivarii Culinec, Podravec şi Burley 235 deosebindu-se nesemnificativ comparativ cu martorul Burley 320.

Producătorii şi consumatorii produselor de tutungerie apreciază calitatea produsului după aromă, gust, tărie, combustibilitate care sunt influențați de compoziția chimică a materiei prime: conținutul de nicotină, hidrați de carbon, clor, albumine etc. [5,9].

Printr-un conținut înalt de albumină şi diminuat de hidrați de carbon se evidențiază cultivarii HB 40P, NC 5, Culinec şi Podravec. Astfel, materia primă la cultivarii HB 40P şi NC 5 se caracterizează printr-un conținut ridicat de albumină ce se răsfrânge pozitiv la capacitatea de absorbție şi reținere a sosurilor şi aromatizatorilor, atribuind calități specifice ce contribuie la înobilarea produselor de tutungerie. Capacitatea de absorbție şi reținere a sosurilor şi aromatizatorilor fiind la nivelul materiei prime de tutun Burley de import. Cel mai ridicat conținut de nicotină a fost depistată în materia primă a cultivarului Podravec fiind de 1,9%, pe când la cultivarul NC 5 constituie cca 1,3%. Calități fumative înalte posedă materia primă a cultivarului HB 40P care a acumulat cel mai înalt punctaj la degustare, însă prin cel mai bun gust specific de Burley şi tărie s-a evidențiat cultivarul Podravec - cu 17,8 puncte, cel mai diminuat punctaj fiind atestat la cultivarul Burley 235.

## Concluzii

1. Cultivarul HB 40P se evidențiază prin formarea unui răsad calitativ ce permite plantarea lui în termeni optimali, toleranță la vătămare, maturizare uniformă a frunzelor, recoltă înaltă a materiei prime, fiind economic rentabil pentru cultivatorii de tutun..

2. Materia primă de tutun a cultivarului HB 40P posedă proprietăți tehnologice înalte, pierderi reduse la procesare, compoziție chimică, aromă şi gust, capacitatea de absorbție şi reținere a sosurilor şi aromatizatorilor la nivelul materiei prime de tutun Burley de import.

3. Implementarea hibridul HB 40P omologat în Republica Moldova din anul 2008 prin extinderea suprafețelor şi creşterea volumului de producere a materiei prime a acestuia, având un potențial înalt de export şi obținerea unei surse stabile de venit va contribui la dezvoltarea complexului agroalimentar şi rezolvarea problemelor social-economice din spațiul rural.

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# PLANTS OF THE GENUS *ALLIUM* L. AS A SOURCE OF BIOLOGICALLY ACTIVE SUBSTANCES WITH INSECTICIDAL AND ANTIFEEDANT EFFECTS

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**Summary.** *It has been proved that extracts obtained from plants of the genus Allium possess insecticidal and antifeedant properties against potato beetle. However, the character of properties and activity level directly depend on the nature of biologically active substances accumulated by plants. Plants of the genus Allium can be used as a source of biologically active substances and a basis for obtaining means of natural origin for reducing number of L. decemlineata.*

## Introduction

The genus *Allium* L. numbering 750 to 800 species according to different estimates (Vvedensky, 1935, Stearn, 1992) is widespread in Eurasia and America and has been attracting the attention of researchers for a long time owing to presence of various biologically active substances [17, 18]. Representatives of the genus *Allium* are not only used as food but also have found usage in healthcare and are cultivated as garden and ornamental plants.

Species of the genus *Allium* possess a wide range of biological effects, as in addition to sugars, organic acids, vitamins and micronutrient elements, they contain such classes of compounds as alkaloids, saponins, flavonoids, coumarins, steroid glycosides, etc. [4, 9, 13, 14].

Variability of biologically active substances in plants of the genus *Allium* stimulates further researches concerning their extraction, identification and study of properties. Current reorientation of agricultural industry towards obtaining ecologically pure products determines necessity of searching alternative means and methods, as well as development of wasteless, environmentally sound technologies on such a basis. In this respect, usage of natural phytogenic compounds as insecticides has a number of undeniable advantages compared with synthetic compounds. They produce a selective effect; resistance of insects to a complex of compounds is developed in a significantly complicated way; available renewable raw materials and more ecologically acceptable production methods are used for extracting natural compounds.

At present, phytogenic preparations registered and used are made on basis of substances extracted from Dalmatian pyrethrum, neem, quassia, needle of Siberian fir (*Abies sibirica* L.), and essential oil of coriander [1, 5, 6, 8, 11, 12, 15, 16]. Despite of existing researches, production of preparations on basis of phytogenic raw materials for agricultural purposes is based on usage of a limited number of species.

In this respect, the objective of the present research consists in studying insecticidal and antifeedant activity of extracts obtained from three plant species of the genus *Allium* L. for regulating number of *Leptinotarsa decemlineata* Say.

## Materials and methods

Observations listed in the present research have been made using laboratories of 'Chemistry of Biologically Active Substances of Natural Origin' and 'Phytopharmacy and Ecotoxicology' of the Institute of Plant Protection and Ecological Agriculture of the Academy of Sciences of Moldova (IPPEA of ASM).

3 plant species of the genus *Allium*, introduced into the territory of Moldova, served as objects of observations (Table 1).

Gathering of phytogenic raw materials has been made according to methods approved in botanical and biochemical researches. Leaves and stalks were gathered during flowering and beginning of fructification when plants accumulated the largest quantities of biologically active substances. Seeds were gathered as they ripened. Bulbs were collected in autumn when concentrations of biologically active substances were maximal. Phytogenic raw materials were dried off at temperatures of 28-30$^{o}$C till hydroscopic moisture concentrations of 8-12% were reached according to standard methods [10]. Dried phytogenic raw materials were crushed using an electric laboratory mill (Type: MRP-1, asynchronous motor).

Experiments have been made for larvae and imagoes of potato beetle – *Leptinotarsa decemlineata* Say (order *Coleoptera*, family *Chrysomelidae*) owing to the highest degree of harmfulness in conditions of Moldova and fast development of resistance to existing protective means.

96% ethyl alcohol has been used as a solvent for obtaining extracts for laboratory tests, allowing extraction of maximal number of classes of biologically active substances from phytogenic raw materials [4, 10, 11].

For testing insecticidal and antifeedant properties of extracts, insects with a natural population have been used. Contact, intestinal and contact-and-intestinal effects of extracts have been studied. Each variant consisted of nine replications using 5 insects per replication. Young potato leaves of standard size served as a substratum for feeding. In variants with determining intestinal and contact-and-intestinal effects, leaves were processed by immerging into an extract and then holding in an exhaust box for 1 hour till complete solvent dissolution. After all, they were placed into double dishes with insects. In variants with determining contact and contact-and-intestinal effects on dorsal area of insects, an extract was applied topically. Concentration of dry solids in extracts was 2.5%. Variants with processing leaves using 12.0% alcohol solution served as the reference. Insecticidal activity was determined using number of dead insects for three days in comparison with the reference according to standard formula [3, 11]. Antifeedant activity of extracts was estimated three days after beginning of each experiment according to standard scale using points (Table 1) [2, 7].

Table 1

**Scale of antifeedant activity**

| *Browsing of leaf surface, %* | *Level of antifeedant activity* | *Points* |
|---|---|---|
| 0 to 5% | very high | 1 |
| 6 to 25% | high | 2 |
| 26 to 50% | moderate | 3 |
| 51 to 75% | low | 4 |
| 76 to 100% | very low (zero) | 5 |

Mathematical treatment of obtained data has been made according to the method of one-factor dispersion analysis using computer-aided methods of data processing: Microsoft Excel package [3].

## Results and discussions

Materials for obtaining extracts include aboveground parts, bulbs and seeds of the following species: *Allium subhirsutum* L., *Allium narcissiflorum* Vill. and *Allium odorum* L.

As a result of laboratory testing, it has been revealed that extracts of *A. subhirsutum* (leaves, stalks) and *A. odorum* (bulbs) are the most effective against imagoes of potato beetle. It has been established that the character of effects of these extracts on insects is intestinal. Other extracts show zero insecticidal activity (Table 2). It should be noted that observed insecticidal activity of above extracts from 13.3 to 20.0% is also very low and insufficient for reducing numerosity of this wrecker to an economically insignificant level.

At the same time, it has been revealed that imagoes of potato beetle are more vulnerable to effects of extracts in comparison with imagoes (Table 2). Thus, the extract from bulbs of *A. narcissiflorum* caused destruction of 26.6% of larvae, and the extract from leaves and stalks of the same species – 46.6% of larvae. It has been revealed that extracts from seeds of

*A. subhirsutum*, bulbs of *A. narcissiflorum* and *A. odorum* do not produce contact effects on larvae of potato beetle. At the same time, the largest insecticidal activity is shown by extracts from leaves and stalks of *A. subhirsutum* and *A. narcissiflorum* – 80.0 and 46.6% respectively. These extracts produce both contact and intestinal effects on larvae of potato beetle.

Table 2

**Insecticidal activity of extracts from species of the genus *Allium* L.**

| *Plant species* | *Plant organs used for extracting* | *Insecticidal activity against L. decemlineata Say, %* | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Larvae of age II-III* | | | *Imagoes* | | |
| *Family ALLIACEAE J. Agardh.* | | *Contact effect* | *Intestinal effect* | *Contact-and-intestinal effect* | *Contact effect* | *Intestinal effect* | *Contact-and-intestinal effect* |
| *Allium subhirsutum* L. | Leaves, stalks | 33.3 | 60.0 | 80.0 | 0 | 20.0 | 20.0 |
| *Allium subhirsutum* L. | Seeds | 0 | 13.3 | 13.3 | 0 | 0 | 0 |
| *Allium narcissiflorum* Vill. | Leaves, stalks | 13.3 | 30.0 | 46.6 | 0 | 0 | 0 |
| *Allium narcissiflorum* Vill. | Bulbs | 0 | 26.6 | 26.6 | 0 | 0 | 0 |
| *Allium odorum* L. | Bulbs | 0 | 40.0 | 40,.0 | 0 | 7.0 | 7.0 |

It is known that aboveground parts of *A. subhirsutum* and *A. narcissiflorum* contain steroid glycosides (0.2-0.3%), and aboveground parts of *A. narcissiflorum* contain saponins, phenols and coumarins as well [9, 14]. In addition to steroid saponins and glycosides, a plant of *A. odorum* also accumulates 0.1 to 0.3% of alkaloids [17, 18]. It is most likely that presence of these compounds in extracts explains higher insecticidal activity against larvae of *L. decemlineata*.

Thus, it has been established that the extract obtained from seeds of *A. subhirsutum* shows the lowest level of insecticidal activity: 13.3% – against larvae and zero level – against imagoes, and the extract obtained from leaves and stalks of the same species – the highest level (20.0 and 80.0% respectively).

It has been established that neither of studied extracts shows antifeedant properties against imagoes of potato beetle, as browsing of leaf surface exceeds 75% (Table 3).

Table 3

**Antifeedant activity of extracts from plant species of the genus *Allium* L.**

| *Family* | *Plant species* | *Plant organs used for extracting* | *Antifeedant activity against L. decemlineata Say, points* | |
|---|---|---|---|---|
| | | | *Larvae of age II-III* | *Imagoes* |
| ALLIACEAE J. Agardh. | *Allium subhirsutum* L. | Leaves, stalks | 2 | 4 |
| | *Allium subhirsutum* L. | Seeds | 4 | 5 |
| | *Allium narcissiflorum* Vill. | Leaves, stalks | 2 | 5 |
| | *Allium narcissiflorum* Vill. | Bulbs | 3 | 5 |
| | *Allium odorum* L. | Bulbs | 3 | 4 |

The lowest antifeedant properties against larvae of potato beetle are shown by the extract from seeds of *A. subhirsutum* (browsing of leaf surface exceeds 50%). Medium level of antifeedant activity (3 points) is shown by extracts from bulbs of *A. narcissiflorum* and *A. odorum*.

At the same time, it has been established that the highest antifeedant properties (2 points) against larvae of potato beetle are shown by extracts from leaves and stalks of *A. subhirsutum* and *A. narcissiflorum*. This could be explained by the fact that in addition to essential oil and glycosides, aboveground parts of these species also contain alkaloids and saponins responsible for bitter taste, reducing food attractiveness of potato leaves treated using extracts.

## Conclusions

On basis of laboratory testing, it has been proved that extracts obtained from plants of the genus *Allium* possess insecticidal and antifeedant properties against imagoes and larvae of potato beetle. However, the character of properties and activity level directly depend on the nature of biologically active substances accumulated by plants. Taking into account obtained data, we may conclude that plants of the genus *Allium* can be used as a source of biologically active substances and a basis for obtaining means of natural origin for reducing number of *L. decemlineata***.**

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## THE APPLICATION OF ECOLOGICAL PLANT PROTECTION PRODUCT IN A SUSTAINABLE AGRICULTURE

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**Summary.** *Advancement of strategies of ecological agriculture it is lost in thought without application of biological preparations occupy a separate place among the other biological means for plant protection. The article contains experimental data of biological pest H. cunea development, biological plant protection and, control measures of pests are recommended. This paper reviews the recen applications t of biological preparation Virin ABB-3 -for elimination of H. cunea in laboratory and field conditions. The preparation is based on viruses of nuclear polyhedrosesis and granulose with cumulative and synergetic action. Presently the investigation are being carried out the elaboration of other virus insecticide for control in the systems of integrated plant protection of different agricultural, ornamental and forest crops.*

### Introduction

The prominent problems facing the world today involve frequent natural disaster excessive use of resources, environmental pollution, etc., which severely restrict sustainable development of human society. Governments and scientific communities around the world have made great effort to deal with these issues. More and more countries have being carrying out research and application of plant biotechnology (Runge and Ryan, 2004). Moldavian government attaches great importance to the field of agricultural biotechnology.

A sustainable agriculture to promote new, no polluted technologies protecting different agricultural, ornamental and forest plant, using new ecological plant protection products, which must have a reduced impact on human health and environment.

A series of problems in the field of plants protection and the growing of ecological products can be solved using three big biological agents: insects, microorganisms (viruses) and bioactive substances (Cross J., Dickler E., 1994; Voloshchyuk L., 2003; 2008).

Recognition of the necessity for application the entomopathogenic viruses and baculoviral preparations elaborated on their basis is determined by the qualitative originality of the pathogenic agents, among which their specificity and epizootic character constitute the main advantages compared with the chemical insecticides. Manifestations of the purpose of rational utilization of these efficient levers it is necessary a profound knowledge of the mechanisms and conformity to natural laws which determine the regulation of the pest insects populations under the action of the baculoviruses (Tanada J. Kaya H., 1993).

## Materials and methods

The researches have been realised on the caterpillars of 2-3 ages of the Hyphantria cunea Drury. In the study, we used the Nuclear Polyedrosis Virus (VPN), selected and indentified in the laboratory of the insects' viruses.

For the contamination of the laboratory insects, we used the dosed feeding, which contains respectively 10 polyhedrons for each caterpillar. The monitoring of the insects population and the estimation of the dead caterpillars has been carried out daily, beginning from the 3 rd day of the contamination.

The effectiveness of the virus action was established according to the Abbot formula, which provides the insects ' natural death:

$$E\ ab = \frac{Me-Mo}{100-Mc} * 100$$

Where Eab- – is the death rate, %; Mo – the number of dead specimens in the experiment; Mc- - the number of dead specimens in the control, $J_o$ - the number of alive specimens in the experiment.

The caterpillars H. cunea were kept under laboratory conditions at 27˚C.

With the of the population density of fall webworm moth stabilization as well as determination of attack frequency and clarifying of some aspect of its biology, during 2004 – 2011 years was carried out investigation in conformity with the accepted methodology. Experiments were accomplished in several orchards of the Republic of Moldova. Observations were held both on the pest adults flying, and on development of other phases of the ontogenesis: eggs, larvae, pupas. As a unit of accounting by 100 of rosettes with leaves. Deporting from these consideration in each orchards were marked by 5 model trees, the last ones were distributed diagonally in the plots. To determine the beginning of pest activity registrations were carried out by utilization of trap-belts, which were attacked round the lower part of trunk of 10 trees dining the previous season.

Laboratory investigation of the sampled material attacked by these species of insects under experiments were carried out, in correspondence with the norms in power, in order to establish frequency, intensity, and attack degree of them. To establish the influence of trophic factor on the insect development, larvae (from the same sites), were reared on a number of 12 species of host-plants (ornamental, forest and fruit trees): mulberry, maple, willow, poplar, lime, apple-tree, walnut, pear-tree, apricot tree, plum, cherry-tree. Under natural conditions observations were made on adults appearance, duration of them flying, copulation. For some special observation cultures isolations of nest with larvae on portions of isolated brunches in gauze cuffs (in sacking). All data were interpreted in relation with the main climatic factors. Control experiments with the microbiological preparations were conducted under natural conditions (by 2 – 3 trees in each variant), and under laboratory conditions as well, using special rearing boxes, crystallizers (for larvae of different age of development) of both generations. Observations on larvae mortality were accomplished after 12, 14, 48, and 72 hours, in case biological preparations and after 5 days.

The mathematical treatment was registered on the 15$^{th}$ day after contamination (Dospekhov, 1985), the statistical treatment was made according to Gar K.A. (1963).

## Results and discussions

Presently it is recommended ecological preparation Virin-ABB-3 for combating fall webworm under laboratory and field conditions. On base of investigations carried out a preparative form of preparation was elaborated. The preparation contains viruses of Baculoviradae family and contains a blend of isolated native baculoviruses and indenficated in the sick larvae of the best. Under conditions of aggravation of the ecological crises Virin-ABB-3 represents a perspective preparation for application in plant –protection.

The experiments with the preparation Virin-ABB-3 on the contaminated caterpillars(larvae) of Hyphantria cunea Drury on different plants became an acute necessity for the determination of the percentage of the mortality of specimens with the same concentration and the same number as well as the biological effectiveness.The results of the experiments are presented in the Table 1.

Table 1

**The infection population of Hyphantria cunea Drury Virin-ABB-3 of different plants**

| *Plants* | *No. of caterpillars* | *Solution Conc.* | *No. of the death caterpillars* | | | | | *The percentage of the mortality* | | | *Biologic Efficacy to the Abbot , on the 15 days, %* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *3* | *5* | *7* | *10* | *15* | *on the 5th day* | *on the 10th* | *on the 15th день* | |
| Mulberry | 40 | $10^6$ | 0 | 12 | 19 | 34 | 39 | 30,0 | 85,0 | 97,5 | 97,3 |
| Maple ash | 40 | $10^6$ | 0 | 8 | 16 | 29 | 38 | 20,0 | 72,0 | 95,5 | 95,2 |
| Walnut | 40 | $10^6$ | 0 | 6 | 9 | 28 | 38 | 15,0 | 70,0 | 85,0 | 84,2 |
| Cherry tree | 40 | $10^6$ | 0 | 5 | 10 | 27 | 32 | 12,0 | 65,0 | 80,0 | 78,9 |
| Acacia | 40 | $10^6$ | 0 | 2 | 5 | 16 | 30 | 5,0 | 40,0 | 75,0 | 73,8 |
| Control | 40 | $10^6$ | 0 | 0 | 2 | 4 | 4 | 0 | 5,0 | 5,0 | - |

According to the table, on the $5^{th}$ day, the death rate of caterpillars of H.cunea Drury on different plants are modified on the average of 2%, on the $10^{th}$ days on the average of 7%, on the $15^{th}$ day on the average of 3,5%.

The highest mortality rate of the caterpillars has the mulberry – 97,5%, the lowest mortality rate has acacia – 75,0 %. The biological effectiveness according to Abbott on the $15^{th}$ day represented 73,8%. The mortality rate in the control on the $10^{th}$ – $15^{th}$ day was 5%.

During the 2004 – 2011 years the fall webworm moth is on an average level of population development. The winter conditions of 2004 – 2011 years had an impact rather strong on the hibernating phase. The first generation going out of diapauses, under the sudden rising of temperature, has given rise of a big number of flies with a numerous egg-slayings.

Table 2

**The infection population of H.cunea with new baculovirus in 2011(I-generation). Natural foods-bouquets of mulberry**

| *The options* | *Repetition* | *No. of larvae* | *Age larvae* | *Solution ml* | *The mortality of day* | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | *7* | | *15* | |
| | | | | | *No. of larvae* | *%* | *No. of larvae* | *%* |
| VG 2011 | I | 50 | II-III | $10^5$ | 24 | 48.0 | 39 | 78.0 |
| VG 2011 | II | 50 | II-III | $10^5$ | 25 | 50.0 | 41 | 82.0 |
| VPN 2011 | I | 50 | II-III | $10^5$ | 26 | 52.0 | 37 | 74.0 |
| VPN2011 | II | 50 | II-III | $10^5$ | 27 | 54.0 | 40 | 80.0 |
| VPN±VG (1:1) | I | 50 | II-III | $10^5$ | 28 | 56.0 | 46 | 92.0 |
| VPN±VG (1:1 | II | 50 | II-III | $10^5$ | 28 | 56.0 | 44 | 88.0 |
| CONTROL | I | 50 | II-III | $10^5$ | 0 | - | 1 | 4.0 |
| CONTROL | II | 50 | II-III | $10^5$ | 0 | - | 2 | 6.6 |

As to the mortality of the caterpillars on the VG 2011 has – 78-82%, VPN has 74-80%. But in the options were used both viruses VG and VPN (1:1), the increased mortality from 88% to 92%. Being analyzed the biological effectiveness of the baculoviruses was 75-90%. Baculoviviruses was used to prepare preparation Virin ABB-3.

Prognostication of the fall webworm moth development on the territory of the Republic of Moldova. On the base of the research data we have builded a phonological calendar for the fall webworm moth development on the territory of the Republic of Moldova (Table 3).

However for timely depistation and hearth of the fall webworm moth liquidation, and its further settling presentations it is necessary to know development terms of the pest. For this aim the phonological calendars for the fall webworm moth allows solving and other ecological problems, such as prognoses of conjugation for pests, precise determination of treatment terms, generation number counting in the given region. In the species number dynamics, considered in the whole condition range of its existence that is a highly multifactor process, then the medium factor number, which essentially influencing on concrete population number of the species, it is always considerably fewer. It takes place because, non possessing ability to be adapted simultaneously to a large number of factors, the population is forced to organize its vital activity in order to avoid contact with the majority of limiting impacts and to depend on minimum of them number.

So, the main factor influencing development of the fall webworm moth is temperature, and in connection with the fact that the most efficient treatments carried out against younger larvae ages of the fall webworm moth we have drawnupa phonological calendar for the territory of the Republic of Moldova (Table 4). In order to tran up the calendar a method of Sergeeva G.E & Levina U.C. (1973) was used.

Table 3

**The phenological calendar for the fall webworm moth H.cunea development in the Republic of Moldova**

| *MAY* | | | *JUNE* | | | *JULY* | | | *AUGUST* | | | *SEPTEMBER* | | | *OCTOBER* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| A | A | A | | | | | | | | | | | | | | | |
| | | E | E | | | | | | | | | | | | | | |
| | | | L | L | L | L | | | | | | | | | | | |
| | | | | | | P | P | | | | | | | | | | |
| | | | | | | | A | A | | | | | | | | | |
| | | | | | | | | E | E | | | | | | | | |
| | | | | | | | | L | L | L | L | | | | | | |
| | | | | | | | | | | | P | P | | | | | |
| | | | | | | | | | | | | A | A | | | | |
| | | | | | | | | | | | | | E | E | | | |
| | | | | | | | | | | | | | L | L | L | L | |
| | | | | | | | | | | | | | | | P | P | |

*A-adults, L-larvae., E-eggs, P-pupa

The calendar is utilized in such way. Let suppose that the beginning of egg deposition by fall webworm moth in Moldova falls on 15th of May, and the average air temperature in ay of current year is higher than of many years norm by 1 degree. Then at line crossing of the first column of 15th of May and of column + Degree we find the date of first generation larvae appearance in the 26th of May. At an average deviation of air temperature for the same period of time by 1 degree, then the beginning of larvae emergence of fall webworm moth will take place on 30th of May. Normally the larvae are not emerged simultaneously from the all layed eggs. The emergency process is hasted during 1-1.5 week. Plant protection against FWM larvae is the most efficient then, when the are at the younger ages. That is why the treatments should be carried out when the larvae emergency from all deposition is fibished. During this period a small part of larvae are at the third, the largest part at the second, and a part at the first stage. Being utilized the presented calendar, it is possible to predict beforehand the terms for beginning protection treatments, that allows not only in good

Table 4

**Phenoprognostic calendar began hatching caterpillars of the *H.cunea* and recommended date of commencement of protective treatments depending on the actual dates of ovipozition and temperature conditions**

| *The actual of the laying begining* | *The actual deviation of the average air temperature for a part of the prognosticated period from the many years norm, °C* | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *0* | *The terms for carring treatments* | *+1* | *The terms for carring treatments* | *+2* | *The terms for carring treatments* | *+3* | *The terms for carring treatments* | *-1* | *The terms for carring treatments* | *-2* | *The terms for carring treatments* | *-3* | *The terms for carring treatments* |
| 1.05 | 19 | 29 | 16 | 26 | 14 | 24 | 12 | 22 | 21 | 1.06 | 25 | 5.06 | 30 | 10.06 |
| 3.05 | 20 | 30 | 17 | 27 | 16 | 26 | 14 | 24 | 23 | 3.06 | 26 | 6.06 | 30 | 10.06 |
| 5.05 | 21 | 1.06 | 18 | 30 | 17 | 31 | 16 | 26 | 24 | 4.06 | 27 | 7.06 | 31 | 11.06 |
| 8.05 | 23 | 3.06 | 21 | 1.06 | 19 | 1.06 | 18 | 30 | 25 | 5.06 | 29 | 9.06 | 1.06 | 12.06 |
| 10.05 | 24 | 4.06 | 22 | 2.06 | 21 | 1.06 | 20 | 31 | 26 | 6.06 | 30 | 10.06 | 2.06 | 13.06 |
| 13.05 | 26 | 6.06 | 24 | 4.06 | 23 | 3.06 | 23 | 3.06 | 28 | 8.06 | 31 | 11.06 | 4.06 | 15.06 |
| 15.05 | 27 | 7.06 | 26 | 6.06 | 25 | 5.06 | 25 | 5.06 | 30 | 10.06 | 1.06 | 12.06 | 5.06 | 16.06 |
| 10.07 | 20 | 27 | 19 | 26 | 19 | 26 | 18 | 25 | 20 | 27 | 20 | 27 | 21 | 28 |
| 13.07 | 22 | 29 | 22 | 29 | 22 | 29 | 21 | 28 | 23 | 30 | 23 | 30 | 24 | 31 |
| 15.07 | 24 | 31 | 24 | 31 | 24 | 31 | 23 | 30 | 25 | 20 | 25 | 20 | 26 | 2.08 |
| 18.07 | 27 | 3.08 | 27 | 3.08 | 27 | 3.08 | 26 | 2.08 | 28 | 4.08 | 28 | 4.08 | 29 | 5.08 |
| 20.07 | 29 | 5.08 | 29 | 5.08 | 29 | 5.08 | 28 | 4.08 | 30 | 5.08 | 30 | 5.08 | 31 | 6.08 |
| 23.07 | 1.08 | 7.08 | 1.08 | 7.08 | 1.08 | 7.08 | 31 | 6.08 | 208 | 9.08 | 2.08 | 9.08 | 3.08 | 10.08 |
| 25.07 | 3.08 | 10.08 | 3.08 | 10.08 | 3.08 | 10.08 | 2.08 | 9.08 | 4.08 | 10.08 | 4.08 | 10.08 | 5.08 | 11.08 |
| 28.07 | 6.08 | 12.08 | 6.08 | 12.08 | 6.08 | 12.08 | 5.08 | 11.08 | 7.08 | 13.08 | 7.08 | 13.08 | 8.08 | 14.08 |
| 30.07 | 8.08 | 14.08 | 8.08 | 14.08 | 8.08 | 14.08 | 7.08 | 13.08 | 9.08 | 15.08 | 9.08 | 15.08 | 10.08 | 16.08 |

time to prepare the necessary facilities and stock but also to prepare the local human population. By the some terms it is possible to begin cutting out the spider nests, in the tree crown. Carrying out of this work earlier of this term can lead to the case that a part of nests which will late weave the immerged larvae will be not observed and the nests will not be destroyed. In consequence, the phonological calendar offers the possibility precisely and the most advantageously to utilize the protect means against the fall webworm moth, and to carry out the mechanical combating by nest cutting out before the elder age larvae are settled.

## Conclusions

The comparison of viral pathogens with conventional chemical pesticides is usually solely from the perspective of their efficacy and cost. In additional to efficacy, the advantages of use of microbial control agents are numerous. These include safety for humans and other non-target organisms, reduction of pesticide residues in food, preservation of other natural enemies, and increased biodiversity in managed ecosystems

During the years 2004 – 2011 the fall webworm moth (Hyphantria cunea Drury L) is on  average level of population development. Climate conditions in the April –June period have stopped appearance and evolution especially of fall webworm. It is to mention the fact that the frosts, high temperature (35 - 40°C) have seriously influenced its population. In America, Europe and in our country the fall webworm has only two generation, and only in exceptional cases a partial third generation. From the presentation of the material it is turned out that the sum of the effective temperatures represents great variation from one year to another and this point of view can not be taken as a single criterion for the prognosis of the first butterflies' appearance in spring. Nevertheless they can be taken into consideration, but only as on orientate mode and in correlation eith other factors of the environment as follows: humidity, sudden changes of temperature, spring frosts, insolation etc. The phenological calendars for the fall webworm moth allows solving and other ecological problems, such as prognoses of conjugation for pests, precise determination of treatment terms, generation number counting in the given region.

In order to reduce the population of fall webworm it is recommended utilization of the ecologically inoffensive preparation Virin-ABB-3, which is an efficient preparation for combating this pest in agricultural, ornamental and forest biocenosis.

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# ÎNTRODUCEREA SPECIILOR DE PLANTE DIN FLORA TROPICALĂ ŞI SUBTROPICALÂ A ORD. ASPARAGALES ÎN GRĂDINA BOTANICĂ (INSTITUT) AŞM, MOLDOVA

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**Summary.** The present work reflects some observations on growth and development of tropical and subtropical plants in the Botanical Garden from Moldova. The study presents the range of plats - 48 species and 25 types of garden trees and shrubs - that were adapted to greenhouse conditions and subsequently tested in various social and cultural venues. It is noted that the plants of the families mentioned above are characterized both by decorative aspect, disease resistance and simplicity vegetative propagation.

## Introducere

Introducerea planificată a plantelor tropicale şi subtropicale în Grădina Botanică a AŞ a R.Moldova – a început 36 de ani în urmă. Seminţele, sporii şi bulbii – se solicitau prin delectus din Grădinile Botanice şi Parcurile Naţionale din diferite ţări cu preponderenţă din lagărul socialist. Plantele vii, sub formă de butaşi, plantule şi rădăcini se aduceau din expediţiile întreprinse în Grădinile Botanice din ex Uniunea Sovietică – Moscova, Kiev, Odesa, Lvov, ulterior din Grădinile Botanice din Romania-Bucureşti, Iaşi, Cluj.

## Materiale şi metode

Ca material de studiu a servit colecţia de plante tropicale şi subtropicale (1) a Grădinii Botanice a AŞM amplasată în secţiile respective. Observaţiile fenologice asupra creşterii şi dezvoltării plantelor au fost efectuate conform „*Metodicii cercetărilor fenologice în grădinile botanice*” 1975.

## Rezultate şi discuţii

În oranjereia de fond a Grădinii Botanice, ordinul Asparagales este reprezentat prin 6 familii şi 12 genuri conform clasificării lui Tahtadjean, 1987.

*Convalariaceae* Horan.-*Aspidistra* Ker-Gawl., *Liriope* Ker – Gawl., *Ophiopogon* Ker- Gawl

*Ruscaceae* Hutch.. – *Ruscus* L.

*Asparagaceae* Juss. – *Asparagus* L.

*Dracenaceae* Salisb. – *Dracaena* Vand ex L., *Sanseviera* Thunb.,

*Asteliaceae* Dum. – *Cordyline* Com ex Juss.

*Nolinaceae* Nakai – *Nolina* Michx., *Dazilirion* Zucc.

În total 48 de specii şi 25 forme de grădina (arbori, arbuşti şi semiarbuşti) adaptate la condiţiile de seră şi ulterior testate în diverse localuri de menire social-culturală. Plantele din familiile sus-numite se caracterizează atât prin decorativitate, rezistenţă la boli şi daunători, cât şi prin simplitatea inmulţirii vegetative. În contextul studierii diferitor grupuri de plante pentru asanarea localurilor şcolare şi preşcolare s-a constatat capacitatea universală de percepere a luminii (de la 50 la 2600 lk.). De un diapazon considerabil se bucură plantele din gen. *Ruscus* (500-2500 lk.) şi *Dracaena* (700-3000lk.). Cele mai rezistente plante la iluminare slabă se dovedesc a fi *Aspidistra* şi *Liriope*, plante cu areal natural pe stânci umbroase şi poale de munţi.

Printre reprezentanţii colecţiei date se află şase specii endemice de *Aspidistra elatior* Blume, *Ophiopogon jaburan* Lodd., *Dasylirion longissimum* Lem., *D.matapensis* Wiggins., *Dracaena draco* L. Speciile respective reprezintă flora diversă a Americii de Nord, Sud-Vestul Asiei, Australiei, şi diverselor regiuni ale Africii, la fel şi flora insulară (insulele: Madagascar, Canare, Madeira, Sri Lanca). Speciile africane-*Asparagus asparagoides* (L.) Wight., *A.setaceus* (Kunth) Jessop., *Sansevieria trifasciata* Prain. *şi Liriope spicata* Lour originara din Vestul Asiei posedă în cadrul arealului de răspândire un spectru vast de răspindire de la savane până la pădurile umede, de la maluri de râuri până la povârnişuri de munte. Diverse nişe ecologice în diverse tipuri de păduri ocupă *Asparagus scandens var. deflexus* Bac., *Cordyline terminalis*(L). Kunt., *Ophiopogon jaburan, Ophiopogon japonicus* Ker-Gawl., *Dracaena hookeriana* C.Koch., *Sansevieria cilindrica* Boj., *Nolina longifolia* Hemsley, *Ruscus aculeatus* L., *Ruscus ponticus* G.Woron.

Amploarea întregului fond genetic a ordinului *Asparagales* este prezentat în tabelul 1 de mai jos:

Tabelul 1

**Componența taxonomică a colecției de plante din ord. *Asparagales* şi indicatorii de introducție**

| *Familia* | *Genul* | *Numarul* | | | | | *Metode de inmultire* | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *Specii, subspecii, forme endemice* | *Cultivar, forma de gradina* | *Total* | *Cu perioade de repaos* | *Reusit introduse* | *Seminte* | *Vege-tativ* | *Ambele* |
| Asparagaceae | *AsparagusL.* | 9 | 1 | 10 | 5 | 9 | 5 | 8 | 5 |
| Asteliaceae | *Cordyline* | 2 | 5 | 7 | 1 | 1 | - | 1 | - |
| Convallariaceae | *Aspidistra* | 2 | - | 2 | 1 | 2 | - | 2 | - |
| | *Lirioper.* | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 |
| | *Ophiopogon l.* | 4 | 1 | 5 | 5 | 5 | 3 | 5 | 3 |
| Dracaenaceae | *Dracaena .* | 10 | 15 | 25 | 23 | 21 | 2 | 20 | 1 |
| | *Sanservieria .* | 10 | 4 | 14 | 2 | 7 | 1 | 8 | 1 |
| Nolinaceae | *Dasylirion .* | 1 | - | 1 | 1 | - | - | - | - |
| | *Nolina .* | 3 | - | 3 | - | - | - | - | - |
| Ruscaceae . | *Ruscus* | 3 | - | 3 | - | 3 | - | 3 | - |
| Total | | **48** | **26** | **74** | **40** | **51** | **13** | **50** | **12** |

În afara terenului închis au fost testate şi folosite pe larg la crearea Grădinilor de iarnă toate genurile *fam.Convalariaceae, Ruscaceae*, majoritatea reprezentanților genurilor *Asparagus şi Dracaena* preponderent din Africa şi Asia

## Concluzii

Rezultatele observațiilor fenologice la speciile din ord. *Asparagales*, testarea lor în afara serelor, ne permit folosirea lor pe larg la crearea Grădinilor de iarna, localurilor slab iluminate.

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# SOME ASPECTS OF INTRODUCING SPECIES OF *AGAVE* L. IN THE BOTANICAL GARDEN (INSTITUTE) OF ASM

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**Summary.** *Nowadays, the plant collection from Agave genus includes 300 taxons. The genus is represented by 35 taxons in Botanical Garden (I) of the Academy of Science of Moldova, among which 4 are blossoming and 3 are fructifying: A. ferdinandi-regis, A. victoriae-reginae, A. Schotti.*

## Introduction

Genus *Agave* (fam. *Agavaceae* Endl.) is a group of plants from *Liliopsida* classis (Tahtadjean, 1987) which includes about 300 taxa (Udalova, 1982), originating from the arid regions of Mexico, but spreaded over the islands of Caribbean Sea, Central America and southern part of USA. The name comes from Greek "agauos", which also translates as "surprising". In Europe *Agave species* were brought in the second part of XVI century, firstly in Spain, then it was Italy and France. In countries with hot climates they are grown in open air and in the continental climates indoors, as well as room plants, and during the warm season in open fields. In countries where agave are grown, they have very important significance as textile plants. It is well known *Agave sisalana* Perr. due to its durable fiber called "sizal" or "pita" from which is produced: ropes, cordage, fishing nets and "lasso". This species is grown mainly on islands of Bahamas, in western India, Brazil and Tanzania (third part of world production). Plantations of this plant are exploited about 12-15 years, each year using 7-9 leaves from each plant.

The second important taxa is *Agave cantala* Roxb., which is cultivated extensively on Jawa islands, islands of Philippines and in the western part of India. From the leaves of *A. fourcroydes* Lem. are extracted fibers "henechen" or "Sisal Yucatan". On these plantations each plant is used about 18 years. Main center of manufacturing (production) – Mexico, Cuba, the Yucatan peninsula. The fibers are used to produce white paper, ropes, fabrics for corrugated package.

It is known also that fibers called "Espadin" extracted from the leaves of A. *falcata* Engelm and fibers called "Keng" produced from leaves of *A.rigida* Mill.

Agave as are succulents, without a stem, with the rhizomes and leaves entire, fleshy, with thorns on the edges, finished tips with a long spin, greenish, grayed, green or blue plume, very rigid, arranged in rosettes. In nature these plants reach the generative stage at the age of 8 to 10 years. Infundibuliforme flowers are gathered in panicle to a rod upto 10-15 m high with circa 10000 flowers. Most species of agave are monocarpic plants, after flowering and fruit ripening plants die, but produce more rhizomes, thus forming roots and plant regenerating.

## Materials and methods

As study material have served the 35 taxon of the genus *Agave*, starting with species small "waist" up to 30-40 cm diameter, closing to 1,5 m, of the succulent plants belonging to the collection of BG (I) of ASM created over a period of circa 40 years (Dvoreaninova, Şestac, 1984). Featers of development have been elucidated according "phenological research methodology in botanical gardens," 1972. Seed production was measured by Vainaghii's Recommendations (1990) and «Metodicheskie ukazania po semenovedeniju introdutsentov (1980)». Multiplication is accomplished through vegetative (suckers) and by seeds from the 3 species, which fructifies. Critical processing of collection was performed by H. Jacobsen, 1970. The systematic phonological observations of the *Agave* species are carried out in the collection.

## Results and discussions

Creating within the BG (I) of the ASM a collection of plants of fam. *Agavaceae* (gen. *Agave*) started dating from the early 70s of XX century (*A. albicans*, *A. americana*, *A. americana cv.* "*Marginata*", *A. potatorum*, *A. sartori* etc.). A major part of species have been brought as seedlings, suckers from the Botanical Garden of the Institute of Botany from Saint-Petersburg, Russian Federation; BG of Odessa's University, the Ukraine; BG "Nikita" in Yalta, the Ukraine; Central BG of Moscow, Russian Academy of Sciences. The seeds of *A. kerchovei* Lem., were received by delectus from BG of University of Craiova (Romania) in a 2004, in 2009 from BG from Amsterdam's University, *Agava colorata* Gentry BG of Monaco (2009) and Netherlands (2010). Taxonomic composition, vegetative propagation ability, origin and provenience of taxons of the *Agave* genus is presented in *Table 1*.

Capacity for vegetative propagation was judged by five-point system: species which on greenhouse conditions are not forming suckers were assessed by 0; the others depending on the number of formed suckers with the appropriate number of points, up to 5 suckers and more from each mother plant by 5 points.Out of those 35 taxa of *Agave*, generative phase by greenhouse conditions of the BG (I) of ASM achieves 4 species (11,43%), and seeds form 3 taxa (8,57%).

Table 1

***Taxonomic composition, vegetative propagation ability, origin and provenance of plants collection of the genus Agave***

| *Nr.* | *Name of species* | *Plant diameter in green-house condition* | *Vegetative propagation ability (points)* | *Origin* | *Provenance* |
|---|---|---|---|---|---|
| 1. | *A. albicans* Jacobs | 80 cm | 2 | Mexico | 1983, B.G., Yalta,the Ukraine |
| 2. | *A. americana* L. | 1,5 m | 5 | Mexico | Old collection |
| 3. | *A. americana var. marginata* Hort | 1-1,5 m | 4 | _ | Old collection |
| 4. | *A. americana var. medio- picta* Trel. | 80 cm | 3 | _ | 1972, B.G. I.B., St.-Petersburg, RF |
| 5. | *A. americana* L.*v. pallida* Bgr. | 10 cm | 0 | _ | 2010, B.G. "Fomina", |
| 6. | *A. angustifolia* Haw.var. *marginata* Trel. | 1,5-1,7 m | 4 | _ | 1983, Germany |
| 7. | *A. attenuate* SD *var. serrulata* Ter. | 40-70 cm | 5 | _ | 1979, B.G., I.B., St.-Petersb., RF |
| 8. | *A. bracteosa* S. Wats. | 80 cm | 5 | NO-Mexico | 1985, C.B.G, Moscow, RF |
| 9. | *A. colorata* Gentry | 10 cm | 0 | Mexico | 2009, B.G. Monaco |
| 10. | *A. ferdinandi-regis* Bgr. | 30-70 cm | 4 | Mexico | 1983, seeds. Germany |
| 11. | *A. ferox* C.Koch | 1-2,0 m | 4 | Mexico | 1985, C.B.G, Moscova, RF; 1988 G.B. Yalta, |
| 12. | *A. filifera* Salm. | 60 cm | 1 | Mexico | 1976, B.G. from Univ. Odessa, the Ukraine |
| 13. | *A. filifera* Salm.*cv.flamentosa* | 50-60 cm | 1 | _ | 1979, B.G., I.B., St.-Petersb., RF |
| 14. | *A. funkiana* C.Koch et Bouche | 50 cm | 1 | Mexico | 1979, B.G., I.B., St.-Petersb., RF |
| 15. | *A. ghiesbreghtii* C. Koch | 40 cm | 3 | Mexico | 1979, seeds, Belgium |
| 16. | *A. ghiubrechti* Lem. | 80- 1,20 m | 1 | Mexico | 1988, seeds, Ialta |
| 17. | *A. horrida* Lem. | 40 cm | 1 | Mexico | Old collection |

| | | | | | |
|---|---|---|---|---|---|
| 18. | *A. kerchovei* Lem. | 40-60 cm | 0 | Mexico | 2004, B.G., Craiova, Romania |
| 19. | *A. kerchovei* Lem.cv. | 10 cm | 0 | _ | 2009, B.G., Univ. Amsterdam |
| 20. | *A. lophantha* Shiede et Kunth | 50 cm | 3 | _ | 1993, B.G., Univ., Odessa |
| 21. | *A. lophantha var. coerulescens* Jacobs. | 70 cm | 3 | _ | 1991, B.G. "Fomina", Kiev, the Ukraine |
| 22. | *A. micracantha* Salm. | 45-65 cm | 4 | Mexico | 1987, B.G. Drezden, Germany |
| 23. | *A. multiflora* Tod. | 30 cm | 0 | Mexico | 1985, C.B.G., Moscow, RF |
| 24. | *A. nissonii* Bac. A. Hison | 70 cm | 3 | _ | 1979, B.G., I.B., St.-Petersb., RF |
| 25. | *A. nizadenzis* Cutak | 10 cm | 0 | Mexico | 2010, seeds, Munchen, Germany |
| 26. | *A. parviflora* Torr. | 50 cm | 4 | Mexico | 2005 |
| 27. | *A. potatorum* Zucc.*v.verschaffeltii* Bgr. | 30 cm | 3 | _ | 1988, B.G. "Nichita", Yalta |
| 28. | *A. schotti* Engelm. | 40 cm | 5 | SUA, S. of Arizona | 1979, B.G., I.B., St.-Petersb., RF; 1979 seeds. Belgium |
| 29. | *A. striata* Zucc | 1-1,5 m | 0 | Mexico | 1979, B.G., Univ., Odessa |
| 30. | *A. striata* Zucc.*var. nana* | 60 cm | 0 | _ | 2008, Amateur |
| 31. | *A. univitata* Haw. | 70 cm | 1 | Mexico | 1976, B.G., Univ., Odessa |
| 32. | *A. victoria-reginae* T.Moore | 30 cm | 0 | Mexico | 1980, B.G., Univ., Riga |
| 33. | *A. victoria-reginae var. longispina* Breit | 50 cm | 3 | _ | 1981 B.G., Univ, Odessa |
| 34. | *A. weberi* Cels | 0,80-1,20 m | 5 | Mexico | 1979 B.G., I.B., St.-Petersb. |
| 35. | *A. x winteriana* Bgr. | 50-1,0 m | 0 | _ | 1979, B.G., I.B., St.-Petersb. |

All species and varieties of *Agave* grown in our collection are propagating vegetatively (by the suckers), and those that form seeds are multiplying by seeds (*A. ferdinandi-regis*, *A. victoriae-reginae*, *A. schotti*). Seed production of these three species is presented in *Table 2*.

Table 2

***Seed production – potential and real in some secies of Agave***

| *Nr.* | *Name of species* | *Number of fruits on plant* | *Number total of seeds in 1 fruit* | *Number of mature seeds in 1 fruit* | *Number of undeveloped seeds in 1 fruit* | *% of mature seeds in 1 fruit* |
|---|---|---|---|---|---|---|
| 1. | *A. ferdinandi-regis.* | 143 | 267 | 43 | 223 | 16,3 |
| 2. | *A. schotii* | 13 | 22 | 2 | 20 | 9,44 |
| 3. | *A.victoriae-reginae* | 80 | 115 | 7 | 108 | 6,26 |

Seeds of *Agave* species are situated in dried dehiscent capsule-type fruit. According to the Table 2, potential seed production on average varies from 267 seeds in a fruit of *A.ferdinandi-regis* up to 22 at *A.schotii*. Real productivity is much lower compared to the potential: 43 (16,3%) in *A. ferdinandi-regis*, 2 (9,44%) at the *A. schotii* and 7 (6,26 %) to *A. victoriae-reginae*. A huge number of fruit according to the seeds in a one fruit can be observed in the *A. ferdinandi-regis* bloom when it was developed outdoor over greenhouse's roof at the height reached about 4m and flowers were pollinated more intense so by the wind as well as a greater number of insects. By the size, fruits vary from 2,5 cm length and 1,3 cm width from *A. ferdinandi-regis* up to corresponding 1,6 cm and 0,7 cm of *A. victoriae-reginae*. These three species were brought in collections of BG (I) of ASM as follows: *A. schotii* in 1976 from the BG of Odessa University and in 1979 of the BG from the Botanical Institute from St.-Petersburg; *A. victoriae-reginae* – in 1980 from the BG of the University of Riga and in 1981 from the BG of the Odessa University and *A. ferdinandi-regis* in 1985 from CBG of Moscow. All these 3 species reached generative phase in land protected conditions under the BG (I) in Chisinău during a 2011. After fruit ripening of *A. ferdinandi-regis* the plant dried (died) in a short time, but *A. victoriae-reginae* – is still alive.

The optimal period of vegetative multiplication is in spring-summer. Rooting success depends on air temperature (22-26°C). Cuttings are rooted in sand.

Optimal substrate in which plants are planted – chernozem: peat: humus: sand volume ratio 2: 1: 0,5: 0,5 parts. The plants are placed in bright places, but not in direct sun. From spring to autumn, wet thoroughly and sprinkle. In the winter amount of water should be reduced.

## Conclusions

Genus of *Agave* in collection BG (I) of ASM is represented by 35 taxons. First plants were brought into the collection at the early 70's of XX century.

Summarizing the investigations of almost 40 years, it was found that the 35 studied taxa achieves generative phase 4 taxa (11,43%), fructifies only 3 species (8,57%): *A. ferdinandi-regis, A. victoriae-reginae*, *A. schotti*.

Species and varieties of investigated plants, being the particularly decorative plants and having a large potential for adaptation can be widely used for arranging use and interiors with different destinations, either as solitary plants in different compositions, or as well as outdoors during warm period of the year.

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# SPECIES OF NEW PLANTS FOR PRODUCING BIOFUELS IN MOLDOVA

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**Summary**. *Republic Moldova possess few energy resources, so being forced by the importing near 95% of necessary, and totally depending on supplying countries, that's all determining the policy orientation of researches and innovation with the target of discovering new energo-resources, the main being the production of vegetable biofuels, based on productivity analysis, environmental impact, economic* *efficiency and which will not affect the ensuring the people with food. Economic value, and botanical peculiarities (vigorous rooting, soil protection, restoration of soil structure) provide perspectives for species cultivation, as follow: Polygonum sachalinense Fr. Schmidt (Fallopia sachalinensis, Reynoutria sachalinensis), Silphium perfoliatum L., Sida hermaphrodita Rusby (Virginia fanpetals,V. mallow, Napaea hermaphrodita), Galega orientalis Lam., Helianthus tuberosus L., Phalaris arundinacea L. of 15-20 years longevity. Cultivation and harvesting of these species do not need sophisticated mechanisms and specific equipment as in forest exploitations, ensuring a high quantity of dry biomass: 10-23 t / year / ha with great caloric value - 17 to 19 MJ / kg. Energy potential of these plants can be developed in three main directions for obtaining bio-ethanol, biogas, briquettes or pellets, being transformed into energy.*

## Introduction

XXI century is remarked as well as by rapid growth of fuel prices, the reserves of which are about exhaustion and make mankind to orient to new possibilities of energy stable, unpolluted and paying. Complex problems of development of renewable energy have become a global political widespread, being dealt with at the highest forums, such as the Conference on Environment and Sustainable Development, Rio de Janeiro (1992), Special Session of UNO of General Assembly, the adoption of Millennium Development Targets (2000) and World Summit for Sustainable Development, Johannesburg (2002). European Commission (2007) approved the Energy Policy for Europe which envisages the following objectives for 2020: increasing in energy efficiency by 20%, reduction of 20% of greenhouse gas emissions, achievement of 20% proportions of renewable energies.

Republic of Moldova has few energy resources, being forced to import 95% of necessary, depending on the total supplying countries, which determines the orientation of research policy and innovation for identifying new sources of energy, primary being the production of biofuels from vegetable sources in the basis of analysis the productivity, of the impact on the environment, economic efficiency and unaffecting the population insurance food. Therefore, the question of utilization renewable energy sources has been and remains more than real. Moldova has taken its first step in this field: in 2007 renewable energy Law and Energy Strategy up to 2020 were adopted. This document provides insurance up to 2010 the rate of 6% of energy from renewable sources and 20% to 2020. Concerning the biomass energy used to produce current, Statistical Yearbook of Moldova's Republic from 2007 shows turnover 78.4 TOE (tonne of oil equivalent), which is equivalent to 3.2% of total inland energy consumption [2], other sources indicate equivalence of biomass used for producing energy in Moldova, at about 180 to 190,000 TOE / year or 7.4 to 7.8% of the gross national energy the consumption per country [1]. Unfortunately, the indices referring to the year 2010 haven't been achieved. According to the calculations performed by the Moldova Technical University (based on Statistical Yearbook from 2007), results that the energy potential of biomass produced annually in Moldova could be around 550 thousand TOE, which is equivalent to 23% of annual gross the internal consumption of energy (2.43 million TOE in 2006). In other words, the contribution of biomass in future energy needs could be up to 1/5 - ¼ of the total consumption [2].

For Moldova the solving the problem concerning creation of alternative sources energetic requires reliable, first of all, to ensuring the production the volume of vegetable biomass on an industrial scale, processing which allows obtaining the required amount of renewable fuel. Structure expected by 2020 total production and consumption of energy obtained from renewable sources based on biomass will be about 70.0%. For biomass production should be identified acclimatized and, implemented the most effective plant species with a high efficiency of photosynthetic capture of solar energy during the growing season, those who accumulate a considerable amount of solids with optimal costs for production and processing [3, 5, 6, and 11].

## Materials and methods

As biological initial material for research served new species from fodder plant collection of the Botanical Garden (Institute) ASM, as follow: *Polygonum sachalinense* Fr. Schmidt, *Silphium perfoliatum* L., *Sida hermaphrodita* Rusby, *Galega orientalis* Lam., *Helianthus tuberosus* L., *Phalaris arundinacea* L. Scientific research concerning growth, plant development and their productivity were performed by methodical instructions [8, 9]. Assessment of biomass energy was performed at the MS-10A LAGET apparatus.

## Results and discussions

As a result of performed our investigations have been identified herbaceous perennial plants species with large growth capacities, of high productivity beginning the vegetation in early March, when air temperature is positive and ends in late autumn, as soon as the establishing of negative temperatures.

***Polygonum sachalinense*** **Fr. Schmidt** (*syn. Fallopia sachalinensis, Reynoutria sachalinensis*) (*Polygonaceae*) – origination from Sakhalin Island, one of the most efficient plants.

The Sakhalin buckwheat is a perennial plant, herbaceous, is crawling rhizomes. Stems erect, tubular internodes and looks similar to that of bamboo, vigorous, reaching 5.3 m height, and stem diameter at base - 3.2 to 6.0 cm, green or brown. Possess more capacity extension, growth and development. In Moldova this plant the vegetation begins with the establishment of positive temperatures (March-April). After 20 days from the beginning of vegetation reaches 1.5 m high; in May - 1.8 to 2.6 meters and in June prevails from 3.6 to 4.0 m. Stem weight in the middle of May is 73.5 to 90.4 g or 9.2 t / ha of dry mass, while at the end of vegetation one absolutely dry mass stems without leaves is 134.2 g; thus, annual harvest dry mass exceeds 22-25 t / ha. With the establishing of negative temperatures the leaves falls totally, favoring the rapidly the dehydration and dryness of the stems, allowing early harvesting, transporting and processing, in comparison with other plants, such as willow and poplar. Energetic capacity of absolutely dry matter is of 19.5 MJ / kg. Research carried in other countries have demonstrated that the potential of this species is 50-60 t / ha dry mass and may contribute to obtaining from 970-1164 GJ / ha. This species can be grown on degraded land that can't be used for traditional cultures, is resistant to disease and pests. The plantation can be cultivated more than 20 years, requiring expenses from establishment and maintenance in the first years, and from the third year are only harvesting costs.

Is created the autochthonous sort of Sakhalin Buckwheat – "Gigant", is approved.

***Silphium perfoliatum* L.** (*Asteraceae*) – species introduced from North America, with the complex utilities. Sylph is a perennial herbaceous plant, polycarpic, erect strain into four edges with hairs, branched in the upper part, reaches at the base 250-370 meters on height and 2-4 cm thick. Light-green leaves, cordiform, reaching 25-35 cm in length and 16-22 cm width, embossed, rough toothed, opposite arranged, those inferior with the petiole and, the superior – amplexicaul, forming a cup, which allows efficient use of humidity and of the solar radiation. The root palar system extends up to 3.5 m depth. From the second year of vegetation, blooming, in the middle of July to August, inflorescence composed by 20-30 flowers / raceme, yellow, 3-5 cm in diameter. Seed productivity is 2.9 to 4.5 q / ha. Generative (by seeds) and vegetative (by rhizomes and, plantlets) is propagated. In spring, the early days from the beginning of vegetation, the growth is slower, but after 25-30 days the growth is accelerating, forming shoots, at the end of May, reaching 1.3 to 1.6 m height. During this period the growth potential reaches 5-9 cm per day. Annual harvest of fresh mass varies between 89 t / ha and 142 t / ha, depending on climatic conditions or 16 to 23 t / ha dry mass. Pellets sylph produced from plants have a capacity of about 18.3 MJ energy / kg. In Germany, the Czech Republic and Poland sylph biomass is used for biogas production and, from 1 tonne of fresh mass is obtained around 500 $m^3$ of methane gas content up to 70%. Manifests high frost and freeze resistance, moderate - to heat and drought. Recovers well and wet soils and those contaminated with the heavy metals.

As a result of amelioration, the autochthonous sort "Vital", was created, registered in the State Register of Plant Varieties of the Republic of Moldova (2012), homologated for all agro-climatic zones.

***Sida hermaphrodita* Rusby** (syn. *Virginia fanpetals*, *Virginia mallow*, *Napaea hermaphrodita*) (*Malviceae*) – herbaceous perennial plant, originating from North America, with tubular stems, erect, with smooth surface, vigorous, has very good resistance to falling. Initiates an intense development in early spring, shoots appear in mid April, vigorous and many, by taking advantage of soil humidity accumulated during the autumn-winter, and thanks to palar root system with strong branching, which penetrates to a depth of 2.5 to 3.0 m, is developing intensively, and at the end of vegetation reaches 3-4 meters high and 3-7 cm in diameter. For propagation are used the generative and vegetative methods. It is sown in late fall or early spring with stratified seed. Fresh mass productivity constitutes more than 120 t / ha, but the dry mass prevails from 25 to 28 t / ha. Fresh mass is used for biogas production, and dry mass for the production of pellets and briquettes. The energetic capacity of absolute dry mass of the plants is about 18.7 MJ / kg.

*Sida hermaphrodita* recovers degraded soils, reacts well to high doses of sewage sludge, possess high capacity for phytoremediation of soils contaminated with heavy metals [4,7].

In the category of plants that contribute to solving the above-mentioned problems belongs ***Galega orientalis* Lam., (*Fabaceae*)** – herbaceous and perennial plant, originating from the North Caucasus. Goat's rue due to the their productivity and forage quality high and stable, using of plantation for a period of more than 15 years, high capacity of fixing atmospheric nitrogen, ensuring a good harvest for the bees, its anti-erosion properties, this plant is very requested by farmers, foresters, and bee-keepings from Russia, Ukraine, Baltic States, Belarus, etc. Into Botanical Garden (Institute) of ASM goat's rue is investigating from the 80s of last century. In Moldova's conditions the plant reaches a height of 155-175 cm, has palar root system, strong branching, and penetrates to a depth of 50 to 135 cm. The plants possess an intense development in early spring, ensuring the harvest stability. At the beginning of May the plants reach a height of 70 cm, ensuring the harvest of 30-39 t / ha fresh mass, and the total harvest of the 2-4 sews can reach 90 t / ha or 20-22 t / ha dry mass. The plants are propagated by seeds. Plantations require extensive processing and soft of the soil. Up to incorporating into the soil the seed requires the scarification works and bacteriological processing. In the first year of vegetation the growth and plant development is slow, and requires strict observance of agrotechnical and technological works; in subsequent years, due to intensive development, in the spring, and high capacity to restore growth after harvest, the productivity is high, but with minimal maintenance of expenses. The biomass fresh or conserved (hayfield) is used to produce biogas. Hay pellets and briquettes are produced with energetic capacity from 16.8 to 17.8 MJ / kg.

It was created, approved the sort "Speranta" (1998) and included in the State Register of Plant Sorts of the Republic of Moldova.

***Helianthus tuberosus* L. (*Asteraceae*)** – herbaceous plant, perennial, originally from North America. Stems erect, cylindrical, slightly wrinkled, rough, hairy, high, from 2.5 to 4.0 meters in height, ramified in the superior part. Jerusalem artichoke (turnip pork) does not have high demands to soil type, ensure good harvests on clay-humus meadow soils, humid and loose sufficiently; possess a major power of adaptation to different climatic conditions; resistant to low temperatures, from -30$^0$C to -40$^0$C, remaining in the soil; young plants, during the vegetation period in early spring, and mature in late autumn, frosts until -5$^0$C supports. Plants are multiplied (propagated) vegetatively and by seed. During vegetative propagation the plants develops fibrous roots and tuber-like rhizomes, which penetrate into ground up to 50-80 cm depth; the plants obtained by generative method, in the first year of vegetation, forms pivoting root systems, well ramified (branched), which can develop up to 2.5 meters depth, the extension being, as compared with potato, is 6-8 times higher. It was established that 1 hectare of Jerusalem artichoke could absorb and use about 6 tonnes of carbon dioxide, while 1 hectare of forest vegetation – only 3-4 tons, ensuring with oxygen around 30 humans. In the basis of investigations have established that the plants uses solar energy efficiently, possessing the coefficient of recovery of the photosynthetic active energy over than 3.5%, exceeding the corn in this index of 3 times. This allows reaching production potential of 150 tons fresh mass, and about 230 tonnes of tubercles per hectare [10]. Fresh biomass is used for biogas production, and at the finalization of the vegetation period the dried stems are used in the production of briquettes and pellets, which has an energetic capacity of 18.7 MJ / kg, the tubercles can be used to produce liquid biofuels.

***Phalaris arundinacea* L. (*Poaceae*)** – perennial species, of high-use perspective, used as a source of bioenergy production. The species early spring growth begins; during the period of vegetation reaches the high over than 1.7 meters, form pure meadows on the edges lakes and wetlands; is widespread in Europe, Asia, Africa and North America. It is not demanding from the ground. Widely it is used in the exploitation of degraded and polluted soils. The plantation can be exploited for a period of 10-15 years. The production potential constitutes 10.0 t / ha of dry mass. Pellets have the energy capacity from 16.2 to 17.9 MJ / kg.

## Conclusions

New forage species collection of the Botanical Garden (Institute) of ASM, vegetal genetic resources, could serve for the selection of forms and creation of new sorts, necessary for the establishment of energetic plantations in our country.

The establishment of energetic plantations will contribute to strengthen national security under the aspect of reducing the use of energy imported and the improving of the environmental situation; to improving the balance of payments; the recovery, with perennial energetic cultures, of unused lands in agriculture and those degraded, creating new jobs and increasing labor productivity in the agricultural sector.

The cultivation of above-mentioned species ensures a large and stable dry biomass of 10-23 t / year / ha, with superior nutritional value of 14-19 MJ / kg, at the same time for harvesting and primary processing machinery and equipment are used unsophisticated, that used in traditional plant harvesting.

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# THE SYNTHESIS OF NEW GENOME OF GRAPEVINE AS A BIOLOGICAL MEANS TO CONQUER THE PHYLLOXERA (*Viteus vitifolii* (Fitch. Shimer)

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***Summary.*** *The present paper describes the stages of new genome synthesis – n-19, 2n=38 in the basis of the distant hybrid, sterile – DRX-55 (2n = 39), which contains in somatic set for everyone complete haploid set – n-19, 2n=38 from V. rotundifolia Michx., and V. vinifera L., respectively. By performing backcrossing, firstly in "in situ", after in "ex situ" conditions, was eliminated the 39th odd chromosome from the nucleus (karyotype), and distant autofertile hybrids was obtained.*

Preliminary synthesis of new genome of grapevine has been initiated in USA by A. P. Wylie, who for the first time was obtained distant hybrids between species of crop *Vitis vinifera* L. (2n=38, subgenus *Euvitis*) and American spontaneous species *V. rotundifolia* Michx. (2n=40, subgenus *Muscadinia*) [21, 22]. C. Dearing and L. R. Detjen have been crossed again *V. rotundifolia* Michx. with *V. vinifera* L., and other species of subgenus *Euvitis* thus has created hybrids of $F_1$ [1, 2]. After that, in USA, by backcrossing hybrids of $F_1$ (N. C. 6-15, N. C. 6-16) with European and local varieties, R. T. Dunstan has created hybrids of $F_2$, so called DRXs: DRX-58-5, DRX-55 and other. There was finished the stage of preliminary synthesis of new genome of grapevine, that has been ended by creation of 2 generations ($F_1$ and $F_2$) of distant hybrids containing, in somatic cells, diploid number of chromosomes 2n=39, i.e. having a set (n=19 and n=20) from parental species *V. vinifera* and *V. rotundifolia*, respectively [3, 4].

Viala and L. Ravaz (1895) [20] researches, from more than 70 spontaneous and introduced species of the genus *Vitis* L., only *V. rotundifolia* Michx. are with extremely density and hardwood, as the *Cornus max* L., recording the highest degree of resistance to phylloxera -20º, while for the European grapevines that are fragile and have a low wood density, as *V.vinifera* L., the degree of resistance of this blast is up to 0º. Having no knowledge on these outcomes, published 27 years hence, professor Wylie (1868) [21] has determined visually absolutely precisely *'how'* and with *'what'* do crossing for initiating the stage of preliminary synthesis of new genome of grapevine, concomitantly, putting the headstone on creation of grapevine resistant to phylloxera.

At present it has been realized that only through the distant hybridization between the genera *Vitis* L. (2n=38) and *Muscadinia* (2n=40) the forms can be created, which would resist to phylloxera, because of being a real method from the entire set of methods of crossings, which allows blending in a single genotype of quantity and quality of the harvest of species of the crop *V. vinifera* L. with resistance to phylloxera of the American spontaneous species – *V.rotundifolia = Muscadinia rotundifolia* (Michx.) Small. On the basis of, the Great Russian geneticist N. I. Vavilov related that to solve the practical problems we must pay attention mainly to the distant hybridizations. At the same time, N. I. Vavilov considers that the genetics strategy consists in development of the ways of synthesis of the new forms [18, 19].

Systematic and multiple experiments, performed in the field of distant hybridization between *V. vinifera* L with *V. rotundifolia* Michx. by the scientists of the USA during the 19$^{th}$, 20$^{th}$ and 21$^{st}$ centuries, resulted in creation of the $F_1$ generation, for example: N.C.-6-15, N.C.-6-16 and a number of derivates from the crossing with *V. rotundifolia* Michx. Great works devoted to the selection of the parental forms, correct choices of the hybridization direction, use of the sorts *V. vinifera* L., as a ♀ mother plant, and the best clones of *V. rotundifolia*, as producers as plants ♂ pollinators, was contributed to the successful of crossings (Wylie, 1868, 1871); Detjen (1919); Dunstan (1962, 1964); Xu Xia, Lu Yang (2002) [1, 3, 4, 21, 22]. The hybridizations, as a rule, in the back direction were ended in no results. The attempts of obtaining the hybrids between the cultivated species *V. vinifera* and the American spontaneous *V. rotundifolia* were undertaken in many countries: France (Millardet, 1901); USA (Munson, 1909); Moldova (Topală, Savin, 1983), etc., but all of them failed.

*In the world, up to present, only the American ameliorator scientists succeeded to obtain the veritable distant hybrids of $F_1$ with 2n=39 from crossing of the species V. vinifera* L. with *V. rotundifolia* Michx. This extraordinary fact may be grounded only by the ideal conditions of hybridization, the talented, perfectly made actions, a clear vision of the finished result and, of course, by the daily pragmatism characteristic to the American scientists (Wylie, 1868, 1871); Detjen (1919); Dunstan (1962, 1964); Xu Xia, Lu Yang (2002) [1, 3, 4, 21, 22]. In the majority of the cases, the $F_1$ hybrid plants of containing the number of chromosomes 2n=39, were characterized by a big uniformity and intermediary heredity of the morphological characteristics in the crossing combinations.

The absolute sterility of male gametophytes and high or partial one of female gametophytes, specific to distant hybrids of $F_1$-$F_2$ has remained intact. Because of this essential disadvantage, they have not presented any interest to genetic improvement of grapevine and mostly have been abandoned. Key problem, i.e. high degree sterility of hybrids, that prevented their engagement in the process of improvement, has been solved by us within intensively backcrossing under *in-situ* conditions with fresh pollen collected in the moment of effecting crosses or collected in previous years and preserved in liquid nitrogen (Topală (1983, 2008); Topală, Dadu, Istrati, 2005); Topală, Dadu (2009) [10, 11, 12, 14]. Above-mentioned backcrosses have caused continuation of the biochemical reactions of indigenous synthesis of a new genome of the vine in the NIWW, initiated 115 years ago in USA (Topală, Guzun, 1987).

Based on the distant hybrid "odd chromosome" DRX-55 with 2n=39 between the species *V. vinifera* x *V. rotundifolia*, in 1982, under *in-situ* conditions, the first backcross was made between Aramon and *V. riparia*. Thus, the first 32 autochthonous distant hybrids in Moldova were created. In 1984, 15 hybrid backcrossing combinations were between DRX-55 and Seyve Villarii, the initial species, polyploidy forms and *V. vinifera* varieties. As a result of the backcross were created 412 and a total of 444 autochthonous distant hybrids, which formed conventional the $F_3$ generation or the $BC_2$ hybrid population. At this stage, none researcher of the world has observed any suspected character, distrustful genotypic, phenotypic or cytological at hybrids, that is directly or indirectly to denote on beginning of indigenous synthesis of new genome of vine, as actually such character had not existed.

For the first time the phenomenon of synthesis was revealed in 1987 in the $F_3$ partially fertile hybrids (i.e. after 119 years of the initiation moment), where the appearance of the normal pollen grains as for their size and identical form, as well as the pollen grains in the European standard sorts: Aligote, Cabernet, Chasselas etc. (Topală, 1988, 2008) [11]. This phenomenon indicates the start of the reductional division regulation in the male and female gametophytes or the beginning of the meiosis normalization in the male or female sphere, which leads to the reestablishment of the complete fertility of the distant grapevine hybrids.

Therefore, from the beginning the synthesis of the new grapevine genome proper was realized under the *in-situ* conditions in NIWW and under the *ex-situ* conditions in Botanical Garden Academy of Sciences of Moldova and in NIWW. The presence of the normal pollen grains in the pollen sacs along with the sterile ones shows that namely here at this moment the final stage of conclusion of the synthesis of the new grapevine genome proper started and runs, which happened under the *ex-situ* conditions under the interaction of the internal and foreign factors. In 1987, in the $F_3$ hybrids, which began yielding, the process of the new grapevine genome was impulse by making of 2 combinations of backcrossing under the *ex-situ* conditions with the freshly collected pollen from 2 hybrids S.V.: DRX-$M_3$-90 x S.V.20-366 and DRX-$M_3$-232 x S.V. 12-309. Thus, as a result of these 2 very successful backcrosses, a new population of the distant hybrids amounting over 200 has been created, which constituted the generation $F_4$ conventionally or the progeny $BC_3$ (Topală, Istrati, 2005).

From a restrained amount of the backcrossing with the hybrids of $F_4$ as a mother-plant ♀ and the European sorts of grapevines as a father-plant ♂, approximately 80 plants of $F_5$ conventionally or the progeny $BC_4$ constituted from the plants of crossings and the saplings obtained from the seeds collected from the free pollination of the flowers, preponderantly from the forms with a reestablished fertility additionally. The generation of distant hybrids mixed $F_5$ has been planted in 2001 in a NIVW's experimental plot. Some of hybrids of this generation in 2003 bloomed and, judging according to normal size and form of grains of pollen, similar to bisexual standard varieties of vine, we state, meiosis incurs without impairment, and fertility of $F_5$ has been completely restored. These experimental data attest and incontestably prove finalizing process of synthesis of new genome at hybrids of $F_5$ under natural conditions and extinguishing biochemical complex reactions in nucleuses of mother cells of pollen and mother cells of ovules gradually under interaction of internal and external factors Topală (2007; 2008; Topală, Dadu, 2006, 2009) [13, 14].

Thence, there for the first time in the world has been effected synthesis of new genome of vine – n=19, constituted from chromosomes of genome of species of crop *V. vinifera* - n=19 and chromosomes of genome of American spontaneous species *V. rotundifolia* - n=20, which value consists of absolute immunity to diseases and blasts, phylloxera included. Under action of backcrosses well-planned and effected with fresh pollen collected, in the first place, has been impulse synthetic genesis of synthetic species (Zavadskii, 1968) [23], in the second place, there has been forced elimination from karyotype (nucleus) in cytoplasm of 39$^{th}$ odd, "trouble" or “tricky” chromosome, which caused all impairments (perturbations) in meiosis of both gametophytes - female and male, - i.e. absolute sterility of pollen and null fertility at hybrids of $F_1$, $F_2$, even some hybrids of $F_3$ or incapability to fruit and form grapes with seeds under *ex-situ* and *in-situ* conditions at hybrids of $F_1$, $F_2$, as well as $F_3$ (Topală, Dadu, Istrati, 2005; Topală, Dadu 2006, 2009; Topală 1983, 2008) [10, 11, 12, 14, ].

The mechanism of elimination of the odd chromosome consisted in making of the back crossings with the freshly collected pollen first under the *in-situ* conditions, then under the *ex-situ* conditions, which inhibited its movement in the anaphase from the equator to one of the cellule pole, forcing this way its elimination in the cytoplasm. Also, the odd chromosome was a reason of incapacity to yield and to form grapes with the seeds under the *ex-situ* and *in-situ* conditions in the hybrids $F_1$, $F_2$, and in more than ½ of the descendants of $F_3$ and in some hybrids from $F_4$.

According to D. Goriunov (1960) [5] the hybrids with odd number of chromosomes in somatic cells are sterile, do not fruit, do not give descendants and do not fructify. We must underline that there are many cases where infertility is caused not by an odd number of chromosomes hybrid, but completely by other reasons, for example, the first synthetic hybrid, Kölreuter’s “impair chromosome” was obtained from the crossing of two species of *Nicotiana paniculata* L. (2n = 24) x *N. rustica* L. (2n = 48). Thus, hybrids somatic chromosome number was (2n=36), although the hybrid was completely sterile, due to the lack of consistency, concordance or compatibility between parental chromosomes and the different inner construction of chromosomes in components of cross combination. The synthesis of the new grapevine genome was performed for a long time, comprising the centuries XIX-XXI – a relatively short historical period. In conclusion, we may assert that the synthesis, conform our opinion, is definite, complete and irreversible [13, 14].

Therefore, in the process of the new grapevine genome synthesis, the haploid set with the genes localized in it was reconstituted, where 5 main stages were determined to run, respectively:

1) Stage of preliminary synthesis, effected by American scientists A.P. Wylie (1868, 1871) [21, 22], C. Dearing (1917), L. R. Detjen (1919) [1], which begins with creation of distant hybrids of $F_1$ between *V. vinifera* and *V. rotundifolia*; stage is finished by creation of DRXs of R. T. Dunstan (1962, 1964) [3, 4]: DRX- 60-24, DRX-58-5, DRX-55 etc., containing in somatic cells diploid number of chromosomes equaled to 2n=39;

2) Stage of indigenous synthesis of new genome of vine, which begins with effecting backcrosses *in-situ*: DRX-55 x (Aramon x *V. riparia*),

then continues by backcrosses with parental species, hybrids Seyve Villari, polyploidy forms and varieties of *V. vinifera* L. As a result, a new population of distant hybrids indigenous ($F_3$) has been created having 444 unique forms;

3) The third stage consists in the impulse or the stirring-up of the process of the new genome synthesis, simultaneously with the process of synthetic genesis of the synthetic species of vine (Zavadskii, 1968) [23] was performed under the *ex-situ* conditions by making 2 backcrosses: DRX $M_3$-90 x S.V.20-366 and DRX-$M_3$-232 x S.V. 12-309. Thus, generation $F_4$ including > of 200 of indigenous hybrids has been created;

4) The fourth stage included the forming and becoming process of the new genome through the making based on hybrids of $F_4$, ~ 80 hybrid plants of $F_5$ have been created, from crosses specially assigned: DRX-$M_4$-510 x Moldova (28 seedlings), DRX-$M_4$-520 x GM-325-58 (11 s.), DRX-$M_4$-520 x Crystal (28 s.), as well as seedlings obtained from seeds from free pollination of flowers;

5) The fifth step was the consolidation, the emergence and exteriorization of the biomorphological features of the new genome. Thus, in $F_5$ under *ex-situ* conditions, the most important events from the long cycle synthesis of new genome and synthetic genesis of synthetic species of vine have been performed. In the first place, there has been finalized and gradually extinguished process of synthetic genesis of synthetic species (Zavadskii, 1968) [23] of vine under interaction of internal and external factors; in the second place, synthesis of new genome of vine (it is confirmed by AGEPI has been finished by definitive and irreversible elimination from karyotype (nucleus) in cytoplasm of odd chromosome, called "tricky" or intriguing, attested by direct counting of chromosomes in somatic cells -n=19, 2n=38 at descendants of synthetic species, as well as the remained descendants from $F_5$; in the third place, incurring meiosis without impairments in both gametophytes has been stated at hybrids of $F_5$, if we conclude on size and normal form of grains of pollen similar to bisexual varieties of *V. vinifera* L.; formation of the compact grapes with the seeds of a normal density alike in the hermaphrodite (bisexual) sorts of *V. vinifera* L.; finally, the apogee of synthetic genesis has been effected – restoration of fertility, i.e. fundamental quality of plants to fruit and produce new generations, reflected in renewing vital functions of generative organs, enclosing generative mechanism of maintaining species itself. These are stages of radical transformation of the sterile hybrid DRX-55 "vegetal mule" in synthetic species, which are bearers, exponents of new genome and harmoniously geminate in one genotype quality of harvest with resistance to diseases, blasts, phylloxera

included. The results of blending the germ plasm grapevine forms, i.e. the content of male gametes germ plasm and hybrids DRX form content ova or female gametes, have shown that these processes took place in time. Grapes produced in this case, where the density of grains in the cluster, the number of viable seeds in berry, have shown that male embryos and gametes function normally, which indirectly indicates the drifting of meiosis in the parent cells of ova (CMO) and cells pollen parent (CMP) in normal speed without essential disturbance. Was found that in these distant mitosis and meiosis in hybrids and CMO, CMP is carried out normally, without disturbance, fertility is restored completely, for example: distant hybrids DRX-$M_5$-757, DRX-$M_5$-790, DRX-$M_5$- 734 et al., Developed hybrid seed production capacity proved to be forms an important element that can be used in programs to improve the vine. Test parallel to forced and free pollination of flowers, the hybrids showed the same capacity. The ability of sugar accumulation in bean juice to hybrids evolved on this criterion, also at 01.09.09 proved a stately at 18,2 to 25,0%.

Thus, the positive evidence obtained as a result of racial mixing, forced pollination, determining capacity of sugar accumulation, increased resistance to disease, phylloxera denotes the fact that after these criteria taken together, hybrids can be used in genetic improvement program grapevine mother: the parents plant or plant – father. The average mass of a grape in hybrids DRX-M5-757, DRX-M5-790, DRX-M5-734, accordingly, is equal to 169.9 g, 199.6 g and 252.7 g. Meanwhile, the mass of all grapes harvested from a hybrid plant DRX-M5-734 summary is - 3544 g. The maximum mass of a grapevine – 477 g and the minimum - 110 g. The implementation of these hybrids (common ancestor), but particularly, the generation of selected species basis, the scale of the 4 continents, where phylloxera spread, undoubtedly, make a big profit mankind.

At present for the genetic scientists of our country and not only is put an important task, i.e. to decipher the new grapevine genome, which will indicate how many chromosomes belong to the *V. vinifera* L. and spontaneous American species resistant to phylloxera; in addition to that required the complete sequence of genome in order to determine with genetic markers the succession of nucleotides of the new genome of grape which necessarily might be a fundamentally new face of traditional genome. Is notable that this research was made by us during 30 years, independently from the researches of many other countries (Boubals, 1966), Gargiulo (1972), Hidalgo, Candela (1969), Hochberg, Safran (1969), Huglin et al., 1969), Pospesilova, (1969), Olmo, Pool (1986) which do not contain even allusion of synthesis new genome of vine, all devoted on the use of the species *V. rotundifolia* in the field amelioration and special grapevines genetics.

## Conclusions

1. For the first time in the world, a new genome of vine - n=19 has been synthesized from chromosomes of genome of species of crop *V. vinifera* L. – n=19 and chromosomes of genome of American spontaneous species, resistant to phylloxera *V. rotundifolia* Michx. – n=20; (apparently, the ratio of chromosomes 9 VV + 10 VR, but more precise membership of chromosomes will be determined using the method of differential staining them and other contemporary methods of investigation.

2. Among hybrids of $F_5$, synthetic species of vine: *V. vinifolia*, *V. rotundifera*, *V. crucestiana, V. nigra* etc., which are exponents of new genome of vine and successfully geminate quality and quantity of harvest of species *V. vinifera* with resistance species *V. rotundifolia* have been revealed.

3. In the world premiere, the odd chromosome 39$^{th}$, called "tricky", "quarrelsome" or intriguing because it was the cause of the sterility of gametophytes and decreased fertility of hybrids, practically equaled 0, under pressure of backcrossing with Seyve Villari; it was eliminated from karyotype (nucleus) in cytoplasm during three generations $F_{3,}$ $F_4$ and $F_5$.

4. Based on hybrid DRX-55, a new species of crop *V. vinfera* L. type similar to that cultivated on proper roots before phylloxera appearance (1868) and being distinguished by hybridogenous origin and high-degree resistance to phylloxera has been synthesized.

5. For the first time the *synthesis of* new grape *genome*, which assures high quality and resistance of the grape to phylloxera, allowed confirming by the example of species *V. vinifera* L., veracity of the chromosomal heredity theory of T. H. Morgan, Nobel Prize Laureate (1933).

6. Recently was confident established that the synthesis of the new grape genome of the *chromosomes* of two species – *V. vinifera* L. and *V. rotundifolia* Michx. – was realized on the international science level, because the object of synthesis investigations – *chromosomes* is identical to the research objects from the work: "the discovery of how *chromosomes* are protected by telomeres and the enzyme telomerase", made by Blackburn E. H., Greider C.W., Szostak J.W., Nobel Prize Laureates (2009).

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## CONTRIBUŢII LA CUNOAŞTEREA FORMELOR PRECOCE DE NUC (Juglans regia F. Fertilis retz.et kirch.)

***I. Comanici***

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**Summary.** *Precocious forms of walnut have a set of characters and valuable features: early fructification, lateral fruiting, racemiferous fructification, high kernel content up to 50-60%. Precocious forms we have introduced from Primary Centre (Central Asia) in the Republic of Moldova.*

Nucul comun (*Juglans regia* L.) intră pe rod la înmulţirea prin seminţe în condiţii de cultură în al 7-8-lea an, iar în stare spontană – la al 12-16 an şi chiar mai târziu. Cât priveşte formele precoce puieţii răzleţi înfloresc chiar în primul an de vegetaţie, la al 2-3-lea an înfloresc şi leagă fructe. În anii următori coroana se îndeseşte rapid, asigurând o fructificare abundentă. Multor forme le este caracteristică fructificarea mixtă, adică din mugurele terminal şi 1-2-3 muguri subterminali. Sunt forme cu fructificare terminală-laterală, adică din mugurele terminal şi din mugurii laterali, ceea ce constituie baza organică structurală pentru o fructificare abundentă. Formele precoce au şi alte caractere şi însuşiri desirabile, cum ar fi fructificarea racemiferă, de câte 4-12 fructe pe pedunculul comun; înflorirea şi fructificarea secundară care are loc în timp aproximativ de o lună – după cea dintâi; habitus de talie mică şi mijlocie. Formele precoce prezintă, datorită acestor particularităţi, un viu interes atât pentru producţie, cât şi pentru selecţia de soiuri înalt productive.

Formele precoce se întâlnesc, mai cu seamă, în centrul genetic primar – Asia Mijlocie, în semicultură şi în stare spontană (Kalmîkov, 1948; Şevcenko, 1968; Comanici, 1978, 1980).

Având experienţă în studiul nucului obişnuit, am socotit că este nimerit să introducem formele precoce în Moldova pentru studierea lor în condiţiile locale (Comanici, 1980, 2008).

În cadrul a trei expediţii, cu durata de o lună de zile, le-am efectuat în Asia Mijlocie (1965-1973), unde se află faimoasele păduri naturale de nuc în amestec cu specii pomicole, am studiat diversitatea nucului în centrele cu mai mare frecvență a nucului: Arslanbob (Kirghizstanul de Sud); Varzob (Tadjikistan); Bostandîk, Ramit (Uzbekistan) (Comanici, 1978, 1998, 1980). Din aceste centre am adus semințe (nuci) de forme precoce. Trebuie de menționat că centrul de origine a nucului se caracterizează prin condiții naturale de temperatură înaltă şi umiditatea relativă a aerului foarte scăzută, media lunilor de vară fiind de 24-37%, iar în orele amiezii cade sub 15% (Alisov, Lupinovici, 1949; Zapriagaeva, 1964).

Populația inițială, fiind introdusă în zona republicii cu umiditate mai înaltă în perioada de vegetație, s-a dovedit a fi mai puțin rezistentă la condițiile noi şi în curs de câțiva ani plantele au pierit, dar în aceşti ani am reuşit să obținem, din materialul inițial, prima reproducție (generație) pe care o numim moldovenească. Această primă generație provine, evident, de la polenizarea liberă de către formele obițnuite locale şi este heterozigotă după caracterul precocității. Pentru studierea de mai departe au fost selectate şi introduce în colecție numai acele exemplare care au moştenit precocitatea, adică puieții care au înflorit şi au legat la al 2-3-lea an de vegetație. Dar, şi prima reproducție nu a fost îndeajuns de adaptată la condițiile locale şi în decurs de 10-13 ani copăceii, rând pe rând, au pierit, astfel că până în prezent a rămas un singur exemplar.

Reproducția a doua a fost înființată în 1993 şi cu timpul a mai fost completată pe măsura apariției puieților cu înflorire şi legare timpurie, astfel colecția de forme precoce enumără 50 de genotipuri de diferită vârstă.

Copacii sunt de talie mică şi mijlocie, având înălțimea de 2,10-3,40 m şi diametrul coroanei de 1,65-2,75 m. Coroana globuloasă, răsfirată, creşteri anuale moderate. Roada, în general, bogată, dar cu oscilații, de la an la an, din cauza condițiilor meteorologice nefavorabile şi atacul bolilor şi dăunătorilor (gărgărița mugurilor). Desfacerea mugurilor şi înflorirea au loc, în general, în aceleaşi termene ca şi formele obişnuite, în anii (primăverile) cu regim termic comparabil cu media de mulți ani – dezmugurirea în prima jumătate a lunii aprilie, iar înflorirea florilor unisexuate female – la sfârşitul lunii aprilie – prima decadă a lunii mai. Sosirea fazelor fenologice este puternic influențată de factorii meteorologici. Astfel diferența dintre termenele înfloririi, la unele şi aceleaşi exemplare în diferiți ani poate fi de 20-25 de zile. La formele protogine florile înfloresc mai devreme cu 4-6 zile decât la cele protandre, iar florile mascule, respectiv, cu 4-6 zile mai târziu. Gradul de legare a fructelor (завязываться, образовать завязь) s-a înregistrat la diferite forme între limitele de 10-74%. Formele precoce, în principiu, sunt rezistente la gerurile de iarnă, dar suferă în anii cu înghețuri târzii de primăvară, de altfel ca şi formele obişnuite. Masa nucilor se clasează între 6,1-9,1 g, iar randamentul de miez între 42,6-53,2%.

Mai jos redăm descrierea succintă a unor forme precoce de nuc din colecția Grădinii Botanice (Institut) a AŞM.

**Forma 2-3 RM.** Este unicul exemplar din prima reproducție moldovenească care s-a păstrat până în prezent, în vârsta de 38 de ani, după o reîntinerire radicală atinge înălțimea de 3,35 m. Coroana aproape globuloasă, răsfirată, mijlociu de deasă, 2,65 m în diametru. Creşterea anuală din mugurii terminali este încetinită, lungimea lăstarilor de 12-15 cm, internodurile sunt scurte (apropiate), creşterea lăstarilor terminali fiind încetinită, se dezvoltă lăstari din 2,4 muguri subterminali aproape de aceiaşi lungime ca şi lăstarii terminali şi astfel se formează la vârful ramurilor din anul precedent, un fel de ”buchete”, ceea ce dă copăcelului un aspect anormal. În anii ploioşi suferă, în măsură mai mare sau mai mică, de marsonioză (antracnoză).

Tipul de înflorire protandric, perioada de înflorire a florilor femele este de 10 zile. Înfloreşte şi leagă abundent, în unii ani are loc căderea fructelor de-abia legate, astfel gradul de legare a fructelor se stabileşte la 29%. Tipul de fructificare terminal-lateral.

Masa medie a nucii 7,0 g, limitele între 5,6-8,2 g, randamentul miezului 53,0%, se extrage uşor întreg (tabelul 1). Această formă transmite caracterul precocității la descendenți în proporție de 17-25%.

**Forma 3-3 SW.** În vârsta de 18 ani atinge 2,0 m înălțime, coroana globuloasă, răsfirată, destul de compactă, diametrul de 2,2 m, frunziş bogat, verde-deschis. Rezistența la marsonioză se apreciază ca supramedie (4 puncte după scara de 5 puncte). Creşteri anuale de 20-25 cm. Tipul de înflorire protogin, durata de înflorire 11 zile. Fructifică şi leagă abundent, tipul de fructificare terminal-lateral, gradul de legare a fructelor 76,2%, cel mai înalt dintre toate formele. Florile şi respectiv fructele, câte 4-12, sunt dispuse în frutescențe.

Nucile de mărime mijlocie, masa de 8,2 g cu limitele de 6,2-9,8 g, de formă rotundă, endocarp neted, de culoare gălbuie-cafenie, miezul plin constituie 48-7% din masa nucii, se extrage uşor întreg.

**Forma 4-3 NW.** De vigoare mijlocie sau supramedie, de 3,2 m înălțime. Coroana puțin întinsă vertical, de 2,3 m în diametru, deasă, frunziş bogat, verde vie. Rezistența la marsonioză medie sau supramedie. Înfloreşte abundent, gradul de legare a fructelor de 45,4%, ceea ce asigură o roadă bogată. Tipul de înflorire protogin, perioada (durata) de înflorire11 zile. Tipul de fructificare terminal-lateral.  Nucile de mărimea mică, 6,3 g cu limitele între 5,3-8,4 g, de formă elipsoidală, conținutul în miez – 46,0%, miezul se extrage uşor întreg.

**Forma 4-3 NE.** Formă de vigoare mijlocie, de 3,1 m înălțime, coroa-

Tabelul 1

**Masa nucii şi a miezului la formele precoce de nuc**

| Denumirea formei | Masa nucii, g | | | Masa miez, g | | | Randament miez, % | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{x} \pm_{S\bar{x}}$ $\bar{x} \pm S\bar{x}$ | $\sigma^2$ | CV | $\bar{x} \pm_{S\bar{x}}$ $\bar{x} \pm S\bar{x}$ | $\sigma^2$ | CV | $\bar{x} \pm_{S\bar{x}}$ $\bar{x} \pm S\bar{x}$ | $\sigma^2$ | CV |
| 2-3 RM | 7,0±0,2 | 0,49 | 10,1 | 3,7±0,3 | 0,82 | 22,0 | 53,2±1,3 | 4,22 | 7,9 |
| 3-3 SW | 8,2±0,2 | 1,27 | 15,2 | 4,0±0,3 | 0,60 | 19,5 | 48,7±0,7 | 7,57 | 5,6 |
| 4-3 NW | 6,3±0,3 | 1,78 | 22,1 | 2,6±0,2 | 0,66 | 31,0 | 46,0±0,8 | 5,85 | 5,3 |
| 4-3 NE | 7,6±0,4 | 2,86 | 22,1 | 3,8±0,1 | 0,25 | 13,1 | 50,1±0,6 | 5,22 | 4,5 |
| 4-4 NW | 9,1±0,7 | 6,01 | 26,9 | 4,0±0,4 | 1,86 | 34,4 | 45,6±1,4 | 3,60 | 4,2 |
| 4-4 S | 7,2±0,4 | 3,31 | 25,3 | 3,8±0,7 | 2,09 | 38,3 | 49,7±2,4 | 3,33 | 6,7 |
| 5-4 NW | 8,7±0,8 | 1,93 | 15,9 | 3,7±0,4 | 0,39 | 16,7 | 42,6±1,2 | 4,20 | 4,8 |
| 5-4 NE | 8,9±0,3 | 1,22 | 12,4 | 3,9±0,2 | 0,56 | 19,2 | 45,7±0,8 | 6,16 | 5,4 |
| 5-5 NW | 7,9±0,3 | 0,44 | 8,4 | 3,9±0,4 | 1,40 | 29,8 | 49,8±1,5 | 3,96 | 7,9 |

na aproape globuloasă, puțin întinsă vertical, de 2,3 m în diametru, bine garnisită. Înflorește şi leagă abundent, dar în scurt timp o parte din fructele de-abia legate se scutură, rămânând 23,0% din numărul florilor. Forma este protogină, perioada de înflorire 10 zile, tipul de fructificare mixt. Nucile de formă rotundă, cu punctul pistilar aciform, masa medie a nucii 7,6 g cu variație între 6,0-9,5 g. Miezul umple bine cavitatea nucii, constituie 50,2% din masa nucii, se extrage uşor întreg.

**Forma 4-4 NW.** Formă cu creştere mai viguroasă, înălțimea pomului de 4,25 v. Coroana cilindrică, deasă, diametrul orizontal 2,75 m, pe verticală 3,65 m. Creşterea anuală 30-35 cm. Înflorește mai târziu cu 4-6 zile decât celelalte forme, în 2011 începutul înfloririi s-a înregistrat la 6 mai, durata înfloririi 10 zile. Tipul de înflorire protogin. Înflorește şi leagă abundent, gradul de legare a fructelor 50,0%. Tipul de fructificare terminal-lateral.

Nucile larg ovale, suprafața endocarpului netedă, atrăgătoare, masa medie 9,1 g cu limitele 6,8-12,2 g. Conținutul în miez de 45,6%, se extrage uşor întreg sau jumătăți.

**Forma 4-4 S.** Habitusul de mărimea mijlocie sau supramedie, înălțimea de 3,4 m, coroana îngust piramidală, diametrul la bază de 1,75 m, potrivit garnisită, frunziş ce densitate mijlocie, culoarea verde-deschis. Rezistența la marsonioză supramedie.

Tipul de înflorire protogin, durata de înflorire 8 zile. Înflorește abundent, gradul de legare a fructelor de 40,3%. Tipul de fructificare mixt. Nucile de formă rotundă, masa medie a nucii de 7,2 g cu limitele 6,2-10,2 g, coaja subțire. Miezul umple bine cavitatea endocarpului şi constituie 49,7%, se extrage uşor întreg.

**Forma 5-4 NW.** Mărimea habitusului supramedie, de 2,7 m înălțime, coroana globuloasă răsfirată, compactă, de 2,3 m în diametru, creşteri anuale de 20-25 cm. Frunziş bogat, verde viu.

Înflorește în primele zile ale lunii mai, durata de înflorire 8 zile. Tipul de înflorire protogin. Înflorește şi leagă abundent, dar în ultimii ani leapădă, în mare parte, fructele de-abia legate, astfel recolta este foarte joasă. Tipul de fructificare terminal-lateral.

Nucile de formă elipsoidală, de mărime mijlocie, masa medie a nucii de 8,7 g, limitele 6,7-10,8 g. Miezul nu umple complet cavitatea nucii, constituie 42,6%, se extrage uşor întreg.

**Forma 5-4 NE.** Formă de mărime submedie, de 2,7 m înălțime, coroana aproape rotundă, de 2,0 m în diametru, destul de deasă, răsfirată. Tipul de înflorire protogin, înflorește în ultimile zile ale lunii aprilie, durata de înflorire 11 zile. Înflorește şi leagă abundent, dar ca şi la forma precedentă fructele de-abia legate cad în masă, din cauza, deocamdată nelămurită.

După unele date cauza ar fi prezența unui virus care se răspândeşte cu ajutorul polenului. Tipul de fructificare mixt. Nucile lunguiețe, subțiri la coajă, de mărime mijlocie, masa medie 8,9 g, limitele 6,5-10,3 g. Conținutul în miez de 45,7%, se extrage uşor întreg, de culoare albă-gălbuie.

**Forma 5-5 NW.** Formă cu creştere moderată, înălțimea pomului de 2,2 m. Coroana lat-piramidală, diametrul la bază de 1,8 m. Frunziş destul de dens, de culoare verde-intens.

Înfloreşte mai târziu decât celelalte forme timpurii, în anii cu regim termic normal – la sfârşitul primei decade a lunii mai, durata înfloririi 7 zile. Tipul de înflorire protandric. Tipul de fructificare terminal-lateral. Înfloreşte şi leagă abundent, gradul de legare a fructelor este de 40,0%. Nucile de formă aproape rotundă, cu coaja subțire, netedă, masa medie a nucii 7,9 g, limitele între 6,2-9,1 g. Miezul umple bine cavitatea endocarpului şi constituie 49,8% din masa nucii, de culoare galbenă-cafenie, se extrage uşor întreg.

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# ИНТРОДУКЦИЯ SATUREJA HORTENSIS L. В БОТАНИЧЕСКОМ САДУ ЖИТОМИРСКОГО НАЦИОНАЛЬНОГО АГРОЭКОЛОГИЧЕСКОГО УНИВЕРСИТЕТА

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**Summary.** *The results of research on introduction of Satureja hortensis L. in the Botanical Garden of Zhytomyr National Agroecological University have been presented. The characteristics of growth and development of plants of S. hortensis in the course of ontogeny have been determined. The dependence of the main biometric parameters and productivity of plants from the area of nutrition were shown.*

## Введение

Последнее время возросло значение эфиромасличных и лекарственных растений как источника биологически активных веществ, в том числе стимулирующего и адаптогенного действия. Все интенсивнее идет поиск препаратов, полученных из растительного сырья, которые могли бы стимулировать механизмы резистентности и повышения иммунных свойств организма человека. Спрос на фитопрепараты и непосредственно на эфирные масла с каждым годом увеличивается. Восполнить их все возрастающую потребность возможно только благодаря расширению базы сырья эфиромасличных и лекарственных растений, в том числе за счет поиска новых культур и возможных зон их выращивания.

Успешное введение в культуру новых перспективных видов растений возможно только благодаря изучению их биологии развития и особенностей их выращивания.

С точки зрения использования в фармации, в пищевой отрасли, как источника бактерицидных веществ перспективными являются растения семейства Яснотковые *(Lamiaceae* Lindl.). Вследствие неограниченного сбора лекарственных растений, ассортимент их из года в год уменьшается. Поэтому интродукция новых видов этого семейства даст возможность расширить сырьевую базу эфиромасличных и лекарственных растений.

С целью увеличения видового состава эфиромасличных и лекарственных растений в Житомирском Полесье в ботаническом саду Житомирского национального агроэкологического университета были изучены биологические, экологические и технологические особенности растений *Satureja hortensis* (чабера садового) в связи с его интродукцией.

Чабер садовый (народные названия: чабер, чабор, чабиор, чобр, чабрец, чибрец, чембарь, чебчик, чебрчик, шебер, шеберник) - однолетнее растение семейства Lamiaceae. Родина этого растения – восточные области Средиземноморья и Причерноморья. Хорошо был известен чабер еще древним грекам и римлянам. В рукописях Вергилия находят рекомендации по употреблению его в пищу для ее ароматизации. Особенно популярен был в Англии, Германии, Скандинавии. В настоящее время *S. hortensis* растет во всех уголках Европы, Азии, Южной и Северной Америки, Африки и Австралии [2].

Чабер садовый в местах произрастания используется в качестве пряной приправы в солениях в свежем и сушеном виде, в медицине – как антисептик, благодаря наличию эфирного масла и флавоноидов, в парфюмерии – за приятный запах, в виде экстрактов или эфирного масла [3].

Растение содержит до 2% эфирного масла, главными компонентами которого являются карвакрол, борнеол, цимол, пиненн, цинеол и другие терпены. Кроме того, в сырье содержаться смолы и дубильные вещества. Стебли чабера содержат урсоловую кислоту. В семенах найдено жирное масло, в гидролизате кислоты: пальмитиновая, стеариновая, олеиновая, линолевая, линоленовая. Жирное масло семян может заменить льняное. В листьях чабера садового содержится до 1% эфирного масла, состоящего из тимола, пинена, фенола, карвакрола. Молодые стебли и листья чабера садового богаты минеральными солями, каротином, витамином С (до 50 мг%), фитонцидами и эфирными маслами [4].

Известно, что экстракт травы растения обладает антибактериальным, антифунгальным, инсектицидным и противоглистным действием, используется как ароматическое, ветрогонное, при нарушениях деятельности желудочно-кишечного тракта; в гомеопатии – как отхаркивающее [6].

Прямо с грядки или высушенный, он – отличная пряная приправа. Свежая, мелко нарубленная зелень хороша в салате из свежих огурцов или с молодым картофелем. Чабер сочетается с рыбой, добавляют его и при панировке. Придает пикантный запах мясным блюдам из свинины, баранины, птицы; добавляют его в фарши, соусы, супы, а также кладут в отварную капусту. Используют его при варке фасоли и гороха, а также в маринадах и солениях из огурцов и помидоров [6].

## Материал и методы исследований

Интродукционные исследования растений *Satureja hortensis* проводились в ботаническом саду Житомирского национального агроэкологического университета на протяжении 2009-2011 гг. В опытах использовали семена растений из Национального ботанического сада им. Н.Н. Гришко НАН Украины (г.Киев).

Средняя продолжительность безморозного периода в условиях Житомирского Полесья – 150-160 суток. Лето – теплое, средняя температура июля 25-26°С. Средняя многолетняя температура наиболее холодного зимнего месяца – минус 6°С, наиболее теплого – плюс18,4°С. Средняя относительная влажность воздуха в апреле-мае составляет 68 и 69%, в июне-сентябре 72 и 82%. Весенние заморозки в большинстве случаев заканчиваются в третьей декаде апреля, а первые осенние начинаются чаще всего в последней декаде сентября – первой декаде октября. Годичная сумма осадков колеблется от 659 до 727 мм.

Растения выращивали на открытом, хорошо освещенном участке. Почва темно-серая подзолистая, имеет следующий химический состав: гумус – 3,00-3,22 %, гидролитическая кислотность – 0,75 мг.экв/100 г, рН-солевое – 6,2; содержание $K_2O$ – 78,0 мг; $P_2O_5$ – 406 мг; $N_k$ – 67,2 мг/кг почвы, Са – 12,12 и Mg – 1,00 мг.экв/100 г.

Размножение чабера садового осуществляли семенами. Посев проводили в различные сроки: вторая декада апреля; третья декада апреля; первая декада мая.

С целью изучения влияния площади питания на рост и развитие *Satureja hortensis* растения размещали по различным схемам (см): 10 × 30, 10 ×45, 20 ×30, 30 × 30, 40 × 30, 30 × 45, 40 × 45, что соответствовало площади питания (см$^2$): 300; 450; 600; 900; 1200; 1350; 1800.

В процессе исследований были использованы общенаучные и специальные методы исследований. Полевые исследования и фенологические наблюдении проводили за общепринятыми методиками (И.Н. Бейдеман,1974; О.А. Порада, 2007).

## Результаты и обсуждения

Чабер садовый – однолетнее травянистое растение. Корни – слабо развитые и размещены в верхнем слое грунта. Стебель 40-70 см высотой, сильноветвистый от основания, с супротивно расположенными побегами (12-20), покрытый короткими волосками, с фиолетовым оттенком. Листья темно-зеленые с цельным краем, линейно-ланцетовидные, супротивные, остроконечные, длиной 1,5-3,0 см, с точечными железками. Цветки мелкие, собраны в ложную мутовку, сидят по 1-5 в углах листьев, нижние – на коротких цветоножках, верхние – сидячие. Чашечка опушенная, пятизубчатая, около 3 мм длиной. Венчик двугубый, лиловый, с пурпурными пятнышками в зеве, около 4,5 мм длиной. Завязь верхняя четырехлопастная, четырехгнездная с одним столбиком и двураздельным рыльцем. Пыльники лиловые. Цветение растения наблюдается с июня по октябрь. Плод по созревании распадается на 4 орешка коричневого цвета.

Установлено, что *S. hortensis* в условиях Полесья Украины проходит полный цикл развития. Всходы появляются в среднем на 15-22 сутки в зависимости от климатических условий. При наличии достаточного количества влаги в почве, а так же при оптимальном температурном режиме (12-15$^{o}$C) всходы появляются через 10-17 суток. При дефиците влаги всходы появляются через 21-28 суток. Вначале на поверхности почвы появляются семядоли, а через 5-10 суток – первая пара листьев. С момента образования 4-5 узлов начинается стеблевание. Период формирования растений от всходов до бутонизации длится от 38 до 49 суток. В этот период растения очень изменяются – они сильно ветвятся, появляются мелкие листья. Цветение длится 35-40 суток, созревание семян столько же (рис.1-2). Полная вегетация растений завершается в конце сентября – начале октября в зависимости от срока сева и климатических условий. Вегетационный период длится 125-135 суток, период от сева до уборки семян 135-166 суток. При севе растений во второй декаде мая вегетативная масса нарастает интенсивнее, чем в конце третьей декады апреля, но семена в таком случае начинают созревать в октябре месяце.

Рис.1. Развитие растений *Satureja hortensis* от всходов до начала стеблевания

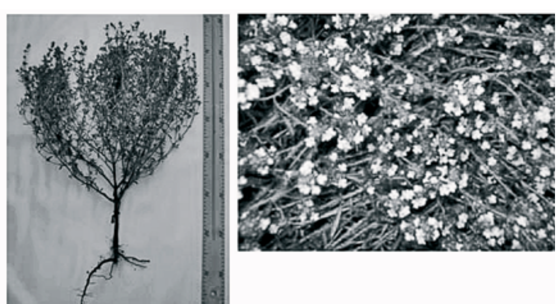

Рис. 2. Растения *Satureja hortensis* в фазу цветения

Изучение оптимальной схемы размещения растений *S. hortensis* проводили при севе в третьей декаде апреля. Исследованиями установлено, что с увеличением площади питания растений (от 300 до 1800 см$^2$) наблюдается существенное увеличение ростовых и продуктивных показателей, а именно: длина стеблей в 1,5 раза; длина корней, количество побегов I порядка и их длина, количество соцветий и их длина – в 1,6; количество цветков в соцветии – в 2,9; количество листьев – в 2,1; масса растения – в 4,0 раза (табл.).

Таблица

**Биометрические показатели и продуктивность растений *Satureja hortensis* в зависимости от площади питания (среднее 2009-2011 гг.)**

| *Площадь питания, см$^2$* | *Длина стебля, см* | *Длина корня, см* | *Количество побегов I порядка, шт* | *Длина побегов I порядка, см* | *Количество соцветий, шт* | *Длина соцветий, см* | *Количество цветков в соцветии, шт* | *Размер цветка, см* | *Количество листьев, шт* | *Масса растения (с корнем), г* |
|---|---|---|---|---|---|---|---|---|---|---|
| 300 | 45,5 ± 2,6 | 8,7 ± 0,5 | 10 ± 0,8 | 24,2 ± 1,0 | 162 ± 5,0 | 6,0 ± 0,3 | 44 ± 1,8 | 0,25± 0,04 | 1215,8 ±16,4 | 66,9 ± 1,4 |
| 450 | 49,1 ± 1,4 | 9,2± 0,3 | 12,3± 0,90 | 32,1± 1,2 | 181,9 ± 3,6 | 9,4 ± 0,4 | 56,4 ± 1,9 | 0,31± 0,04 | 1423± 23,4 | 74,6± 1,9 |
| 600 | 51,2 ± 1,1 | 9,8 ± 0,4 | 14 ± 0,94 | 33,0 ± 1,0 | 196± 6,8 | 9,5 ± 0,5 | 66,5± 2,3 | 0,36± 0,04 | 1545± 23,6 | 81,3 ± 1,7 |
| 900 | 53,0± 1,4 | 10,0 ± 0,5 | 13 ± 0,91 | 33,5 ± 0,9 | 211± 2,5 | 9,7 ± 0,4 | 77,6± 1,8 | 0,38 ± 0,02 | 2015± 5,8 | 113,2± 1,7 |
| 1200 | 55,4± 1,0 | 10,1± 0,5 | 15± 1,12 | 34,3 ± 1,1 | 228 ± 5,1 | 9,9 ± 0,5 | 89,1± 2,2 | 0,4 ± 0,02 | 2181,8 ± 44,3 | 160,3± 4,9 |
| 1350 | 60,1± 2,1 | 12,5 ± 0,9 | 15.3± 0,72 | 36,9± 1,3 | 246 ± 3,8 | 10,2± 0,8 | 102,1± 2,6 | 0,41± 0,03 | 2267± 12,6 | 219± 5,2 |
| 1800 | 66,8± 1,7 | 14,5± 0,7 | 16± 0,82 | 39,6± 2,6 | 261± 5,7 | 10,5 ± 0,8 | 126,5± 6,7 | 0,43± 0,03 | 2552± 42,7 | 268,9± 5,7 |

Установлено, что с целью формирования высокопродуктивных растений чабера садового наиболее оптимальная площадь питания составляет 1800 см$^2$. При выращивании чабера с площадью питания 300 см$^2$ растения образуют наименьшее количество боковых побегов, более мелкие листья, минимальное количество соцветий и цветков (рис. 3-4).

Рис. 3. Растения *Satureja hortensis* в период цветения при площади питания 300 см$^2$

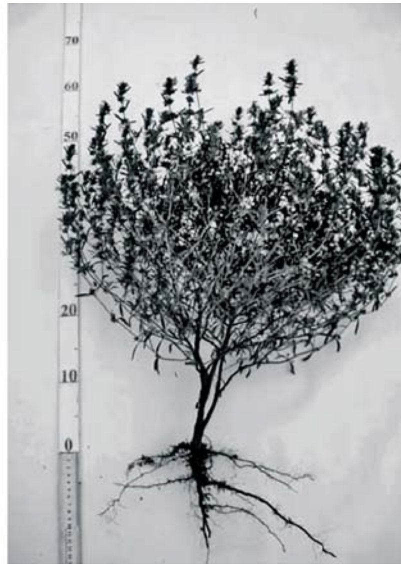

Рис. 4. Растения *Satureja hortensis* в период цветения при площади питания 1800 см$^2$

**Выводы**

Изучение биологических особенностей *Satureja hortensis* показало, что в условиях интродукции в Житомирском Полесье растения проходят полный цикл развития и обеспечивают хорошие ростовые параметры и продуктивность. Семена обеспечивают дружные полевые всходы. Растения обильно цветут и формируют полноценные семена. Продолжительность вегетационного периода составляет 125-135 суток, период от сева до уборки семян – 135-166 суток.

Рост и развитие растений *Satureja hortensis* существенно зависят от сроков сева и площади питания. Увеличение площади питания растений от 300 до 1800 см$^2$ способствует увеличению ростовых и продуктивных показателей в 1,6-4,0 раза.

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## BREEDING OF NEW SORTS OF CHRYSANTHEMUMS

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***Summary.*** *In the present article are described the biological characteristics of main sorts and varieties which are revealed that sorts well for cultivating in the Republic Moldova. The methods of breeding sorts of chrysanthemums are carried out.*

Breeding and introduction of new sort and forms of floral ornamental plants obtained as a result plant breeding have a great advantage both in decorativeness and in the biological and economic properties and characteristics, in comparison with the introduced (Garstea, Leshenko, Dashkeev, 1987). As a result it was revealed a great variety of chrysanthemums, which differ inform of inflorescences, their coloring, dimensions and number, height of bush, timing of flowering. However, the sorts bred in various countries, differ from the local climatic conditions, and are often not adapted to the specific conditions of the region's culture. As a consequence, appear undesirable changes in color and shape of inflorescence, which reduces their decorativeness and quality. In the Republic of Moldova can be grown only high-grade ornamental, strong and easy to culture, with a high coefficient of reproduction, resistant to pests and diseases and to unfavorable climatic conditions. We have carried out a large breeding work to produce new sorts chrysanthemums, and the purpose of this study is to obtain of their own local sorts of chrysanthemums with high decorativeness and also high resistance in the conditions of Republic Moldova.

### Materials and methods

The breeding work was carried out at the experimental area of floriculture laboratory, in the conservatory stock and, on plot of the State Botanical

Garden varietal (sort) testing. As a biological material for researches12 varieties of small flowers chrysanthemums, mostly of them early flowering was served (Starfall, Wee Willie, Denise, Meried Deo, Golden Rain, White Daisy, Superform, Enset Bella, Alba, and Child of the Sun, Darkie, and Marunțele). Experiments were carried out according to the State Varietal Testing of agricultural crops (Issue 6, Section ornamental crops, 1968), Yabrowoy-Kolakowskoy (1972) and Dworyaninova (1982) methods.

## Results and discussions

Chrysanthemums, like many other ornamental herbaceous flowering plants, are reproducing by vegetative and generative ways. It is known, that the main method of chrysanthemum reproduction is considered that vegetative, in which all the characteristics of the mother plant are transmitted to daughter plants. Generative method of reproduction is used for the development of new varieties, and generally has a selective importance. This method has several advantages in comparison with vegetative. This method allows obtaining a large number of diverse and pure (uninfected) for planting, since vegetative propagation is inevitable transfer of young plants of fungal and viral infections from contaminated plots. Plants obtained from seeds, also are durable, have a more developed root system, is easier to port a transplanting, they are adapted to the climatic conditions of the local earth.

The technology of reproduction chrysanthemums by the method of breeding Yabrovoy-Kolakowskoy was (1972) carried out by artificial hybridization, also by free cross-pollination, and vegetative reproduction of resulting sorts. According to special literature (Yabrova-Kolakowskaya, 1972; Dworyaninova, 1982, Andrianov, 1990, Kuznetsov, 2006, etc.), the most diverse progeny in chrysanthemum is obtained by cross-pollination free.

Our selection work is based on two directions: getting early flowering varieties, low, with compact, free-flowering shrubs for landscaping, and using in open soil, in containerized culture, as well as varieties for cutting with high not lodging bushes, which formed a large number of highly decorative inflorescences. In our work we did not use artificial hybridization, and used the free-pollination between the plants of selected of parental pairs. By the method of free cross-pollination of two groups of parental varieties, during the period 2000-2007, were obtained mature seeds of which were subsequently grown more than 2,000 seedlings of various shapes and color of the inflorescence, the structure of the shrub, foliage and other characteristics. From the first group of parental sorts – Child of the sun, Fuchsia fairy, White daisy, Darkie, Married Deo, Superform (1999-2001)1024 seedlings were grown, but is madeonly 3% of the total number of selections from seedlings.

The main criterion for initial selection was the common decorativeness of plants. With such a combination of parental pairs progeny happened less diverse. Predominated the homogeneity coloring of inflorescences and chamomile-shaped form, the bushes are not resistant to lodging. Were obtained highly ornamental selective forms, three of which (Olguța, Raza soarelui, Gingăşie), in 2007-2009, have successfully passed the State varietals testing and submitted for approval at the sort. The study of chrysanthemums sorts growing in the open field showed that the maturation of seeds is irregularly, but only in years with soft and long fall. In 2005-2007, for pollination has been taken, another group of parental varieties – Starfall, Wee Willie, Denise, Golden Rain, Superform, Enset Bella. The most diverse progeny happened from the sorts of Starfall and Wee Willie. Grown from these species were obtained variegated populations, and in the inheritance of characteristics the maternal plant a great variety was observed. It concerns the shape and coloring of inflorescences size, shape and leaf size, height and habitus bush, and the timing of flowering. These effects suggested the conclusion of being this group of sorts as good parents.

Studies on the inheritance of characteristics from maternal plant chrysanthemums in the first generation have shown that in this case is observed a determined law. For example, in the progeny of the yellow varieties dominate seedlings with yellow flowers up to 45%, pink-violet up to 25%, and red (various shades) - 15%.White color, at free pollination provides in the progeny (offspring) up to 40% white, 20% yellow, 35% pink and lila can do very small percentage of red and purple. The most dominant is the pink-purple color which gives in the seed progeny of up to 49%, 20% – of closely related-purple color. Thus, in the seed progeny quantitatively the type of mother plant predominate. Obtained by us selective form chrysanthemums, over the years, were cultivated and were adapted on experimental plots (sectors) Laboratory of Floriculture Botanical Garden. During the tests, many specimens have died from high temperatures in the winter and spring-summer periods. The stationary varietal test was carried out on his plot of the State Varietal Tests, where perspective and future sorts were planted insufficient quantities for further and in-depth study. Culling of seedlings was carried out over several years, and with the target of further investigating was submitted by 35 selective forms. At 20 of them, the development phase, performance on decorativeness and morphological features was identified. Main breeding form: Olguța, Raza soarelui, Gingăşie, Wee Willie 3 / 05, Wee Willie 6 / 05, Wee Willie 7 / 05, Starfall 9 / 05, Golden rain 1 / 07, Mărunțele 1 / 07 were commended as perspective for obtaining sorts.

Characteristics of perspective breeding forms chrysanthemums:

**Olguța** – buds are deep pink with a lilac tint, double, diameter of4,5-6,0cm.Bush60 cm tall, pyramid-shaped, semi-spreading. The leaves are large, rounded, dark green, glossy. The plant blooms in early September, the duration of flowering2-2.5 months. This form may be used for cutting, in gardening, in group plantings and mixborders.

**Raza soarelui** – bright yellow inflorescences, simple, chamomile-shaped, up to 3 cm in diameter. At the same flowering shoots 20-25 inflorescences. The bush is up right, pyramidal shape, up to 70-75 cm tall. The leaves are medium sized, light green. The plants blossoms in the first half of September during 70-80 days. It is recommended for cut, in the group plantings and high borders.

**Gingăşie** – inflorescences white-cream, pompon, double. The diameter of the inflorescence 3-3,5 cm, they are disposed in the upper crown. Shrub height of 25-30 cm, hemispherical shape. Leaves medium-sized, delicate, and green with blue-gray tint. Is flowering from the middle of October, a total loss of decorativeness within 1.5-2 months. Suitable for creating borders and group plantings, alpine gardens, container culture.

**Golden rain** 1 / 07 - bush spreading, pyramidal shape, achieves till 70 cm in height. At one bush flower-bearing shoots 7.5. Average number of leaves. Leaves of medium size, dark green with a bluish tint. Inflorescences double, flat and bright orange 3.5-6.5 cm in diameter, on the same flowering shoots up to 35 inflorescences. Blooms from mid-October, during 30-35 days. Recommended for high borders and cutting.

**Mărunțele** 1 / 07 – bush pyramidal shape, height up to 65cm. Stems are thin, bendable, at a bush 7.5 flower-bearing shoots. Leaves are light green mean leaf blade 4-6cm, width 1-1.5 cm at the base of inflorescences smaller. Inflorescences double, pompom, brick, with bright yellow center 2-3 cm in diameter. At the same flowering shoots 40-45 inflorescences, disposed in the upper crown. The plants bloom in early September, the duration of flowering 40-45 days. The form is recommended for high borders, group plantings and for cut.

**Wee Willie** 6 /05 – is a spherical bush, height 25-30cm, the average foliage. Leaves are small, light green, slightly pubescent. Inflorescences double, pompon, yellow-cream, at the beginning of the dissolution of the center is brighter, the end of flowering acquire a pinkish tint. Inflorescences of 2-4 cm in diameter, one flowering shoots up to 20-25 cauliflowers abundant blooms on one bush 200 or more inflorescences. Is a variety of early flowering, early flowering in September and remains decorative within one-two months. The variety is resistant to diseases and pests, drought-resistant and frost-resistant. It is recommended for planting, can be used in flower gardens for various purposes and containerized culture.

**Wee Willie** 7 /05 – bush height up to 35 cm, semiglobular shape, densely leafy. Leaves are dark green with pointed tips, pubescent on the inside. Inflorescences are double, pink with a lilac tint, the end of flowering at the base of the petal share almost white. Petals slightly pointed, 2.5-3 cm in diameter of the inflorescences. The variety is blooming abundant, on the bush up to 200 inflorescences. Not affected by diseases and pests resistant to adverse environmental conditions. It flowers from September 35-55 during the day. It is recommended for use in landscaping, for borders, group plantings, flower beds and containerized culture.

**Starfall** 9 /05 – bush height 60 cm, the shape of pyramid, spreading, and dense foliage. The leaves are rounding, dark green, medium size. Inflorescences are double, dark purple, the petals on the outside with a white shade, which gives the effect of silver. Inflorescences of 4-6 cm in diameter, one flowering shoots up to 20 inflorescences. Blossoms in the first decade of October within 1,0-1,5 months. This form is resistant to diseases and pests, drought and frost resistant. It is recommended for group plantings and for cut.

## Conclusions

1. Highly decorative chrysanthemum varieties resistant to diseases, pests and unfavorable climatic conditions in Moldova can be with drawn only in local area.

2. Was established that the most diverse and vital offspring (progeny) may be obtained by free cross-pollination of parental sorts.

3. The inheritance of characteristics was confirmed in the maternal plants.

4. Better parents, from all the varieties under study were: Starfall, Wee Willie, Denise, Superform, and White Daisy.

5. Main breeding forms of chrysanthemums Olguța, Raza soarelui, Gingăşie, Wee Willie 3 / 05, Wee Willie 6 / 05, Wee Willie 7 / 05, Golden rain 1 / 07, Mărunțele 1 / 07 have highly decorativeness, are resistant to disease and pests, and to unfavorable climatic conditions and can be recommended for widespread use in landscaping, in containerized culture, for cut.

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# IV. LANDSCAPE ARCHITECTURE

## MODELAREA CREŞTERII ARBORILOR ŞI ARBUŞTILOR (TOPIARY)

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*Grădina Botanică (Institut) a AŞM*

**Summary.** *In Joint Operational Programme Romania - Ukraine - Moldova 2007-2013, EU-funded program, was developed the "Cross-border initiative for developing playful topiary art for education and leisure (TopArt)". The partner in this project are the Botanical Garden "Anastasie Fatu" the University "Al. I.Cuza", Iasi, Romania and Botanical Garden (Institute) of the Academy of Sciences of Moldova. This project aims to improve cooperation between the two botanical gardens on both sides of the Prut River in order to increase their capacity to provide cultural, educational and relaxation to the final beneficiaries: young children, the elderly and increasing public awareness on cross-border cooperation between Romania and Moldova, through this program in order to find solutions for common problems series and/or similar. Visitors will be able to spend time in a space with natural light and lovely shapes, anthropomorphic and zoomorphic, very suitable for organizing educational activities profile, culture and relaxation: shows, competitions, television broadcasting etc.*

În cadrul Programului operațional comun România – Ucraina – Republica Moldova 2007-2013, finanțat de Uniunea Europeană, a derulat proiectul „*Inițiativă trans-frontalieră pentru dezvoltarea unui spațiu ludic prin intermediul artei Topiare pentru scopuri educative şi de relaxare (TopArt)*".

Instituțiile partenere în cadrul acestui proiect sunt Grădina Botanică "Anastasie Fătu" a Universității „Al.I.Cuza", Iaşi, România şi Grădina Botanică (Institut) a Academiei de Ştiințe a Moldovei.

Scopul acestui proiect este (i) îmbunătățirea colaborării între cele două grădini botanice de pe ambele maluri ale râului Prut în vederea sporirii capacității acestora de a furniza servicii culturale, educative şi de relaxare pentru vizitatori şi (ii) creşterea gradului de conştientizare din partea publicului asupra colaborării trans-frontaliere dintre România şi Republica Moldova, prin intermediul acestui program, în vederea găsirii unor soluții pentru o serie de probleme comune şi/sau similare.

Vizitatorii îşi vor putea petrece timpul liber într-un spațiu natural deschis şi încântător cu forme geometrice, antropomorfe şi zoomorfe, foarte potrivite pentru organizarea unor activități cu profil educativ, cultural şi de relaxare: spectacole, concursuri sportive, emisiuni televizate etc.

## Materiale şi metode

Întru modelarea formelor topiare au fost utilizate tipare metalice confecționate din sârmă de diferită grosime: sârmă arsă cu diametrul de 1,5 – 2,5 mm şi cu diametrul de 5,5 mm, plasă metalică cu ochiuri hexagonale cu latura de 3 cm, țesătură de iută.

La umplerea spațiului din interiorul tiparului s-a utilizat sol fertil şi semințe de iarbă de gazon. În calitate de material săditor au servit exemplare de: *Thuja sp, Buxus sp. Taxus sp. etc.*

## Rezultate şi discuții

Ce-a mai frumoasă exprimare a gândurilor omului este arta. Topiary este o artă străveche, inclusiv tehnici horticole utilizate în scopul de a obține forme clar definite şi forme geometrice stilizate din plante vii. Practic, se referă la formarea şi modelarea plantelor care suportă tăierea frunzelor şi ramurilor sub forme dorite şi întreținerea acestor forme prin aplicarea tăierilor respective la anumite intervale de timp.

Termenul provine din latină de la „*topiarius*” şi a avut inițial un sens mult mai larg, referindu-se în general la grădinăritul ornamental.

Primele datări privitor la topiary provin din Egiptul antic, unde oamenii au însuşit tehnologia de a modela arborii şi arbuştii în forme geometrice. Astfel, a primit o răspândire largă grădinile simetrice şi geometrice, cu alei dreptiliniu şi arbuşti frezați şi cu gard viu. Apoi arta de tăiere şi modelare a ajuns în Europa şi chiar în Extremul Orient.

În perioada medievală arta grădinăritului  s-a dezvoltat şi s-a menținut numai în complexele mănăstireşti şi castele. Grădinile din această perioadă erau amplasate pe suprafețe mici.

În timpul perioadei renaşterii este caracterizată prin condiții de dezvoltare, linişte şi păşnicie, castelele războinice au fost treptat înlocuite de vile, ale căror terenuri erau aranjate din punct de vedere peisagistic. Arhitectul casei se ocupa şi de gradină, pentru a realiza un ansamblu armonios.

În perioada renaşterii (sec. 14.) arta topiară este supusă curenților stilului arhitecturii perioadei respective, dar totodată se ține cont şi de stilul clasic şi tipizat al artei topiare. Grădinile din perioada renascentistă reprezintă rezultatul unei ambianțe a omului şi natură. Aceste grădini nu sunt altceva decât nişte opere de artă.

Pe parcursul dezvoltării micile grădini au fost completate cu sculptură verde, inclusiv oameni, păsări, animale şi diverse forme abstracte.

În America de Nord arta topiară de asemenea a avut o răspândire largă. Desigur că grădinile americane nu puteau concura cu cele din Europa din secolul 18, dar totuşi au fost create elemente, care au caracterizat grădinile americane ale perioadei respective.

În Europa (secolul al 16-lea, perioada renaşterii) arta topiară se asociază cu parterele şi terasele din grădinile de elită. Acea perioadă se caracterizează prin modelarea figurilor geometrice: bile sau cuburi, abeliscuri, piramide, conuri, spirale oblice şi forme reprezentative care înfăţişează oameni, animale etc.

Figura 1. Florence, Villa Medici la Petraia. // E. Kluckert. European Garden Design. 2007. ISBN 978-3-8331-1044-3

Perioada *Baroque* iniţial a păstrat stilul simetriei, apoi mai târziu a fost introdus şi răspândit stilul barocului asimetric. În concepţia acestui stil grădinile erau create pe terenuri imense plate, la mijloc fiind amplasată clădirea centrală. Acest stil creează vizitatorului posibilitatea de a vedea grădina ca un tot întreg coerent, dar în acelaşi timp, este imposibil de a vedea toate componentele grădinii.

Figura 2. Grădină în stil Baroque (Castelul Frederiksborg). (http://www.panoramio.com/photo/5506651)

Arta modernă topiară nu se bazează numai pe arta topiară tradițională ci şi utilizează diverse tipare din metal, plante, care servesc în calitate de ghid în timpul tăierii. Aceste forme asigură o modalitate uşoară de a crea un topiary rapid cu puțin efort.

Figura 3. Viespe**.** (Canada)

Speciile de plante utilizate în arta topiară sunt cele care pot prelua şi menţine anumite forme la tăiere. Plantele sempervirescente cu frunze mici şi dese sunt cele mai pretabile şi utilizate în arta topiară.

Speciile de plante des utilizate în arta topiară:.

- *Buxus rotundifolia*
- *Buxus sempervirens*
- *Carpinus betulus*
- *Fagus sylvatica*
- *Hedera helix*
- *Larix kaempferii*
- *Ligustrum vulgaris*
- *Picea abies*
- *Ribes alpinum*
- *Taxus baccata*
- *Thuja occidentalis*
- *Thuja plicata*
- *Tilia sp. (T. tomentosa)*

Arta topiară constă în tunderea arborilor şi arbuştilor până se obţine o anumită formă, cu totul diferită de forma naturală pe care planta şi-o asumă în mediul său natural. Totul din scopuri pur ornamentale. Astfel, se realizează un gard viu cu forme în special geometrice, dar şi plante singulare sau în mici grupuri forţate să primească forme dintre cele mai neaşteptate.

Figura 4. Spirală. (*Thuja occid.* Fastigiata)

Această latură a artei grădinăritului este tot mai răspândită în arhitectură şi în arta contemporană, deoarece permite realizarea unei ambianțe vii şi creativă, în armonie cu natura şi cu tendinţele estetice ale momentului.

**Spirala** este una dintre cele mai cu efect forme care nu poate lăsa indiferent privirea vizitatorului. Nu poţi rezista tentaţiei de a nu opri privirea la ea şi trece cu mâna pe planta care este modelată spirala, aceasta fiind una dintre cele mai însemnate aprecieri ale măiestriei. Pentru a crea o spirală cu adevărat atractivă şi interesantă este necesar de multă iscusinţă şi măiestrie.


Figura 5**.** Sfera/semisfera. **(***Buxus sempervirens)*

**Sfera/semisfera** sunt nişte forme foarte simple şi destul de atractive în orice expoziție a grădinii. Plantele pentru modelarea acestor forme pot fi crescute atât direct în sol cât şi în diverse recipiente.

Pentru obținerea formei dorite planta trebuie „*educată*". În prealabil trebuie hotărâtă forma ce se doreşte să se obțină (pentru începători modelul trebuie sa fie cât mai simplu), apoi se realizează o siluetă tridimensională cu ajutorul unui fir metalic inalterabil la intemperii. Se mai poate opta pentru o silueta gata făcută.

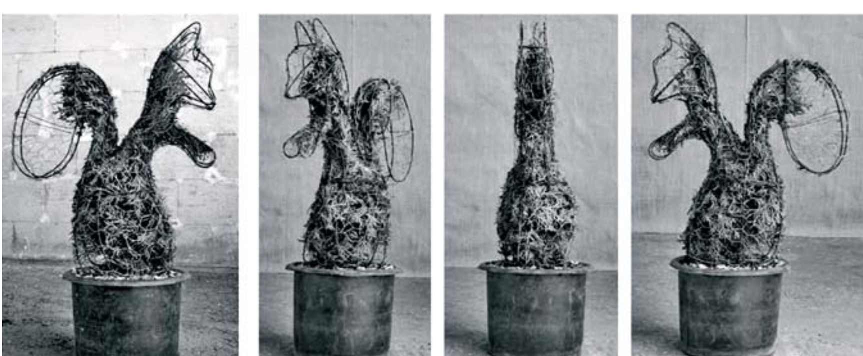

Figura 6. Veveriță**.** (*Thuja occidentalis*)

Apoi tiparul se va fixa peste plantă şi se tunde tot ceea ce depăşeşte tiparul. Silueta din metal va fi lăsată pe plantă, repetându-se de mai multe ori operațiunea de tundere, astfel încât, încet, încet, crescând în înălțime şi lățime, planta va umple complet tiparul, preluându-i modelul.

Tiparul pentru veverițe a fost modelat din sârmă arsă cu grosimea de 2,5 – 3,5 mm, apoi îmbrăcat pe *Thuja occidentalis*. Pentru a reda o formă cât mai posibil de adevărat tiparul a fost îmbrăcat cu plasă metalică cu ochiuri hexagonale cu dimensiunile laturilor 3,5 – 4,0 cm şi grosimea sârmei de 2,0 mm. Ramurile şi frunzele plantei care nu se înscriu în tipar sunt înlăturate.

Conform aceleiaşi tehnologii au fost confecționate tipare în formă de delfin din sârmă cu grosimea de 5,5 mm, apoi îmbrăcați pe exemplare de *Thuja occid. „*Fastigiata*"*.

În final a fost creat un rond cu diametrul de 8,0 m, în interior fiind amplasate formele topiare modelate de delfini, sfere cu diametrul de 35 cm din *Thuja occid*. Ellwageriana şi cu diametrul de 50 cm din *Buxus sempervirens*.

Întru crearea fonului de apă poate fi înşirat un strat cu grosimea de 5 cm de prundiş de granit de o nuanță sur-albastru, sau se pot planta flori de *Lobelia erinus.*

Figura 7. Rond cu delfini. (Grădina Botanică (Institut) a AŞM)

Pentru confecționarea instrumentelor muzicale, a fost aplicată tehnologia de modelare a tiparului metalic, care apoi s-a îmbrăcat cu țesătură de iută şi plasă metalică. Golul din interiorul tiparului a fost împlut cu substrat de sol fertil şi semănat cu semințe de iarbă de gazon. Pe parcurs ce iarba de gazon regulat creşte se frezează şi se menține la înălțimea de 5 – 7 cm.

Figura 8. Tobe. (Grădina Botanică (Institut) a AŞM)

Figura 9. Doamnele la plimbare. (Grădina Botanică (Institut) a AŞM)

## Concluzii

1. Figurile topiare sunt foarte interesante şi atractive, bucurând privirea vizitatorului în orice anotimp al anului.

2. La modelarea unei sau altei forme este necesar inițial a se determina concret ce figură se doreşte a se obține în final şi selectarea corectă a plantei.

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## EDUCATIVE IMPROVEMENT OF TOPIARY ART (CASE STUDY: BOTANICAL GARDEN OF IAŞI)

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**Summary.** *The art of topiary seeks to control the growth of the plant and to form from it the desired shapes. Also to control the extent of growth annually in order to maintain those shapes once they have been achieved. The practice is to increase the surface density of the pieces and a strong and relatively rigid structure beneath. In 'Anastasie Fătu' Botanical Garden of Iaşi, children, students and educators worked together to explore environmental issues using action-oriented inquiry. An interdisciplinary approach to curriculum helped children and students to understand specific ecological conditions and enabled them to learn about the complexities of surrounding contemporary ecological art. Students and biologist learned about topiary design, construction and how maintenance is an ongoing process.*

### Introduction

Topiary, the art of fashioning living plants into ornamental shapes, is often a feature of the grand country houses and great estates, with their spectacular gardens containing magnificent sculptured hedges and geometric shaped trees and shrubs [5].

Many of the old cottage gardens too have their living works of art. Peacocks and all manner of animal creations rise above the packed, colourful borders to create a traced back to the Ancient Greeks and Romans.

It became fashionable in Europe in the late 16$^{th}$ Century when many of the grand palatial residences were built. Topiary is an art form that anyone with a pair of shears can create [3].

The effect can be stunning; topiary can add character and individuality to any garden. Today's topiaries have become popular garden features once again and take on a variety of shapes from formal to playful. Teddy bears, cats and many other forms now join the more traditional shapes. The art of topiary seeks to control the growth, to form from it the shapes we desire. Also to control the extent of growth annually in order to maintain those shapes once they have been achieved [1].

The practice is to increase the surface density of the pieces - to promote a very even and close finish on the exterior and hopefully a strong and relatively rigid structure beneath. With most species used for topiary and in most climatic zones, there are definite seasons of growth (spring and summer) and a dormant period (autumn/fall and winter). Aesthetically, the topiary pieces look best when trimmed to the tight lines of their allotted forms [2].

Topiary is a plant grown over a framework into a specific three-dimensional shape. Plants used for topiaries, including ivy, can grow both indoors and outdoors. Ivy varieties are favourites because of their fast growth and ease of maintenance. Larger topiaries are found in landscaping bush and shrubs while smaller versions become ornamental fixtures inside entryways or halls [4].

## Materials and methods

Topiary is the art or practice of trimming and shaping plants into ornamental shapes. The shapes can be any object or geometric shape one can think of. A shrub or tree can be purchased and shaped by anyone, or purchased from a local nursery where it has already been formed. The most popular forms of topiary are *spirals*, *pompoms*, *poodle tier* and *standards* [1].

Maintaining the creations at optimum sharpness of outline for the longest period is achieved by cutting the growth off at the end of the growing season. This is a popular technique used most often in large collections where maintenance must be kept to a minimum because of the shear number of pieces and the amount of work involved [6].

## Results and discussions

In 'Anastasie Fătu' Botanical Garden of Iaşi, children, students and educators worked together to explore environmental issues using action-oriented inquiry. An interdisciplinary approach to *curriculum* helped children and students to understand specific ecological conditions and enabled them to learn about the complexities surrounding contemporary ecological art. Students and biologist learned about topiary design, construction, and how maintenance is an ongoing process.

Case study: exhibition of topiary organized on the occasion of the *Celebration of a Century* and a half after the foundation in Iaşi of the first modern University of Romania. The 34-th edition of the *Autumn Flowers Exhibition*, organized from October, 23-rd to November14-th, 2010, offered to the specialists in Botanical Garden of Iaşi the opportunity to use topiary elements for achieving the symbols for the 15 faculties of the 'Alexandru Ioan Cuza' University of Iaşi.

For this, they used inflorescence different in shape, colour and size from the collection of chrysanthemums grown in the botanical garden, and some waste products (wire, wood, cloth, rope, PVC net, glass etc.) resulted from current activities carried out by gardeners. In the selected photos are some examples where more chromatic and playful sensibility besides the geometric rigor can be observed.

The symbol realized for the *Faculty of Biology* (Figure 1) suggests the life, the result of eternal complementarities between positive and negative, between plus and minus or between male and female. The flowers used for this ensemble realization represents the biodiversity which makes the planet Earth unique, where the green heart of nature is pulsating.

Figure 1. Faculty of Biology

The floral symbol for the *Faculty of Chemistry* (Figure 2) represents the multitude of links established between organic and inorganic elements.

By this representation the mission of chemistry in the deciphering of the possibilities of combining these elements and to realize this phenomenon in the benefit of nature has been identified.

Figure 2. Faculty of Chemistry

The symbol through is represented the *Faculty of Law* (Figure 3) suggests a cage in which a delicate white chrysanthemum is closed, and, through this, the very nature that gave us life, the most valuable asset. By this representation it has been considered that nature is his own lawyer, who makes his case with every flower, bee or blade of grass. And the tenderness of flowers, raw green of the grass or the bees buzzing makes inevitably that the Justice to incline the balance in favour of nature protection!

Figure 3. Faculty of Law

The floral symbol realized for the *Faculty of Physical Education and Sport* (Figure 4) suggests the beauty of human nature and the joy of sports competitors. By this symbol is reinforced the idea that sport is a symbol not only for competition but also for health, relaxation and team spirit.

Figure 4. Faculty of Physical Education and Sport

The symbol created for the *Faculty of Letters* (Figure 5) suggests words that can be written and remains immortal over the centuries. The letters from the Latin alphabet made of flowers and open book may include an entire universe.

Figure 5. Faculty of Letters

The symbol created for *Mathematics Faculty* (Figure 6) speaks of reason. Surprisingly, the floral arrangement proves that this science is so close to art. Whether there are circles, squares or triangles, their harmonious or fancy combination after the rigorous laws of mathematics can give rise to forms that speak to the heart and nature simultaneously.

Figure 6. Faculty of Mathematics

The symbol realized for the *Orthodox Theological Faculty* (Figure 7), suggests the monogram of Jesus Christ, the first two Greek letters of the name of Christ, and the alpha and omega characters are symbolizing the beginning and the end, the divinity and the eternity of Christ.

Figure 7. Faculty of Theological Orthodox

The courtyard topiary project was designed to illustrate art's connection to other subject areas. Biologist from Botanical Garden of Iaşi worked in teams to formulate interdisciplinary connections that crossed disciplines, grade levels, and established community partnerships. Students and biologist worked together to learn more about the interconnectedness of art, aesthetics, culture, and ecology through action-oriented inquiry.

In horticulture, the mosaic-culture is the art of composing colour paintings with the help of living plants which are chosen mainly depending on the leaf's colours and growth uniformity and planted after a predetermined design. This practice brings outdoor the principles of carpets and paintings in order to realize genuine celebrations decorations.

From our experiences at the topiary exercises in the Botanical Garden of Iaşi, team members developed educational and ecological skills for the courtyard topiary project. Eighth graders would mentor sixth and seventh grade students on ways to maintain the topiary project at the school. When the sixth graders entered seventh and eighth grade, they would assume mentor roles and offer prior knowledge and understanding to maintain the plants and metal wire forms. From visiting and observing the existing topiary site new ideas formed for *curriculum* implementation. The child can count out loud as he adds each gumdrop to the topiary, and see how high he can go. This activity will also help the child to practice colour recognition and learn about different materials and textures. Topiary is the art of trimming and shaping trees into sculptural, ornamental shapes.

## Conclusions

The Botanical Garden of Iaşi plays an important role in the society, contributing by research, education and popularization to plants diversity conservation.

Since 1975 exhibitions presenting taxa from the botanical garden's collections are being organized: azaleas, camellias, peperomias, begonias, fittonias, maranthas, crotons, euphorbias, cactuses in from January to March and chrysanthemums, cabbages, pumpkins, decorative peppers and numerous samples of fruits and seeds collected from species from all the continents in from September to November.

Multipurpose trees and shrubs have the capacity to provide for a variety of end uses while reversing the process of land degradation.

Most of our environmental problems can be solved to a great extent if we grow more trees, especially in urbanized localities and cities.

As discussed above, topiary art are of great importance to people, not only ornamentally and bio-aesthetically but also ecologically.

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# TOPART PROJECT – A WAY TO CAPITALIZE THE EXPERIENCE OF THE BOTANICAL GARDEN OF IASI IN TOPIARY ART

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**Summary.** *Project TopArt is developed within the Botanical Garden of Iasi, having as a main objective the revival of topiary art for playful purposes. The Botanical Garden has some experience in practising this art, as proven by the topiary forms and ground floors within the Ornamental sector. The practice of topiary art is realized in different manners on different occasions. Utilised plants are either sempervirent shrubs or annual flowery plants and indoor plants. Topiary elements that are shown are permanent or temporary, especially those made for traditional thematic expositions at the garden. Existing experience will be of great value in developing the TopArt project, in which fixed and mobile topiary forms, with their own advantages, will be realized. Chosen themes will take into account the characteristics of the target group.*

## Introduction

The TopArt project aims, through practical field activities, to bring to the fore two of the most important functions of a botanical garden: the cultural one and the leisure one. The garden fulfils these defining functions in many ways, but choosing topiary art as a way of expressing them requires solid knowledge, experience and a remarkable esthetical vision. All stages of the project have to take into consideration the specifics of the final beneficiaries, represented mainly by children, so it is absolutely necessary for all approaches to be impregnated with a playful spirit.

Although the term of topiary art is little known even by those working in the gardening field, the practice of this art is very old, having its origins in the Greek antiquity. At the beginning (in the ancient Rome) the gardeners were named *topiarius* in the old Latin texts, meaning landscape designers, and their form of art was called *ars topiariae* [*Constantinescu S. Viorica, 1992*]. Later, the meaning of *ars topiariae* was restricted only to the art of cutting trees, with a late development at Romans, half century after the appearance of gardens, during the first century B.C.

The Latin term, used by Pliny the Elder to describe the art of gardening, was *opus topiarium* (derived from the Greek term *topia*, meaning landscape). During Augustus, Pliny wrote about an invention named „nemora tonsilia" or regular cutting of plants. The one who invented "nemora tonsilia" was a Roman knight, friend of Augustus, by the name of Gaius Matius [*Amery C., B. Curran, 2002*]. He initiated the "carving" of Roman deities not only in stone but also in buxus and laurel. The term comes from Latin: *nemus, moris* – forest, *tonsilis-e* – cutting and clearing.

The Italian Renaissance garden, following the Roman gardens tradition of almost completely ignoring the floral element, was considered by Stendhal "the most beautiful union of architecture and the beauty of trees".

From the very rigid principles of topiary art, initially referring only to cultivation and modelling of wooden plants in ornamental forms, things have evolved gradually, coming to a less formal approach nowadays. At present, an extreme form of expressing topiary art may be found in the gigantic wooden and herbaceous forms depicting complex images [*Diarmuid Gavin, 2002*] inspired by fairy tales or allegorical cars, mounted at various events. Finding equilibrium between the two aspects mentioned above might represent an interesting provocation.

## Discussions

Topiary art, under its various forms, has been practiced in the Botanical Garden of Iasi for decades. One can distinguish some different ways of expressing topiary art, according to the plants that have been used and the period of exposure of the elements that have been realized.

At the exterior there are the most popular classical topiary art forms, placed within the Ornamental section of the Botanical Garden. The area between the administrative pavilion and the garden's central axe was arranged after the east-west direction by combining renaissance style in the centre with landscape style (natural) in the marginal north-west and south-west areas.

Figure 1, 2. Arabesques made from *Buxus sempervirens*

Figure 3, 4. Specimens of *Buxus sempervirens* cut as geometrical topiary forms

The core of the composition contains lots of topiary forms made especially from two taxa: *Buxus sempervirens* (cimişir) and *Taxus baccata* (tisă), both sempervirent shrubs [*Gilgemeister Heidi, 1996*]. Using the two plant species there were realized ground floors with decorative patterns as well as various geometrical forms: spheres, cubes, rhomb, parallelepipeds. Such geometrical forms made by buxus can be found in other areas of the Ornamental sector as well. The way of conducting the plants was the classical one, following the principles known from antiquity under the name of „*nemora tonsilia*".

In different times of the year, outdoor spaces too, different topiary elements were made by annual flowery plants. From spring till late autumn, using vernal plants (hyacinth - *Hyacinthus sp.*, primrose - *Primula sp.*), summer plants (verbena - *Verbena hybrida*, begonia - *Begonia semperflorens*) or autumn plants (chrysanthemum - *Chrysanthemum* *indicum*), topiary compositions with zoomorphic (butterfly), geometric (spheres) and decorative character are displayed. Using specimens of *Sedum hexangulare* a vegetal clock was arranged, whose figures were receiving the shadow projections of some stone spheres.

Figure 5. Summer topiary element made from *Begonia semperflorens*

Figure 6. Vegetal clock made from *Sedum hexangulare*

Figure 7, 8. Topiary elements made from chrysanthemum (*Chrysanthemum indicum*)

Most of the examples shown do not require any helping stands, with the exception of those presented in fig. 8. These forms, occasioned by the "Autumn Flowers" 2010 exhibition, required metallic models filled by a mix of soil for planting the mums.

Protected areas of the Botanical Garden are used to exhibit, all year round, topiary forms made by indoor wooden or herbaceous plants, with pendent port. Metal or wooden helping stands are necessary to obtain these forms. Utilised plants are represented by species of *Hedera helix* L. (*‚Eva'*, '*Gold heart'*, ‚*Marmorata'*), *H. canariensis ‚Gloire de Morengo'* or *Vinca major 'Variegata'*.

Figure 9, 10. Topiary forms made by pendent indoor plants

Another category of topiary forms practiced in the botanical garden are those occasioned by temporary exhibitions such as “Autumn Flowers” and “Flowery Messages”. The final outcomes have geometrical, zoomorphic and floral patterns, sometimes abstract featured and sometimes playful.

Figure 11, 12. Aspects from exhibitions held at the Botanical Garden of Iasi

The area for the implementation of the TopArt project is placed in the Ornamental sector of the Botanical Garden of Iasi, which contains, as previously shown, lots of classic (renaissance style) topiary elements.

The aim of the project is to enrich and improve the field reality and, at the same time, to merge the already existing elements with modern ones. Specimens purchased or obtained by the Botanical Garden’s specialists will have an attractive appearance, with various forms such as animals, insects, letters, fairy tale characters loved by children, representative symbols. The biological material for the realization of these forms may be exclusively woody (species of *Taxus, Juniperus, Thuja, Buxus, Carpinus orientalis, Parthenocissus, Vinca, Hedera helix* etc.), exclusively herbal (species of *Begonia sempervirens, Stachys lanata, Cineraria maritima, Ajuga* *reptans, Sedum spurium, Echeveria sp., Iberis sempervirens, Lysimachia nummularia, Helichrysum petiolare* etc.) or a combination of the two.

The combination of the modern form with the existent traditional ones could be achieved in many ways, taking into consideration the target group that the final result is aimed at.

In order to maintain the classical style of the focus area, a version of mobile topiary forms will be chosen. These forms will have the value of temporary exhibition elements. The main advantage of mobile forms is the ease of changing, relocating, moving and replacing them whenever we choose, according to necessities, events that take place in the respective area or characteristics of the participating target group. Forms that are attractive for preschool children do not hold the same interest for teens or students. There are disadvantages thou, related mainly with the shorter and more laborious maintenance period.

In order to achieve a stronger impact space, with an aspect as close to natural as possible, south-west and north-west areas will be arranged. Topiary elements shaped as animals, birds or insects are the most suitable for this kind of site which they complement entirely, yielding a uniform look of flora and fauna biotope. A placement as close to the natural as possible can contribute to creating a true image, expected to have maximum impact on the target group in mind. Implementation of elements derived from widely known fairy tales that take place in nature will also be taken into consideration (e.g. Little Red Riding Hood, Hansel and Gretel), especially for target groups represented by pre-schoolers or primary school children.

Inside this area, topiary form can be both fixed and mobile [*Gallup Barbara, Reich Deborah*, 1987], made from specimens permanently planted in a given place. The latter have the advantage of a longer timespan to be exhibited and a less laborious maintenance work needed.

Taking into consideration the already existing plants, that form a relatively monotonous and rather dark assembly (various shades of green and grey), it is recommended for the topiary forms the use of coloured taxa, in order to refresh the overall look: either wooden plants with variegated leaves (eg. varieties of *Buxus*, *Hedera*) or herbaceous plants with colourful flowers (eg. *Begonia sempervirens, Clarkia amoena, Verbena sp.*).

Upon completion of the project the area would be enriched with forms and species that constitute a suitable assembly for conducting various ecological activities as well as educational and artistic ones.

## Conclusions

The implementation of the TopArt project benefits from the experience acquired over time by the specialists working in the Botanical Garden of

Iasi. Topiary forms that are to be purchased or obtained in the garden will be chosen based on the target group particularities; they could be fixed or mobile, as needed.


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## TOPIARY – THE MOST MAGNIFICENT HORTICULTURAL ART THROUGH THE YEARS


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**Summary.** *The wonders fanciful topiary - renderings of animals, humans, and objects created from evergreens, perennial herbs, and other natural plant material- never fails to leave a lasting impression on all who experience it. This art form has been practiced for centuries, resulting in elegant green constructions of seemingly endless size, shape, and subject matter. Yet with continuing interest in gardening and crafts, this elegant form of self-expression is enjoying a fresh vogue among celebrities and other prominent people worldwide. Topiaries is a unique survey of the splendid parterres, arches, pyramids, spheres, columns, knot gardens, and other formations that constitute this magnificent and enduring art.*


Topiary is the horticultural practice of training live perennial plants, by clipping the foliage and twigs of trees, shrubs and sub shrubs for developing and maintaining clearly defined shapes [1], perhaps geometric or fanciful, plants which have been shaped in this way. It can be an art and is a form of living sculpture. The word derives from the Latin word for an ornamental landscape gardener, *topiarius*, *and creator of topia or places*. A Greek word that Romans applied also to fictive indoor landscapes executed *in fresco*. No doubt the use of a Greek word betokens the art's origins in the Hellenistic world that was influenced by Persia, for neither Classical Greece nor Republican Rome developed any sophisticated tradition of artful pleasure grounds.

The plants used in topiary are evergreen, mostly woody, have small leaves or needles, produce dense foliage, and have compact and/or columnar (e. g. fastigiate) growth habits. Common species choices used in topiary include cultivars of European box (*Buxus sempervirens*), arborvitae (*Thuja spp*.), bay laurel (*Laurus nobilis*), holly (*Ilex spp*.), myrtle (*Eugenia* or *Myrtus* species), yew (*Taxus species*), and privet (*Ligustrum species*) [2]. Shaped wire cages are sometimes employed in modern topiary to guide untutored shears, but traditional topiary depends on patience and a steady hand, small-leaved ivy can be used to cover a cage and give the look of topiary in a few months. The hedge is a simple form of topiary used to create boundaries, walls or screens.

## History and origin

European topiary dates from Roman times. Pliny's Natural History and the epigram - writer Martial both credit Cneius Matius Calvena, in the circle of Julius Caesar, with introducing the first topiary to Roman gardens, and Pliny the Younger describes in a letter the elaborate figures of animals, inscriptions and ciphers and obelisks in clipped greens at his Tuscan villa (Epistle VI, to Apollinaris). Within the atrium of a Roman house or villa, a place that had formerly been quite plain, the art of the topiaries produced a miniature landscape (*topos*) which might use the comparable art of stunting trees, also mentioned, disapprovingly, by Pliny (Historia Naturalis, XII.6).

## Far eastern topiary

Clipping and shaping of shrubs and trees in China and Japan has been practiced with equal rigor, but to entirely different aesthetic aims: the artful expression of the *natural* forms of venerably aged pines, given character by the forces of wind and weather. Their most concentrated expressions are in the related arts of Chinese penjing and Japanese bonsai. Japanese cloud-pruning, i.e. illustration, is closest to the European art: the cloud-like forms of clipped growth are designed to be best appreciated after a fall of snow. Japanese Zen gardens (karesansui, dry rock gardens) make extensive use of so-called Karikomi it means, topiary technique of clipping shrubs and trees into large curved shapes or sculptures, and Hako-zukuri, understanding as shrubs clipped into boxes and straight lines.

## Renaissance topiary

From its European revival in the 16th century, topiary has historically been associated with both the parterres and terraces in gardens of the European elite and equally as features in cottage gardens. Traditional topiary forms use foliage pruned and/or trained into geometric shapes: balls or cubes, obelisks, pyramids, cones, tapering spirals, and the like. Representational forms depicting people, animals, and manmade objects have also been popular. Topiary at Versailles and its imitators was never complicated: low hedges punctuated by potted trees trimmed as balls on standards, interrupted by obelisks at corners provided the vertical features of flat-patterned parterre gardens. Sculptural forms were provided by stone and lead sculptures. In Holland, however, the fashion was established for more complicated topiary designs; this Franco-Dutch garden style spread to England after 1660.

## Decline in the 18th century

In England topiary was all but killed in fashion by the famous satiric essay on ”Verdant Sculpture” that Alexander Pope published in The Guardian, 29 September 1713, with its mock catalogue descriptions of:

- Adam and Eve in yew; Adam a little shattered by the fall of the tree of knowledge in the great storm; Eve and the serpent very flourishing.
- The tower of Babel, not yet finished.
- St George in box; his arm scarce long enough, but will be in condition to stick the dragon by next April.
- A quickset hog, shot up into a porcupine, by its being forgot a week in rainy weather.

In the 1720s and 1730s, the generation of Charles Bridgeman and William Kent swept the English garden clean of its hedges, mazes, and topiary. After topiary fell from grace in aristocratic gardens, however, it continued to be featured in cottagers gardens, where a single specimen of traditional forms, a ball, a tree trimmed to a cone in several cleanly separated tiers, meticulously clipped and perhaps topped with a topiary peacock, was passed on as an heirloom.

## Revival

The revival of topiary in English gardening parallels the revived *Jacobethan* taste in architecture; John Loudon in the 1840s was the first garden writer to express a sense of loss at the topiary that had been removed from English gardens. The art of topiary, with enclosed garden *rooms* burst upon the English gardening public with the matured example of Elvaston Castle, Derbyshire, which opened to public viewing in the 1850s and created a sensation: *within a few years architectural topiary was springing up all over the country (it took another 25 years before sculptural topiary began to become popular as well*) [3]. The following generation, represented by James Shirley Hibberd, rediscovered the charm of specimens as part of the mystique of the *English cottage garden*, which was as much invented as revived from the 1870s:

It may be true, as I believe it is, that the natural form of a tree is the most beautiful possible for that tree, but it may happen that we do not want the most beautiful form, but one of our own designing, and expressive of our ingenuity (James Shirley Hibberd).

The classic statement of the British Arts and Crafts revival of topiary among roses and mixed herbaceous borders, characterized generally as *the old-fashioned garden* or the Dutch garden [4] was Topiary: Garden Craftsmanship in Yew and Box by Nathaniel Lloyd (1867-1933), who had retired in middle age and taken up architectural design under the encouragement of Sir Edwin Lutyens: Lloyd's own timber-framed manor house, Great Dixter, Sussex, remains an epitome of this stylized mix of topiary with "cottagey" plantings that was practiced by Gertrude Jekyll and Edwin Lutyens in a fruitful partnership. The new gardening vocabulary incorporating topiary required little expensive restructuring in plan: "At Lyme Park, Cheshire, the garden went from being an Italian garden to being a Dutch garden without any change actually taking place on the ground", Brent Elliot noted in 2000 [4].

Americans in England were awake to the renewed charms of topiary. When William Waldorf Astor bought Hever Castle, Kent ca 1906, the moat surrounding the house precluded adding wings for servants, guests and the servants of guests that the Astor manner required: he built an authentically-style Tudor village to accommodate the overflow, with an "Old English Garden" including buttressed hedges and free-standing topiary [4]. In the preceding decade, expatriate Americans, led by Edwin Austin Abbey, created an Anglo-American society at Broadway, Worcestershire, where topiary was one of the elements of a "Cotswold" house-and-garden style soon naturalized among upper-class Americans at home. Topiary, which had featured in very few eighteenth-century American gardens, came into favor with the Colonial Revival gardens and the grand manner of the American Renaissance, 1880–1920. The beginning of a concern with the revival and maintenance of historic gardens in the 20th century led to the replanting of the topiary maze at the Governor's Palace, Colonial Williamsburg, in the 1930s.

## 20th century

American Portable style Topiary was introduced to Disneyland around 1962. Walt Disney helped bring this new medium into being - wishing to recreate his cartoon characters throughout his theme park in landscape shrubbery. The frame allows the plants to grow into every curve with a built in guide. This style of topiary is based on a steel wire frame that is both stuffed with sphagnum moss and planted, or a frame that has shrubbery growing from within as a permanent cutting guide. The sculpture slowly transforms into a permanent topiary then as it grows in. This style has led to imaginative displays and festivals throughout the Disney Resorts and Parks, and Mosaiculture (multiple types and styles of plants creating a mosaic, living sculpture) competition worldwide includes the impressive display at the 2008 Summer Olympics in China. Living corporate logos along roadsides, green roof softcopies and living walls that biofilter air is an offshoot of this technology was established.

Artificial topiary is another offshoot similar to the concept of artificial Christmas trees. This topiary mimics the same style of living versions, often as indoor plants for home decoration. Patents are issued as well in both style design, and concept on the construction of different types of topiary trees [5].

## Notable topiary displays

Australia. Railton, Tasmania known as Railton Town of Topiary (Railton, Tasmania) Railton is a part of the Kentish Municipality, Tasmania's "Outdoor Art Gallery". Railton's topiary is one facet of the outdoor art gallery. There are much topiary underway in various stages of growth [6, 7 and 8].

Asia. Mosaiculture 2006 (Shanghai, China). The Samban-Lei Sekpil in Manipur, India, begun in 1983 and recently measuring 18.6 m in height, is the world's tallest topiary, according to Guinness Book of World Records. It is clipped of *Duranta erecta* L., a shrub widely used in Manipuri gardens, into a tiered shape called a sekpil or satra that honors' the forest god Umang Lai.

Europe. Cliveden (Buckinghamshire, England). Levens Hall (Cumbria, England).

A premier topiary garden started in the late 17th century by M. Beaumont, a French gardener who laid out the gardens of Hampton Court (which were recreated in the 1980s).

Topsham railway station (Devon, England) An example of topiary lettering. Canons Ashby (Northamptonshire, England) A 16th-century garden revised in 1708 Stiffkey, (Norfolk, England). Several informal designs, includes a line of elephants at Nellie's cottage and a guitar. Great Dixter Gardens (East Sussex, England): Laid out by Nathaniel Lloyd, the author of a book on topiary, and preserved and extended by his son, the garden-writer Christopher Lloyd. Parc des Topiares (Durbuy, Belgium). A large topiary garden (10 000 m$^2$ with over 250 figures is founded. Château de Villandry, France. Villa Lante (Bagnaia, Italy). Castello Balduino (Montalto Pavese, Italy). Guggenheim Museum, (Bilbao, Spain): A huge sculpture of a West Highland White Terrier designed by the artist Jeff Koons, which is thought by experts and scientists to be the world's biggest topiary dog. The Tsubo-en Zen garden in Lelystad, Netherlands is a private Modern Japanese Zen (karesansui, dry rock) garden that makes extensive use of so called O-karikomi combined all season's close-up of the Tsubo-en (Netherlands) O-karikomi, hako-zukuri topiary with Hako-zukuri. Gardens of the Palace of Versailles outside Paris, France

## North America

Hunnewell Arboretum (Wellesley, Massachusetts). 140-year-old topiary garden of native white pine and arborvitae is created. Ladew Topiary Gardens (Monkton, Maryland). A topiary garden in Maryland established by award-winning topiary artist Harvey Ladew in the late 1930s. Located approximately halfway between the north Baltimore suburbs and the southern Pennsylvania border. Ladew's most famous topiary is a hunt, horses, riders, dogs and the fox, clearing a well-clipped hedge, the most famous single piece of classical topiary in North America; Topiary Garden at Longwood Gardens (Kennett Square, Pennsylvania); Columbus Topiary Park at Old Deaf School (Columbus, Ohio). A public garden in downtown Columbus that features a topiary tableau of Georges Seurat's famous painting Sunday Afternoon on the Island of La Grande Jatte are established. Pearl Fryar's Topiary Garden, (Bishopville, South Carolina); Green Animals – a topiary garden outside Providence, Rhode Island. One of the subjects of the documentary Fast, Cheap and Out of Control (1997) was George Mendonça, the topiarist at Green Animals for more than seventy years: "it's just cut and wait, cut and wait" Mendonça says in a filmed sequence.

## Popular culture

In the Tim Burton/Johnny Depp film Edward Scissorhands, Edward proves to have a natural gift for topiary art, hands is lauded for his skill in the art; a real-life topiary artist is one of the subjects of Errol Morris's Fast, Cheap and Out of Control. Numerous creative works are shown throughout the movie. In the Stephen King novel The Shining, topiary animals that move when people aren't looking frighten the Torrance family. In the children's novel The Children of Green Knowe by Lucy M. Boston, an overgrown topiary figure of Noah plays a sinister role. A real life topiary artist is one of the subjects of Errol Morris's Fast, Cheap and Out of Control. In the TV show Spongebob Squarepantis episode Atlantis Squarepantis, Squidward says to Spongebob that he's only been here two minutes, and already managed to mess up someone else's topiary garden.

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## LANDSCAPE DESIGN STAGES OF RESIDENTIAL NEIGHBORHOODS CASE STUDY


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**Summary.** *This paper reaches aspects related to residential neighborhoods and subdivisions landscape design, identifying design criteria. Considering the fact that realization of good projects designed to enhance the community and aesthetic* *value of this type of development is a stringent problem, this work analyzes existing gaps in mode of development of a residential subdivision developed in a rural area near the Cluj-Napoca city and proposes solutions to improve the aesthetic, environmental, social issues through a landscape design that follows well-defined principles.*

## Introduction

Criticism related to residential developments may include the following aspects: does not match to larger communities, some of them are isolated, with one entry, or in other modes connected with the rest of community, being strictly destined for housing, they do not serve to other purposes, this requires displacement of residents to other areas for commercial purposes or other, while mixed developments take into consideration the commerce and other aspects of community planning, residential developments provides only houses.

This paper reaches aspects related to of residential neighborhoods and subdivisions landscape design identifying design criteria. Considering the fact that realization of projects designed to enhance the community value [2, 7] and appearance of this type of development is a stringent problem, this work analyzes existing gaps in mode of development of an residential subdivision developed in a rural area located near Cluj-Napoca city and propose solutions to improve the aesthetic, environmental and social issues through a landscape design that follows the principles described in "Residential Developments Landscape – Design Principle." The planning process, that can be considered the most important aspect of living space landscape planning, is often neglected.

## Materials and methods

The method used in this paper is both empirical and based on information derived from study of reference works available in the scientific literature regarding the residential neighborhoods landscape design [1, 4]. In the case study conducted for the realization of this paper were used six basic steps for creating the landscape for residential areas.

The stages were:

1. Initial plan elaboration. The first step in landscape design is to develop an initial plan of the site, plan showing the limits and physical characteristics that will affect the final project.

2. Site assessment. Were analyzed environmental characteristics of the site, location, boundaries (Figure 1), topographical features, climatic data, constituent elements of the existing landscape, shadow studies. The way

in which sun affects the site and the buildings, will influence the overall design. By knowing the direction of the sun at different times of the year, can be determined optimal location of the trees in order to obtain an energy efficient landscape.

3. Inhabitants need assessment. Identifying personal needs of inhabitants will help design an aesthetically pleasing and functional landscape. Identifying personal needs of residents will help to design an aesthetically pleasing and functional landscape. Further examples of needs related to landscape are enumerated. These needs should be considered in the design process.

*3.1. Checklist of the needs related to landscape - exampl*e

- Access to house
- Pedestrian walkways - size, appearance, lighting system
- Auto access - surface type and turning space requirements
- Parking - for family members, guests, caravans, boat, bikes
- Family activities
- Outdoor Recreation - cooking, relaxing, patio access
- Playground
- Sport, recreation
- Maintenance
- The owner works in their own backyard?
- Storage for gardening equipment
- Specific interests for gardening (growing vegetables, roses, herbs, fruit trees etc.)
- Space for containers, doghouse, storage space for wood etc.

4. Areas utilization localization. It refers to the location of areas for various uses. For each activity is necessary to allocate sufficient space. Following this stage the site will be divided into several separate areas, each with a specific purpose, but combined to make a whole in the final project.

5. Areas utilization development. For example, public areas and entry must be designed so that traffic flows to be directed by landscape elements; aesthetics can be improved by using interesting textures and lighting.

6. Planning. Landscape planning guided by a set of “rules” do not take into consideration site and inhabitant’s individual needs. Were considered recommendations which say that design should not be restricted by those rules (such as “always shrubs are planted in groups of three or five” or “never planting annual species in public space”) and that never result a good design if it complies with rigid rules.

Figure 1. Studied residential development background

The studied site is situated in a rural area rich in natural resources. Recently, the village registered a fast growth of built areas occupied by residential neighborhoods. Most of the existing rural landscape is transformed to make way for new neighborhoods and related infrastructure [8].

Studied residential ensemble is located west of Cluj-Napoca, with access to E60, close to major shopping centers and 5 minutes from the highway. The assembly is located in a generous natural setting and consists of 68 individual houses and personalized for different needs and different requirements. Following the first four stages it can be concluded that despite some positive aspects (infrastructure well defined even if not all houses are completed (Figure 2), the existence of landscaped public green space, fencing, and landscape related to individual houses) there is dysfunctions identified on the basis of residential neighborhoods development principles.

Figure 2. The roads system of studied residential assembly

These dysfunctions are as follows: vegetation is not significant, are missing street tree alignments (especially those consisting of deciduous trees); lack of decorative water surfaces; insufficient and not delimited for age group playground equipment; area for public park – reduced; non-unitary fencing; not significant area occupied by hedgerows; neighborhood entrance is marked by gates, which is not in accordance with the planning residential neighborhood principles; lack of street landscape design that provides aesthetic interest, improve environmental quality, increase mental and physical comfort of the residents and provide harmonious intercalation of the areas in the surrounding landscape; lack of plant protection windbreaks made of deciduous trees around the neighborhood; narrow sidewalks; lack of green space between sidewalks and roadways; lack of appreciation of valuable areas, while the green area is reduced after an sharpened and irreversible urbanization.

To calculate the influence of existing buildings shadows was established first the geographical localization of studied area. This is the starting point of a sun study. In documentation preparation were taken into consideration geographical coordinates of the studied village: latitude 46 º, 23 º 74’0874 N and 47’3148 E longitude. The sun study was carried out with SketchUp and Google Earth, software used to locate the site exact geographical coordinates and for relevant 3D images rendering to the study. Shading diagrams presented in drawn part in axonometric form, were studied for the four seasons (solstice, equinox) and for hours 9, 12, 16, analyzing the shadows and how they affect the site. Analyzing the result image it may be established that all buildings receive sunlight in optimal conditions, well above the minimum standard of 1.5 hours set out in Order 536/1997 of the Ministry of Health. In conclusion, existing buildings will not be affected in terms of sunshine by the proposed landscaping (Figure 3).

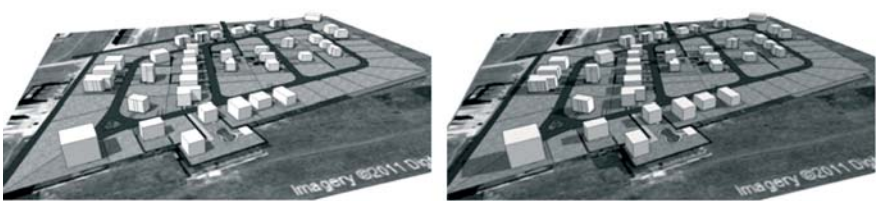

Figure 3. Sun study – image selection

**Results and discussions**

Starting from a quick overview we conclude that rural areas near cities are subject to major changes: natural lands lose this quality and theirs character and function are changed due to increased built areas destined for housing. New residential neighborhoods represents a vertical development, green spaces lose their value, often being annulled.

As a result of planning process are proposed valid solutions for studied residential neighborhood so that landscape redevelopment to enhance the value of social, educational and aesthetic aspects, in an area where the green area is clearly threatened by intensive development of built space. The concept is based on following principles of planning residential neighborhoods and subdivisions discussed in the first part of this work. Designed as a social, interactive open space, in which natural elements sustain and improve living conditions in this neighborhood with a coherent planning and constituting an urban landmark, the plan is designed with multiple functions covering a wide range of issues.

The concept is based on pursuing principles of residential neighborhoods and subdivisions planning discussed in the first part of this paper. Designed as an open space, social, interactive, in which natural elements sustain and improve living conditions in the neighborhood, with a coherent planning and constituting an urban landmark, the plan is designed with multiple functions covering a wide range of issues. A high attention was paid to obtain an aesthetic and functional units and environmental protection [6]. The proposal valued existing vegetation and elements, preserving them and intervening only to correct and improve [5].

Thus design is mainly focused on resizing sidewalks, improving the street landscape by proposing alignments of deciduous trees and separating vegetable strips for pedestrian part by roadway - planted with flower and shrub species; rethinking neighborhood fences and access; protection belts plant of in the areas delineation of the neighborhood; restructuring, remodeling and increasing the existing park area, introduction of new elements (Figure 4 - Figure 8).

Evident, these transformations involve additional costs, in particular because the studied neighborhood infrastructure is completed. These deficiencies can be avoided if the structure of residential developments would pursue principles that respect the environment and provide sustainable solutions since the early stages. In addition, sustainable landscapes, well-designed, implemented and maintained can contribute to increase the value of a residential real estate.

A good landscape design defined by new elements will provide unmistakable identity for residential area. Kevin S. Blake and Daniel D. Arreola [3] shows that residential subdivisions are often criticized because of the lack of identity. Also from the study conducted by them result that landscapes identity can be obtained by personal and institutional contributions and this identity can be achieved by various ways both in neighborhoods with high prices real estate and in those listed as having low real estate value.

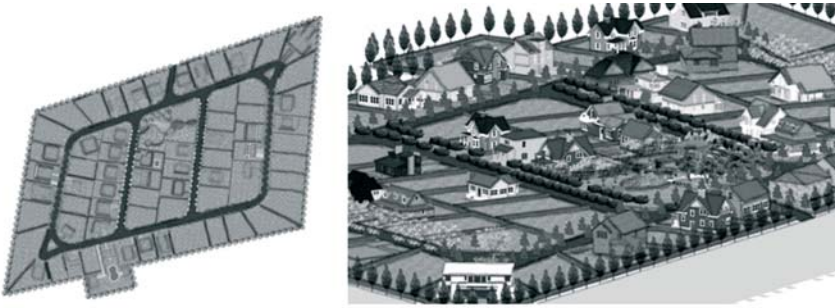

Figure 4. Development proposal

Figure 5. Landscape proposal – street alignment and vegetated strip

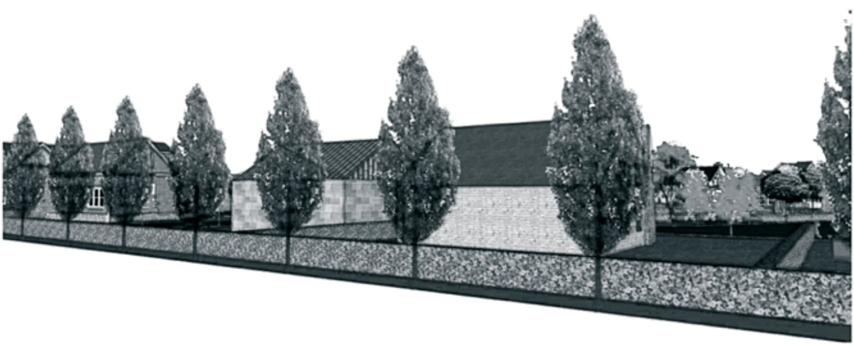

Figure 6. Landscape proposal – fencing

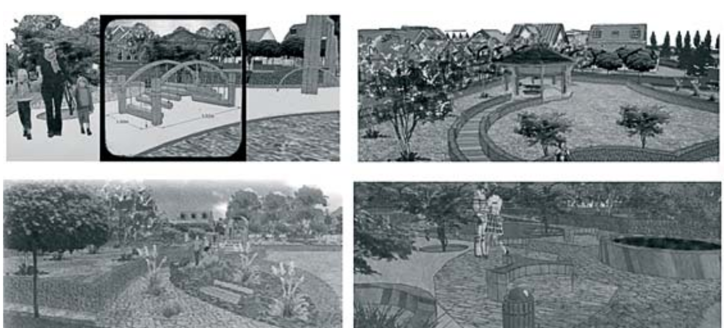

Figure 7. Landscape proposal – public green space

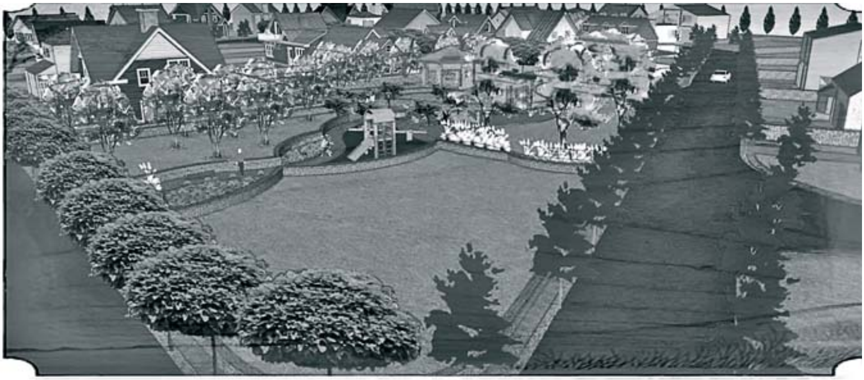

Figure 8. Proposed vegetation composition

## Conclusions

By following these stages, the finished product will be a personalized landscape that will reflect the lifestyle and residents needs and will allow growth and positive change in the future.

Pursuing proper stages of planning ensure landscape design coherence and facilitate the development of its main features.

Residential neighborhoods landscape principles can be easily applied even after the development in order to remedy some initial errors.

A residential area, that do not seeks from the beginning of construction or planning regulations that support an ecological friendly environment, aesthetic and social, can be reconsidered by the addition of some elements complying with common sense reasoning.

However, the redesign and rearrangement to correction requires additional economic resources, resulting higher costs for developers.

Is recommended to apply residential neighborhood planning principles and design elaboration stages in early stages of development.

The result will consist in prevent design errors, obtaining residential neighborhoods well integrated in the context, living environments with well-defined standards and suitable for communities; aesthetic economic, social and ecological benefits.

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# RESIDENTIAL DEVELOPMENT LANDSCAPE – DESIGN PRINCIPLES

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**Summary.** *Lifestyle in a residential neighborhood should not mean eliminating spending time outdoors, the importance of green space having the same positive values as in densely built urban areas. Around the immediate vicinity of cities in Romania there are rural communities filled with natural resources on which depends much of the charm of these localities. In recent years there has been a rapid increase in built area occupied by residential neighborhoods. This paper discusses the landscaping modalities of new residential neighborhoods and subdivisions developed or under development, in order to promote common sense rules to be followed by developers of new residential neighborhoods.*

## Introduction

A large part of the existing rural landscape near the cities in Romania is transformed to accommodate new neighborhoods and related road infrastructure. An important aspect is represented by the manner in which landscape is treated in the context of new residential development:

landscape design is used as a site stabilizing function instead for this to use in landscaping development design program's key components - human and aesthetic scale protection and amortization. Randall Arendt, in the preface of the book „Growing Greener: Putting Conservation into Local Plans and Ordinances" says that „growing in a greener way is also growing in a smarter way, for it is greener both environmentally and economically" [1]. Mike Brill in his article "Problems with community mistaking life for public life. Places." emphasizes that our social relationships spatially defined have three basic forms: private life, public life and community life and that many critics of contemporary urban life have failed to distinguish between the last two forms [2].

Residential developments community life is characterized by close relationships between his members and this relationship can be influenced by the living environment [3]. Establishing standards for residential developments landscape planning will offer newly built areas that benefit from a significant quality: the fact that respects the environment and are compatible aesthetically with the surrounding natural systems [4]. The standards should be applied in any residential development that involve on a lot subdivision or residential neighborhoods construction lot and also for best results, to areas in which is recorded a construction intention [7]. Standards can be achieved by monitoring and compliance with certain principles that will help to: stabilize the locality environment ecological balance; visual aesthetic aspect improvement; increasing the value; preservation and protection of locality identity; energy efficiency; protect public health, safety and general welfare etc. [6].

## Residential areas planning principles

In this paper we will treat a range of planning principles to residential neighborhoods and subdivisions, in order to create an overall of the basic principles. Although these principles promote the development of durable and sustainable neighborhoods, they not cover individually issues and opportunities associated with a particular site or structure [5]. Treated principles are not destined for inventory or for illustrate all possible solutions in any situation. However, they promote quality design and innovative solutions which in turn encourage feasible developments, long-term value; they are not representing mandatory requirement, but instead suggest good ideas for sustainable development [7]. Principles represent prescriptive or mandatory elements of planning or design to be used to determine compliance with a document, reasoning is the based or explanation from that principle start. Each principle includes advisory design guidelines or a number of suggested approaches so that this principle can be achieved. It concerns: design features for residential architecture (general architecture: garages, patios, entries, courtyards, lighting and security) and site plan elements (auto accesses, lot sizing, street landscape, obstacles, important views, orientation to parks / green public spaces).

*1. Principle regarding the general architecture* says that: residential systems, structures and buildings variation are achieved using quality materials and increased attention to design details, this leading to obtaining a greater visual interest, distinctive character and in question community's own identity. The reasoning from this principle starts is that good design and thoughtful details contribute not only to the enduring value of a house, but also to value of the whole neighborhood (Figure 1).

Figure 1. Example of variation in facades design [8]

*2. The principle relating to garages arrangement* shows that minimizing their visual impact as perceived elements from public area creates a visual relationship between the front entrance of the each house and street. The reasoning of applying this principle is that the visual appearance and views perception from the street is improved, and at the same time, is promoted interaction between surrounding area by reducing the garage size.

*3. Terraces, courtyards and entrances development principle* says that an entry clear aspect and an interesting design can be achieved by proper framing of terraces, arches and other architectural elements. The reasoning is that entries and terraces orientation and design quality offers interesting views from the street and contributes to pedestrians and activities safety (Figure 2, Figure 3).

Figure 2. Example of reducing the visual impact of garages on the site appearance [8]

Figure 3. Terrace orientation can offer interesting views from street *Original*

*4. Principle relating to auto and pedestrian accesses shows that* creative auto and pedestrians accesses, obtained by using quality materials and proper sizing, enhance the aesthetics of neighborhoods. The reasoning is that the paths design enables landscaped areas to contribute at neighborhood accessibility.

*5.* T*he principle that considers impediments and dimensioning* show that residential neighborhoods environment is determined by the variety of landscape and architecture - landscape varied due to differences between lots and constraints that can arise. The reasoning on which is based this principle is that the various dimensions of lots and constraints provides an interesting architectural mix, a varied mixture due to density (Figure 4).

*6. Another principle to be followed is that which refers to street landscape.* This principle says: designs, landscape elements and sidewalks quality soften built structures and bring unit to residential subdivisions and neighborhoods. The reasoning from this principle start is that landscape designs add value and increases the neighborhood sustainability (Figure 5).

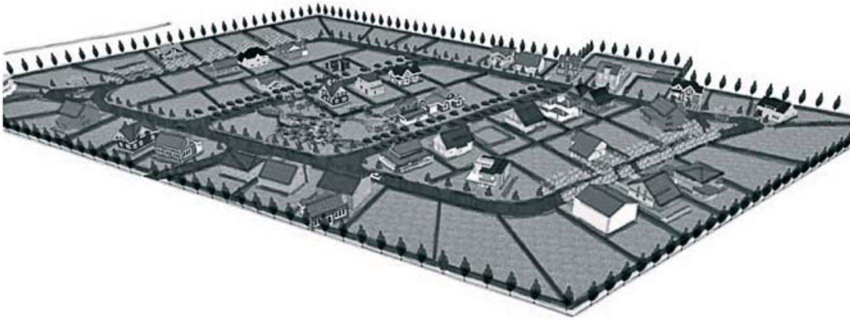

Figure 4. Example of lots sizing in a residential subdivision *Original*

Figure 5. Residential neighborhood landscape design and sidewalks arrangement example [8]

*7. The principle relating to neighborhoods and subdivisions accesses and fencing decor* shows that by using a creative design and quality construction materials, perimeter walls and entrances elements can provide a clear identity to neighborhood. The reasoning on which is based is that perimetral walls and the entry specific elements, harmoniously integrated into the landscape will define the community identity (Figure 6, Figure 7).

Figure 6. Fencing example of residential neighborhood *Original*

Figure 7. Example of accesses and fencing arrangement of residential neighborhoods [8]

*8. The principle relating to park/public garden orientation says that* physical and visual public access to open spaces and parks permit coherent and sustainable viability neighborhood achievement. The reasoning from this principle starts is that the orientation of green spaces design offers active and passive area which enhance the place significance and safety (Figure 8).

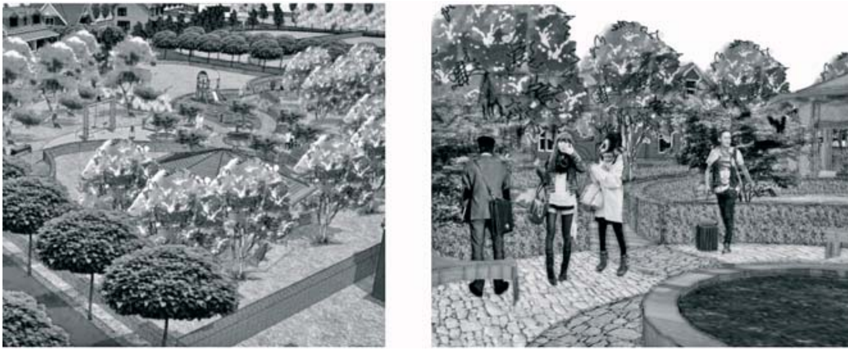

Figure 8. Green spaces design orientation provide active and passive space which enhance the place significance and safety
*Original*

## Conclusions

Approached subject is vast and cannot be exhausted in this paper. There is, adjacent to the presented principles and reasoning, a number of guidelines and alternative approaches that these principles can be implemented successfully. But we conclude on the basis of shown elements that to build a community, residential development actors must take into consideration the design, together with economic and social development.

Landscape is conscious green space arrangement in order to achieve a physical and psychological comfort. A well designed landscape is aesthetic and functional. A correct design will create a visual relationship between buildings, site and neighborhood.

Residential neighborhoods and subdivisions planning principles refer both to landscape elements and built elements, finally to obtain a unitary whole in harmony with the environment.

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## ENERGY EFFICIENT LANDSCAPE

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**Summary.** *In recent years there is an increased preoccupation for sustainable landscapes and, not least, for, energy efficient landscapes. Even if these preoccupations have considerable international experience, in Romania there is minimal information, both theoretical and practical, on this kind of landscape. This paper aims to present energy efficient landscape features and factors to be taken into account when designing their presentation based on a foray into literature. In addition, are shown the stages to be pursued to ensure correct application of the principles of energy efficient design of a landscape.*

### Introduction

Two of the most important contemporary concerns are energy conservation and environmental quality. To mitigate global warming and the greenhouse effect - current and pressing issues that affect the living environment - first, practical solutions must be identified and applied. This paper presents the characteristics of energy-efficient landscapes and the properly application mode of principles of this type of landscape.

Using principles and practices that are environmentally friendly landscape can generate significant changes in micro-climate of private housing, urban public green spaces and streets, adding the quality of being energy efficient [3, 11, 7, 4].

One of the definitions of „landscapes that conserve energy" is: „*reduce buildings energy costs in summer and winter. Ideally, landscapes that con-*

*serve energy conserve water at the same time*." A well planned landscape, well implemented and well maintained will increase the aesthetic value, decrease maintenance costs and increase real estate value.

Concerns for landscapes efficient energy dates from at least forty years, intensifying in recent years due to increased interest in environmental issues and sustainability.

An example of precocity interest in efficient energy landscape is given by Dennis E. Buffington, who in the article „*Economics of landscaping features for conserving energy in residences*" published in 1979 in „Proceedings of the Florida State Horticultural Society", evaluated the a effectiveness of landscape elements according to their value in energy savings. Buffington said that the landscape with "low power" consumption consists in houses with walls and roofs well shaded and painted in bright colors, with East or West orientation. Landscapes that generate "increased energy" consumption are defined by the housing walls and roofs unshaded or dark painted, Northern or Southern oriented [5]. Studies show that landscape planning site depending on the sites orientation, climatic characteristics of areas, buildings characteristics, etc. can make a significant reduction in energy consumption. Robert D. Brown and Terry J. Gillespie in the book „Microclimatic landscape design: creating thermal comfort and energy efficiency", says that "understanding the microclimate may provide necessary tools for create a comfortable thermal habitat for people and energy efficient landscapes for buildings" [6]. Akbari et al. [2] discusses the benefits of trees planting in urban areas. Shade provided by trees prevents direct sunlight action on buildings and, implicit, their heating. By planting vegetation, air conditioning requirement may be reduced and air quality improved.

During the lifetime of a tree, the sums saved reach an amount of $ 200 per tree. By The United States National Renewable Energy Laboratory [10], careful placement of trees can save up to 25% of energy used for building heating or cooling. Vegetation has the potential to moderate the air temperature through provided shading and not only by reducing surface temperature but by the cooling provided by evapotranspiration [8, 9].

## Principles of energy efficient landscape

After review of specialized literature and a number of existing case studies, can be summarized the principles of energy efficient landscape planning and the stages to be followed in their design.

Energy efficient landscape techniques include: using locally-sourced materials, compost producing in-situ, using hand tools instead of electrical maintenance or those that use fossil fuels, use of species adapted to local environmental conditions etc.

***Protection from direct sunlight*** can be obtained by applying several methods. Planting large deciduous trees provide shade during the summer and then, due to loss of foliage in winter, will enable sunlight to warm the buildings (Figure 1). For shading the roof and walls of a building with one floor, should be selected medium and large trees, whose location is recommended to be made at a distance of 4.5 to 6 m from the side or from 3 to 4.5 m from the corner structure. For an increased efficiency tree crown should be extended over the roof. Small trees can be planted near buildings and used for walls and windows areas shading. In addition to shading roof, plants can protect walls from heat and cold. Climbing species, shrubs and some trees can be used with auxiliary trellis systems. Leaf surface of these species will isolate thermal, phonic and protect against dust building walls (Figure 2). There are various modes and systems to conduct climbing plants on the wall surface. In addition modern vertical landscape systems allow various species planting.

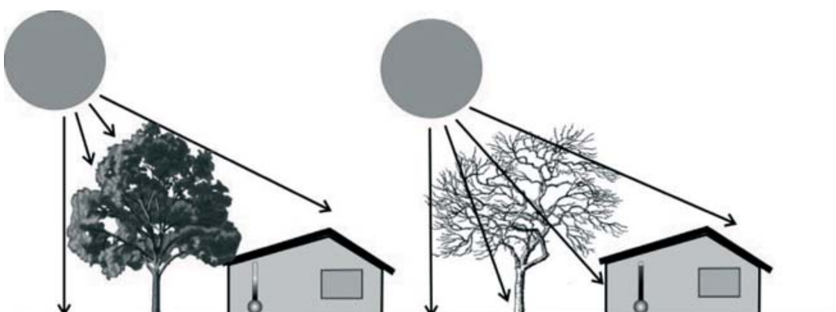

Figure 1. Placing deciduous trees on the eastern and western sides of the house will reduce the indoor temperature in summer and will contribute to increase the temperature in winter

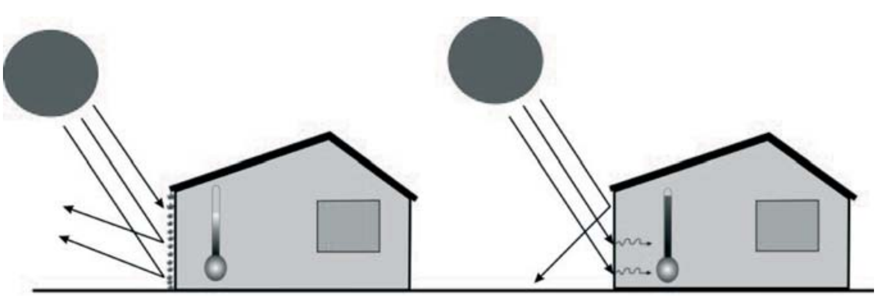

Figure 2. Climbing plants moderates the indoor temperature

Using built shading structures (wooden pergola) is another way to conserve energy, while providing relaxation areas (Figure 3).

It is also recommended ground cover species between building and paved areas (Figure 4). In choice of these species must be considered drought and pest plants resistance.

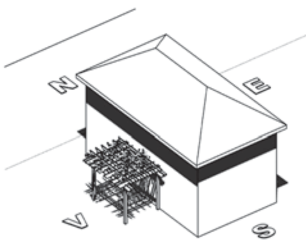


Figure 3. Using pergolas mitigate the propagation solar rays

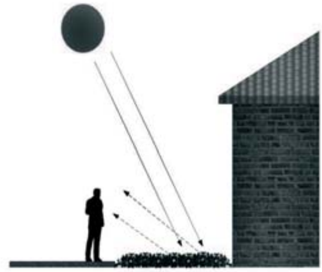

Figure 4. Ground cover species between building and paved areas

***Protection against wind*** and can be achieved by proper selection and placement of vegetation. Therefore, the following criteria can be helpful in designing and implementation of plant protection windbreak: optimum density of foliage is about 60%; plant windbreak are more effective when extend to the ground, the width of planting rows is important because it refers to penetration - for most coniferous species, two or three lines are sufficient, but the use of deciduous species may require four or five rows; plant windbreak are more effective when the length is 11.5 higher than the width of the mature species; species height of the plant should vary in order to create strong edges windbreak. In the north of buildings is recommended planting of large coniferous species to reduce wind speed (Figure 5).

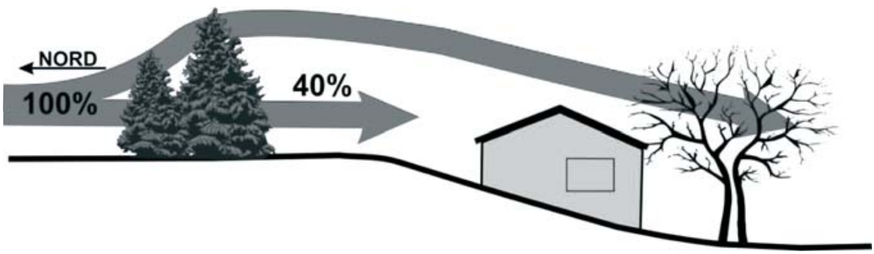


Figure 5. Tall conifers located in the north creates windbreak

Additional to traditional plant windbreak curtains, shrubs can be planted near the buildings with the same role. This protection against the wind is more practical for small areas and subdivision lots where space does not permit the use of conventional windbreak curtains. For this type of protection are recommended dense conifer groups. They should be planted close enough to form a solid wall and far enough from the building (at least 1-1.5 m) to create a neutral airspace. Another way to moderate the indoor temperatures is using shrubs in the North-West side of the site, which will protect the building from cold winter winds and will orient summer breezes around the building (Figure 6).

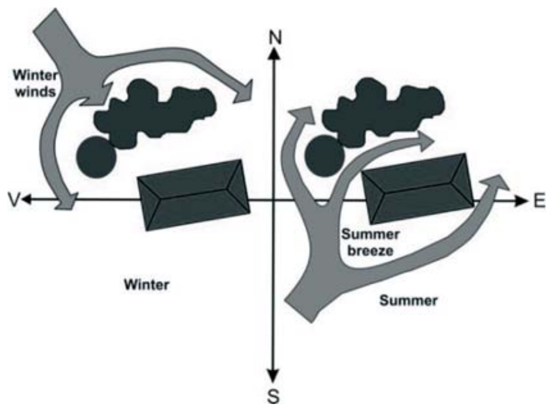


Figure 6. Shrub groups placed in the northwest of of the building for wind protection

***Integration of landscape design according the buildings.*** Often the landscape is not considered until after completion of buildings.

Ideal landscape design is integrated part of an intelligent design process, allowing interaction between building orientation, building design, existing environmental conditions and proposed landscaping. This favors the opportunity to maximize the benefits of landscape on the house and implicit on the occupants. Once the desired features of the proposed landscape have been identified, should be selected plant species that meet the requirements of an efficient energy landscape.

***Site and microclimate analysis***. While climate zones vary within a country more or less, each site has its own microclimate and conditions that will have an impact on the building design and landscape development. Analysis of the site and its microenvironment will provide information that will help landscape architect in decisions regarding the types of required protection. The analysis should take into consideration: the site size, topography, degree of slope of land, soil, drainage, prevailing winds, temperature, humidity, the relationship between patterns of shading and sunlight, existing vegetation and special features, location and other buildings fencing, pedestrian accesses and car location, views, constraints imposed by local regulations and conditions adjacent to the site.

***Design development.*** The concept plan can be developed using the site analysis, this helping to determine the best sites for plants. The landscape design will indicate windbreak belts proper location and position of trees which will control the shading. Detailed plan will show the exact configuration of planted barriers and will ensure proper implementation of a landscape that will help reduce energy consumption.

## Conclusions

Energy efficient landscapes overall aim to reduce building overheating in summer, protection against wind, proper circulation of air currents, reducing the greenhouse effect, high efficiency lighting system and not at least reduced water consumption.

A landscape can be a long term investment for reducing heating and cooling costs, while bringing other benefits to communities living environments [1].

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## ASORTIMENTUL DE PLANTE LEMNOASE DE PERSPECTIVĂ PENTRU ARTA TOPIARĂ

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**Summary.** *Ornamental horticulture is a component part of the landscape architecture, expressed by topiary art, polished by millennia of human experience. Topiary art that was born together with civilization is again in ascension. One of the main problems of topiary art is the assortment's question of woody plants that can be used in pedological and climatic conditions of Moldova. In the article was described 29 species of trees and shrubs, pertaining to 19 families, resistant in our local conditions, with the indication of bioecological parameters and their perspective usage in forming borders, boskets, hedges, geometric and fantastic figures.*

Arta topiară a apărut şi s-a dezvoltat ca formă a arhitecturii peisajere şi parte componentă principală a grădinilor regulate. Încă în epoca sclaviei sunt formate grădini regulate de o compoziție simplă dreptunghiulară. Această formă a rămas viabilă şi la popoarele din lumea antică, la babiloneni, egipteni şi persani. Elementele principale ale acestor grădini erau bazinul cu apă, grădina cu pomi fructiferi şi rândurile de arbori şi arbuşti, amplasate sub un unghi drept unul față de altul şi separate cu un gard format. Elemente geometrice formate, ovale sau rotunde, erau puține. Forma geometrică, în general, era socotită cea mai logică şi estetică. Ca material compozițional vegetal în aceste grădini erau folosite specii din flora spontană, dar pe larg se foloseau şi plantele introduse – trandafirii, iasomia, smochinul, rodiile. Erau foarte apreciate speciile de plante lemnoase producătoare de ulei volatil şi plantele care bine rezistau la formare.

O mare popularitate, în acea vreme, aveau grădinile create pe terase, aşa-numitele ”grădini pendente” ale Semiramidei din Babilonul Antic. Ideea creării grădinilor pe terase sau”grădinilor pendente” a fost viabilă şi a găsit dezvoltare în Persia, Italia, ajungând până la timpurile noastre modificată ca ”grădini pe acoperişuri”.

În Grecia Antică nu au fost construite grădini, în schimb lucrările şi formele geometrice ale matematicianului grec Euclid au fost folosite de romani la planificarea şi construcția grădinilor şi oraşelor în întregime.

În grădinile romanilor care erau numai de formă regulată, geometria după plan şi plantele din compoziția parcurilor, arborii şi arbuştii, erau formați geometric sub formă de glob, piramidă, con care erau structurate compozițional în sculptură. Aceste grădini erau exponentul realității geometrice şi a disciplinei, aceste caractere rămânând ca principii de dezvoltare în continuare a arhitecturii peisajere. În această perioadă arta topiară a cunoscut o ascensiune şi o continuă dezvoltare.

Cu destrămarea Imperiului Roman a decăzut şi construcția noilor grădini. În toată perioada medievală lungă grădini noi au apărut numai pe lângă casteluri şi mănăstiri care aveau mai mult o importanță utilitară, erau pătrate sau dreptunghiulare, despărțite cruciform cu alei şi poteci, în centru cu un havuz, cruce sau o tufă de trandafir.

Arta topiară a cunoscut o ascensiune în epoca Renaşterii, odată cu crearea grădinilor regale din marile imperii ale Europei. Aceste grădini sunt logice şi estetice. Materialul folosit este longeviv – piatra, apa şi figurile vegetale geometrice (formate). În aceste grădini practic nu sunt folosite florile. În perioada de vârf a Renaşterii (secolele XV-XVI) dominau formele liniştite şi simple – pătratul şi cercul, unde era necesar de 1-2 specii de plante lemnoase, mai târziu forme mai dinamice – ovală, dreptunghiulară şi mai complicate, unde este necesar de a folosi mai multe specii, dar nu se ajunge la forme fantastice. În epoca barocco stilul italian a fost primit ca model pentru toată Europa. Se dezvoltau noi forme de artă topiară – partere compuse (*broderii*) cu un desen sofisticat din plante formate, joase, ”palisadă” – gard viu din plante formate de înălțime medie, boschet italian – gard viu din plante formate de înălțime mare, unde se foloseau carpenul, fagul; în țările din nord – ulmul şi, mai ales, molidul; berso – carcasă din lemn sau metal care este din ambele părți împrejmuită cu un rând de arbori, crengile cărora erau împletite în carcasă. La dezvoltare se obține un tunel compact, verde. În această perioadă sunt formate vestitele parcuri Belvedere (Vienna), Versailles (Paris), San Sussi (Potsdam), Levens Holl, Kendal (Anglia), unde pe larg sunt folosite practicile artei topiare. În aceste ansambluri vegetale grandioase, natura care este prefăcută în parc, este supusă arhitecturii, dar parcul ca atare este o legătură între arhitectura şi pădurea naturală din apropiere. Sunt folosite speciile locale – stejarul, ulmul, teiul, fagul, paltinul, frasinul, castanul comestibil, plopul piramidal, iar din conifere – tisa şi molidul; din fructifere – mărul, părul şi vişinul. Boschetele joacă un rol compozițional foarte mare. Fiecare boschet, în dependență de folosirea lui utilitară, erau denumite: Labirint, Sala Mare, Insula Regală, Bibliotecă ş.a.

Cu vremea, în rezultatul influenţei şi a pătrunderii elementelor din arta peisajeră a Chinei şi Japoniei, care a ridicat considerabil costul acestor parcuri şi aşa mărite a adus la o uitare timp de două secole a grădinilor regulate cu caractere geometrice în baza artei topiare. S-a dezvoltat un stil nou – stil liber, natural care mai mult a luat amploare în Anglia, unde s-au format şi condiţii specifice. Autorii acestor grădini-parcuri nu erau arhitecţi peisajeri sau grădinari, ci pictori peisagişti care cu mare evlavie propagau natura. Stilul liber în curând a fost dezvoltat în toată Europa, uitându-se de arta topiară. Acest stil a dominat şi la noi în parcurile moşiereşti create în secolele XVII-XIX. Numai la sfârşitul acestei perioade s-a format un stil nou – mixt, unde în arta peisajeră liberă se introduceau elemente ale artei topiare. În zilele de astăzi această artă este din nou în ascensiune, în dezvoltare. Tot mai insistent şi mai mare este interesul de această artă uitată a arhitecturii peisajere – arta topiară (*topiare*), mai ales, folosindu-se termenii *forme tunse* şi *forme formate*, având în vedere formele artificiale a coroanelor plantelor lemnoase ca garduri vii, borduri, bule ori piramide. Au apărut şi parcuri integral topiare (Ladin, SUA).

Există câteva direcţii în dezvoltarea artei topiare. Cea clasică are la bază formarea artificială geometrică sau fantastică (pe temă liberă) a coroanelor plantelor lemnoase cu ajutorul unui şablon, frânghii ori la ochi. Deseori se foloseşte legarea sau strângerea ramurilor şi lăstarilor. Topiarul nou a fost inventat în SUA şi presupune folosirea unei carcase metalice, în interiorul căreia sunt sădite plantele necesare. Până ele se dezvoltă, ideea figurii o redă carcasa. Green Art este o direcţie modernă care foloseşte diferite construcţii metalice cu umplutură din muşchi cu turbă care se decorează cu plante anuale şi bienale floricole. Este evident că aceste figuri au o viaţă scurtă.

Procesul formării artificiale a coroanelor de plante lemnoase este de lungă durată. Dar există şi o prioritate. Speciile folosite în arta topiară sunt longevive. Orice obiect de artă topiară este unical, excluziv, el atrăgând atenţia şi poate servi ca centru al oricărei compoziţii ornamentale, şi aceasta este mai puţin costisitor decât alte expoziţii ornamentale sofisticate. Tocmai din această pricină, cel mai principal în arta topiară rămâne planta, particularităţile ei ecologo-morfologice, reacţia la formare, timpul de restabilire a coroanei după tundere etc.

Principalele forme de ”tundere” (formare) în arta topiară care sunt folosite pe larg în arhitectura peisajeră sunt următoarele:

- pereţi vii sau boschete (mai înalte de 3 m);

- garduri vii sau palisade care, la rândul lor, se împart în garduri vii joase (0,5-1,0 m), garduri vii medii (1,0-2,0 m) şi garduri vii înalte (2,0-3,0 m);
- borduri până la 0,5 m;
- forme geometrice;
- forme stilizate.

Înălțimea boschetelor depinde de proprietățile biologice a speciilor folosite. De obicei, boschetele sunt constituite din 1-2 ramuri de arbori care bine suportă tunderea şi au o creştere înceată.

Pentru a forma un perete viu frumos, rezistent şi longeviv, este necesar de a efectua tunderea regulat, corect şi la vreme. Nerespectarea acestor cerințe va aduce la pierderea funcțiilor ornamentale şi de protecție. La formarea gardurilor vii (palisade) este folosită tunderea în 2-3 scări. Astfel de palisade, în formă de trapez, sunt mai viabile şi ornamentale. La formarea gardurilor vii sunt folosiți arbuştii. Bordurile care reprezintă aceleaşi garduri vii, cu înălțimea de 0,5 m sunt folosite pentru a dimensiona terenurile şi potecile. Intensitatea tunderii plantelor poate fi diferită, de la o formare uşoară până la formarea unor forme geometrice compuse. Pentru formarea figurilor, de obicei, sunt folosite aceleaşi specii ca şi la formarea boschetelor şi gardurilor vii. Mai jos prezentăm speciile şi formele de plante lemnoase pentru folosirea lor în arta topiară:

*Picea abies* (L.) Karst. (*Pinaceae*) – Molid comun.

Arbore de mărimea I, foarte răspândit în regiunile reci şi temperate ale emisferei nordice, cu longevitate mare, în condițiile Republicii Moldova nu depăşeşte 100 de ani. Este o specie cu temperament de semiumbră, puțin pretențioasă față de fertilitatea solului, dar necesită o umiditate suficientă a solului şi a aerului. Nu suportă praful şi fumul. Se plantează în 1-2 rânduri, se tunde uşor, astfel realizând o coroană regulată şi deasă. Se recomandă în raioanele dendrologice de nord şi centru pentru formarea boschetelor şi palisadelor. Unele forme ornamentale de molid pot fi folosite şi ca forme stilizate.

*Larix decidua* Mill. (*Pinaceae*) – Larice, Zadă.

Arbore de mărimea I, răspândit în munții Europei. Repede crescător. Longeviv, dar în condițiile Republicii Moldova atinge vârsta până la 50-70 de ani. Ácele moi, caduce, de culoare verde-deschis. Nu suportă solurile uscate şi compacte. Creşte bine numai pe soluri bogate, afânate, cu umiditate suficientă. Uşor se pretează tunderii şi nu suferă la formarea coroanei. Se recomandă în raioanele dendrologice de nord şi centru.

*Tsuga canadensis* (L.) Carr. (*Pinaceae*) – Tsugă.

Arbore de mărimea I, originar din Estul Americii de Nord. Longeviv.

Are creştere înceată. Coroana este deasă, cu frunze persistente. Pretinde soluri nisipo-lutoase, permeabile, revene. Suportă bine umbrirea. Se pretează la tundere, formând pereți vii foarte deşi şi regulați. Se recomandă în raioanele dendrologice de nord şi centru.

*Taxus baccata* L. (*Taxaceae*) – Tisă.

Arbore de mărimea II, originar din Europa, ajunge până la 15-18 m. Foarte longeviv. Coroana cu ramuri şi frunziş persistent, foarte des. Este pretențioasă la fertilitatea şi umiditatea solului. Rezistă umbrirea, are un temperament tipic de umbră. Creşte foarte încet. Datorită proprietății de a produce lujeri preventivi şi întâmplător se poate tunde şi modela uşor. Este una din speciile cele mai întrebuințate în arta topiară. Coroana, la tundere, se îndeseşte şi formează un frunziş bogat şi neîntrerupt. Se recomandă pentru toate raioanele dendrologice, cu condiția de asigurare suficientă a umidității solului.

*Thuja occidentalis* L. (*Cupressaceae*) – Tuia occidentală.

Arbore de mărimea II, originar din Nord-Estul Americii de Nord. Frunziş persistent. Creşte încet. Are temperament de umbră. La lumină formează o coroană îngustă şi deasă, iar la umbră o coroană lățită. Este foarte bine adaptabil la orice stațiuni, dar mai bine se dezvoltă pe soluri luto-nisipoase cu suficientă umiditate. Suportă bine tunderea şi formarea. Are o mulțime de forme ornamentale, se deosebeşte prin culoarea ácelor şi port. Poate fi folosit în toate raioanele dendrologice pentru toate formele artei topiare.

*Biota orientalis* Endl. (*Cupressaceae*) – Arborele vieții.

Arbore de mărimea III, originar din China şi Coreea, în condițiile Republicii Moldova atinge până la 8-10 m, tulpina se ramifică neregulat de la bază cu frunziş persistent. Lujerii subțiri. Creştere înceată. Temperament de umbră. Puțin pretențios față de fertilitatea solului, foarte rezistent la secetă şi fum. Este indicat pentru toate raioanele dendrologice, la formarea boschetelor, gardurilor vii şi formelor tunse.

*Eucommia ulmoides* Oliv. (*Eucommiaceae*) – Arborele de gutapercă.

Arbore de mărimea II, originar din China, cu frunzele caduce. În condițiile Republicii Moldova atinge 15-20 m. Temperament de lumină. Longeviv. Pretinde soluri fertile, dar rezistent la secetă. După tundere se îndeseşte. Se recomandă pentru toate raioanele dendrologice.

*Celtis australis* L. (*Ulmaceae*) – Sâmbovină.

Arbore de mărimea II, originar din regiunea mediteraneană, cu frunzele mici, caduce, în condițiile Republicii Moldova atinge 15-20 m. Ramurile şi lujerii subțiri. Temperament de lumină mijlociu. Specie termofilă, creşte bine pe soluri uşoare, fertile, drenate, dar rezistă şi la soluri grele, uscate, calcaroase. Rezistă gazele şi fumul. Se recomandă, în special, pentru raionul dendrologic de sud.

*Ulmus pinnato-ramosa* Dieck ex Koehne (*Ulmaceae*) – Ulm penat-rămuros.

Arbore de mărimea II, originar din Siberia de Vest şi China. În condițiile Republicii Moldova atinge 15-20 m, cu ramuri dese, lujeri subțiri, frunze mici, de 2,0-2,5 cm, caduce. Temperament de lumină. Foarte rezistent la secetă. Are o mare amplitudine de adaptare la condițiile edafice. Suportă bine tunderea şi formarea. Se recomandă pentru toate raioanele dendrologice.

*Maclura aurantiaca* Nutt. (*Moraceae*) – Maclură, Portocal fals.

Arbore de mărimea II, originar din Sudul Americii de Nord, în condițiile Republicii Moldova atinge 18-20 m. Coroana cu ramuri numeroase, lujeri mulți, cu spini puternici, de 1,0-2,5 cm şi frunzele de 5-10 cm. Creşte repede. Rezistentă la secetă, fum şi gaze. Pe soluri sărace rămâne de talie mică. Temperament de semiumbră. După tundere se îndeseşte şi formează pereți vii, spinoşi. Se recomandă pentru raioanele dendrologice de centru şi sud.

*Morus alba* L. (*Moraceae*) – Dud alb.

Arbore de mărimea III, originar din Japonia şi China, în condițiile Republicii Moldova atinge 15-20 m. Longevitatea până la 150 de ani. Coroana foarte deasă, cu ramuri lungi şi numeroase ramificații secundare, lujeri zvelți, abundent foliați, cu frunzele de 6-15 cm. Temperament mijlociu. Suportă bine seceta şi gerurile. Bine se dezvoltă pe soluri uşoare, revene. Se pretează bine la tundere. Se recomandă pentru toate raioanele dendrologice.

*Fagus sylvatica* L. (*Fagaceae*) – Fag comun.

Arbore de mărimea I, răspândit în Europa, în condițiile Republicii Moldova atinge până la 30 m. Longevitatea este mare. Coroana cu frunziş des şi bogată în crăci. Frunzele de 5-10 cm lungime, lucioase şi pieloase. Temperament pronunțat de umbră, de aceea formează coroana cu frunziş des. Pretențios față de climă şi sol. Nu suportă seceta. Este sensibil la geruri şi arşița puternică. Vegetează bine pe soluri brune de pădure, luto-nisipoase, revene, profunde. Timp îndelungat este folosit în arta topiară. Formează pereți vii, deşi şi frumoşi. Se recomandă în raionul dendrologic de nord şi centru (subraionul II b). Posedă varietăți cu frunzele de diferite culori – portocalii, vişinii, albastre, roz, variegate care ridică cu mult decorativitatea pereților vii.

*Carpinus betulus* L. – (*Betulaceae*) – Carpen comun.

Specie indigenă de mărimea I, atinge până la 30 m. Coroana neregulată, cu frunziş des şi ramificație numeroasă, cu lujeri subțiri. Frunzele de 5-10 cm lungime. Longevitatea mijlocie, până la 100 de ani. Temperament mijlociu, suportă bine umbrirea. Este puțin rezistent la secetă şi relativ pretențios față de fertilitatea şi umiditatea solului. Se pretează foarte bine la tunderea repetată pentru obținerea formelor decorative dorite. Ca şi fagul, timp îndelungat este folosit în arta topiară. Se recomandă în raioanele de nord şi centru.

*Tilia cordata* Mill. – (*Tiliaceae*) – Tei pucios.

Specie indigenă, atinge până la 20-25 m înălțime. Coroana largă, densă, abundent foliată. Frunzele de 5-7 cm lungime, mai mici decât la alți tei. Longevitatea până la 150 ani. Temperament de umbră. Specie rezistentă la geruri, dar suportă mai greu seceta. Nu este pretențioasă față de sol, dar se dezvoltă bine pe soluri fertile, revene. De lungă vreme este folosit în arta topiară. Se pretează bine la tunderea repetată şi formare. Poate fi recomandat pentru toate raioanele dendrologice, cu condiția asigurării necesităților ecologice.

*Padus serotina* (Ehrh.) Borch. (*Rosaceae*) – Mălin tardiv.

Arbore de mărimea II, originar din America de Nord, în condițiile Republicii Moldova atinge până la 15 m. Coroana alungită, cu ramuri scurte apropiate de trunchi. Frunziş des, frunzele ating 5-10 cm. Creşte repede. Temperament rezistent la umbră. Rezistă seceta şi gerurile. Preferă soluri uşoare, nisipo-lutoase. Se pretează bine la tundere. Se recomandă pentru toate raioanele dendrologice.

*Prunus divaricata* Ledeb. (*Rosaceae*) – Corcoduş.

Arbore de 4-10 m înălțime, originar din Asia şi Caucaz. Coroana bogată cu lujeri mulți, subțiri şi frunze de 2-7 cm lungime. Creşte activ. Rezistă foarte bine seceta, gerul şi solurile uscate. Se pretează bine la tundere, formează pereți vii care nu se golesc la bază. Se recomandă pentru toate raioanele dendrologice.

*Gleditschia triacanthos* L. (*Fabaceae*) – Glădiță, Salcâm boieresc.

Arbore de mărimea I, originar din America de Nord, în condițiile Republicii Moldova atinge până la 25 m înălțime. Coroana largă, ramuri multe cu spini tari, de 10-15 cm lungime. Frunzele compuse, cu foliole de 2-3 cm lungime. Longevitatea cca. 100 ani. Creşte repede. Rezistă foarte bine seceta. Preferă soluri de luncă bogate, afânate, revene. Se pot forma pereți vii, greu penetrabili care se tund anevoios şi neavând condiții suficiente, se răreşte de timpuriu, necesitând mereu completări. Se recomandă pentru toate raioanele dendrologice.

*Acer monspessulanum* L. (*Aceraceae*) – Jugastru de Banat.

Arbore de 7-8 m înălțime, originar din Europa şi Caucaz. Coroana stufoasă, compactă, cu frunze mici, de 3-7 cm lungime. Creşte încet. Este foarte rezistent la secetă şi ger, nepretențios față de sol, vegetează pe soluri uscate calcaroase. Rezistă bine tunderea şi formarea. Se recomandă pentru toate raioanele dendrologice.

*Elaeagnus angustifolia* L. (*Eleagnaceae*) – Sălcioară angustifolie, Răchițică.

Arbust, atinge până la 10 m înălțime, originar din regiunea mediteraneană şi Asia Centrală. Coroana deasă, cu ramuri spinoase. Frunzele argintii, de 4-8 cm lungime. Temperament de lumină. Creşte repede. Specie pionieră. Foarte rezistentă la exigențele ecologice. Se pretează bine la tundere repetată, formează pereți vii inaccesibili. Se recomandă pentru toate raioanele dendrologice.

*Quercus pubescens* Willd. (*Fagaceae*) – Stejar pufos.

Arbore mic de mărimea III, de 10-15 m înălțime, din flora spontană. Coroana largă, rară, cu frunze relativ mici, de 4-10 cm lungime. Creşte foarte încet. Longeviv. Temperament pronunțat de lumină. Foarte rezistent la uscăciune şi insolație. Creşte pe soluri puternic calcaroase. Foarte bine rezistă tunderea şi formarea, menținând în timp diferite figuri. Se recomandă pentru raionul de sud şi central, subraionul Bălților.

*Hibiscus syriacus* L. (*Malvaceae*) – Hibiscus, Zămoşiță.

Arbust, atinge până la 3 m înălțime, originar din Asia Mică, China, India. Tulpina ramificată, de la bază formează o tufă deasă şi frunze abundente, de 5-12 cm lungime. Temperament de lumină, dar suportă parțial umbrirea. Rezistă la secetă şi ger, nepretențios față de sol. Se pretează bine la tundere, formând garduri vii de 1-2 m înălțime. Dacă este corect tuns, gardul viu poate să devină înfloritor. Se recomandă pentru raionul dendrologic central şi sudic.

*Syringa vulgaris* L. (*Oleaceae*) – Liliac obişnuit.

Arbust, atinge până la 5-7 m înălțime, originar din Asia Mică şi peninsula Balcanică. Tulpina se ramifică de la bază cu lujeri mulți, viguroşi şi frunze dese de 6-12 cm lungime. Drajonează abundent. Creşte relativ încet. Temperament de umbră. Rezistă la geruri şi relativ la uscăciune. Preferă soluri fertile, calcaroase. Se pretează bine la tundere, formează garduri vii de 1-3 m înălțime. Se recomandă pentru toate raioanele dendrologice.

*Ligustrum vulgare* L. (*Oleaceae*) – Lemn câinesc obişnuit.

Arbust din flora spontană care atinge 1-4 m înălțime. Tulpina se ramifică de la bază, formează o tufă deasă cu ramuri flexibile şi lujeri subțiri. Frunziş des, cu frunze de 3-6 cm lungime. Lăstăreşte şi drajonează abundent. Creştere mijlocie. Temperament de semiumbră. Rezistent la gaze şi fum. Este specia foarte des folosită la garduri vii, de 3-6 m înălțime şi forme geometrice, se pretează uşor tundere şi coroana se îndeseşte bine. Se recomandă pentru toate raioanele dendrologice.

*Mahonia aquifolium* (Pursh) Nutt. (*Berberidaceae*) – Mahonie sempervirescentă.

Arbust sempervirescent, originar din America de Nord, atinge până la 1-2 m înălțime. Frunzele dese, persistente, lucitoare, de 4-8 cm lungime. Creştere mijlocie. Temperament de umbră. Rezistentă la ger şi secetă, fum şi gaze. Pretinde soluri bogate, revene. Se pretează uşor la tundere, formează garduri vii de 0,6-1,5 m înălțime şi forme geometrice. Se recomandă pentru toate raioanele dendrologice.

*Physocarpus opulifolium* (L.) Maxim. (*Rosaceae*) – Taulă falsă opulifolie.

Arbust originar din America de Nord, atinge până la 3-4 m înălțime, are multe tulpini viguroase, lujeri mulți subțiri. Frunzele dese, de 3-8 cm lungime. Creşte repede. Temperament de lumină, poate suporta parţial şi umbrirea. Este foarte rezistent în condițiile Republicii Moldova. Se pretează uşor la tundere, formează garduri vii de 1,5-3 m înălțime. O frumusețe deosebită o au gardurile vii formate din *P. o.* “Diabolo” – cu frunzişul vişiniu. Se recomandă pentru toate raioanele dendrologice.

*Spiraea* x *vanhouttei* (*Rosaceae*) (Briot) Zab. – Cununiță Vanhut.

Specie hibridă, de 2 m înălțime, are tufa deasă şi frunziş abundent. Este nepretențioasă față de sol şi rezistentă la ger, fum şi gaze. Temperament de lumină. Prin tundere se îndeseşte, de aceea se recomandă la garduri vii de 1,0-1,5 m şi forme. Se recomandă pentru toate raioanele dendrologice.

*Amelanchier ovalis* Med. (*Rosaceae*) – Amelanchier oval.

Arbust, de 2 m înălțime, originar din Munții Europei, cu ramuri multe îndreptate în sus şi frunziş des, frunzele de 2,5-5,0 cm lungime. Drajonează abundent. Creşte repede. Temperament de lumină. Rezistă la ger, secetă şi condițiile urbane. Bine se pretează la tundere, formează garduri vii joase. Se recomandă pentru toate raioanele dendrologice.

*Buxus sempervirens* L. (*Buxaceae*) – Buxus sempervirescent, Cimişir.

Arbore-arbust, de 5-10 m înălțime, originar din regiunea mediteraneană; la noi în parcurile vechi de 30 m. Tulpina foarte ramificată, formează o coroană cu frunziş des. Frunzele persistente, mici, de 1-3 cm, pieloase, lucitoare. Longevitate mare. Creşterea extrem de înceată. Temperament de umbră, este specie lemnoasă care suportă cel mai înalt grad de umbrire. Foarte rezistent la secetă şi ger, fum, gaze şi praf. Nu este pretenţios față de sol. Suportă foarte bine tunderea. Din timpuri îndepărtate este folosit la crearea bordurilor vii, gardurilor şi celor mai interesante forme. Foarte interesante figuri pot fi obținute, folosind formele ornamentale: *B. s.* “Globosa” - cu coroana densă şi rotundă. Se recomandă pentru toate raioanele dendrologice.

*Cornus alba* L. (*Cornaceae*) – Corn alb, Sânger tătăresc.

Arbust, de 3 m înălțime, cu arealul în Franța, Siberia, Extremul Orient. Are coroana deasă cu lujeri multipli, subțiri şi frunze de 7-9 cm lungime. Lăstăreşte şi drajonează. Longeviv. Creşte repede. Temperament de semiumbră. Este un arbust cu o mare amplitudine ecologică. Rezistă la ger şi secetă, fum şi gaze. Se pretează uşor la tundere, formează garduri vii de 1,0-2,0 m înălțime. Face parte din categoria arbuştilor ornamentali, mai ales, în timpul iernii, când în lipsa frunzelor se ”aprind” lujerii roşii, îndeosebi când este folosită *C. a.* “Sibirica” - cu lujerii roşii-aprins. Se recomandă pentru toate raioanele dendrologice.

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# CASE STUDY REGARDING THE DEVELOPMENT OF GROWN CONTAINER PLANTS BY INNOVATING AN ADVANCED CAPILLARITY IRRIGATION SYSTEM


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**Summary.** *The paper illustrates a conceptual model of an advanced irrigation system based upon the capillarity force of water. The conceptual model will be able to reduce water consumption by relating water plant demands. For a correct evaluation of this irrigation system the following index will be measured SWAP (soil - water - atmosphere – plant). The evapotranspiration rate will be deducted on decade using digital methods of soil water content quantity – electrical conductivity capacity and leaf biometrical measurements using CAD techniques. The 3D model of the capillarity irrigation system will be presented using its main body parts and function capacity.*

## Introduction

The capacity of an irrigation system to reduce water consumption parallel viewed with an conventional irrigation system represents nowadays one of the major concerns of different irrigation systems manufacturers. Statistical data speak for themselves, considering fresh water reserves of Romania in 2009 (Table 1) we can observe a dependency of 80,04% for these kind of resource. Regarding the main consumers of fresh water reserves although the agricultural sector is placed on the third position as main consumer (1171 $km^3$/an), most of the irrigated areas are classical irrigated by water runoff or classical aspersion, resulting improper water management (Grumeza N. et al., 2005). Its imperative to moderate the water consumption in this sector by implementation of advanced drip irrigation systems, or locally by capillarity irrigation systems (Riviere L. et al., 2005).

Table 1

**Fresh water reserves in Romania 2009 (WWW.FAO.ORG)**

| *Area and population* | *Year* | *Value* | *Reference unit* |
|---|---|---|---|
| Total country area | 2009 | 23839 | 1 000 ha |
| Total cultivated area | 2009 | 9151 | 1 000 ha |
| Total inhabitants | 2009 | 21537 | 1 000 |
| Inhabitants density | 2009 | 90,34 | inhabitants/$km^2$ |
| **Fresh water resources** | | | |
| Average precipitation amount | 2009 | 637 | mm/year |
| Precipitation volume | 2009 | 151,9 | $km^3$/ year |
| Total amount of fresh water (internal input) | 2009 | 42,3 | $km^3$/ year |
| Total amount of fresh water (external input) | 2009 | 169,6 | $km^3$/ year |
| Dependency rate for fresh water | | 80,04 | % |
| **Fresh water main consumers** | | | |
| Agricultural sector | 2009 | 1171 | $km^3$/ year |
| City hall | 2009 | 1505 | $km^3$/ year |
| Industry | 2009 | 4200 | $km^3$/ year |
| **Annual fresh water extraction amount (by source)** | | | |
| Surface fresh water reserves | 2009 | 6248 | $km^3$/ year |
| Underground fresh water reserves | 2009 | 0,628 | $km^3$/ year |
| Desalinized water | 2009 | 0 | $km^3$/ year |
| ***Measurement units: 1 $km^3$ = $10^9$ $m^3$ = 1 000 million $m^3$; 1 ha = 10 000 $m^2$*** | | | |

Water, regarded as key element to support life on earth, is located inside soil supporting different physical forces. The most important physical forces that are maintaining optimum water content in soil we can enumerate the following: gravitational forces, capillarity forces, adsorption forces, osmosis forces, hydrostatic forces and submersions forces. The new types of irrigation systems are keen on using these forces at their maximum state to assure optimum water balance and management. From the presented physical forces, capillarity ones are presented as new research boundaries for the irrigation systems manufacturers (Ayse I., et al., 2009). The main definition of these physical forces is presented in their entitle, suggesting that are directly related to soil porosity capacity and its water content (Păcurar Ioan, Mihai Buta, 2007).

Irrigation systems that are exploring capillarity soil forces are considered advanced irrigation systems directly related to plant development stages.

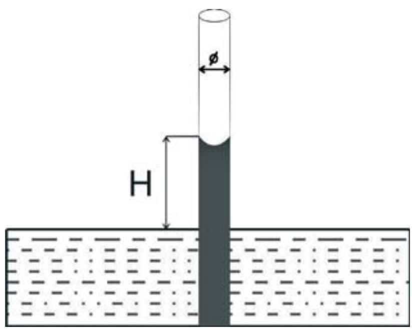


Figure 1. General principle of capillarity physical forces (original)

Due to pressure differences (or capillarity forces) when inducting a capillary tube in a water reservoir, the water from the capillary tube will emerge above the level of water from the reservoir with a height annotated (H) – further more, by reducing the diameter of the capillary tube (Ø) the higher heights of water will be observed in the capillary tube. When the capillarity tube is extracted from the water reservoir, the water in it remains constant, with a force higher than the gravitational one (Figure 1).

Different physical attraction forces where observed in soil. After several years of experience was observed that gravitational forces are less pregnant in soil compared to capillarity ones. A direct positive correlation was observed once with reduction of soil pores diameter. The smaller the pores are the higher attraction capacity was observed for water content (Păcurar I., et al. 2007).

We can conclude that water capillarity dispersion in soil is from bottom to upper levels, due to the increased forces of the capillarity effects much higher than gravitational ones.

## Results and discussions

The research project consists in creating an irrigation system specific to container growth plants keen on capillarity processes in water management, process artificially created by usage of conical sponges in permanent contact with reservoir water. On international scale exists a similar irrigation system entitled (DripMat) conceived for production of nursery plants, not being able to assure an optimum development to the entire lifespan of the plants (Figure 2).

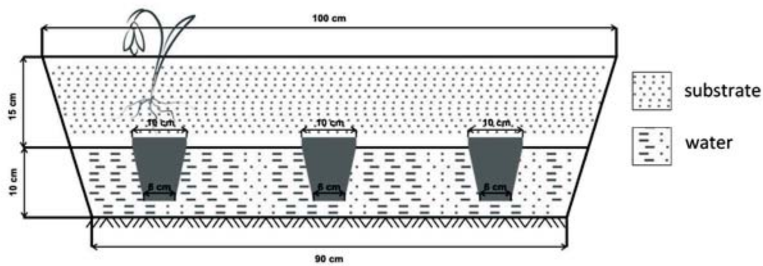


Figure 2. Constructive principle of the capillarity irrigation planter pot (original)

The research project propose the construction of a capillarity irrigation system based upon a trapezoidal planter pot with two distinct compartments: the first compartment with a height of 10 cm will be used as water reservoir, the second compartment with a height of 15 cm will assure substratum plant development. Three trapezoidal sponges that will assure the water retaining capillarity forces assure communication capacity between the two compartments. The irrigation system will be constructed using small pores capillarity sponges for improvement of the water retaining capacity.

For a comprehensive understanding of the irrigation system we propose the generation of different sections and 3D perspectives made by using different CAD solutions (Figure 3).

The capillarity irrigation system is composed by a water level indicator necessary for an optimum water management. This irrigation system can be looked as a closed circuit loop used for draining water excess level. In extreme cases, when water level reaches the maximum amount of water intake the system is equipped with an water excess valve that will assure an optimum water content in reservoirs. The modularity on the irrigation systems helps in general maintenance operations. Fiber glass will be used for the construction of the irrigation system, paint with dark colored acrylic paints for reducing the amount of green algae reproduction in the water reservoirs.

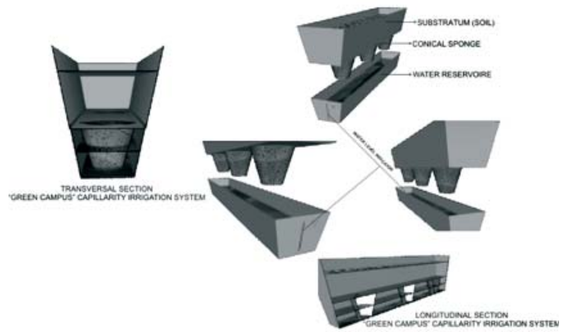


Figure 3. CAD generated perspectives and sections for the capillarity irrigation system (original)

The research projects is keen on reflecting the pros and cons for this kind or irrigation system compared with a classical irrigated planter pot, under the incident of evapotranspiration dynamic balance and plant development. The experimental plot will be conceived as a standard 2 factor randomized trial experiment using the following experimental factors.

First experimental factor - represented by the constructive container type with two graduations:

- classical container (experimental control);
- self irrigation container.

Second experimental factor - culture substratum, with three graduations:

- compost 40% + peat 30% + sand 30% (experimental control);
- leaf compost 40% + peat 30% + sand 15% + water retaining polymers 15%;
- compost 40% + water retaining polymers 30% + sand 30%.

As a particular aspect the experiment will be keen on finding the proper substratum composition for a better water retaining management by increasing the number of peat proportion or water absorbing polymers (Prikhod'ko, V., 2008).

After the combination of the experimental factors will result the followings:

$V_1$- classical container+ substrate 1 (compost 40% + peat 30% + sand 30%) + fertirigation;

$V_2$- classical container + substrate 2 (leaf soil 40% + peat 30% + sand 15% + water absorbing polymers 15%) + fertirigation;

$V_3$- classical container + substrate 3 (compost 40% + water absorbing polymers 30% + sand 30%) + fertirigation;

$V_4$- capillarity auto-irrigation container + substrate 1 (compost 40% + peat 30% + sand 30%) + fertirigation;

$V_5$- capillarity auto-irrigation container + substrate 2 (leaf soil 40% + peat 30% + sand 15% + water absorbing polymers 15%) + fertirigation;

$V_6$- capillarity auto-irrigation container + substrate 3 (compost 40% + water absorbing polymers 30% + sand 30%) + fertirigation;

Interdisciplinary acknowledgments will be made with the help of: soil science department, soil tillage department, physiology, floriculture and computer aided design.

The following experimental measurements will be made:

- environmental conditions monitoring (air temperature OC, above and in soil temperature; relative air humidity %, light intensity lx) using devices as HI 9161 and Testo 545;
- soil humidity determination (gravimetric determination - classical method % or using electrical conductivity capacity of soil - perspective method using Aquaterr A300);
- biometrical determination upon plants (medium height - cm, no. of leafs, no. of flowers);
- leaf area calculation using CAD techniques with specific software's;
- evapotranspiration dynamic rate (soil humidity + leaf area calculation).

## Conclusions

Capillarity irrigation system implementation for ornamental plants growth in pots is considered 100% original approach. The main goal of the experiments wishes innovation brevetting at O.S.I.M (State Office for Trademarks and Inventions). The leaf area surface considered in dynamic for correct determination of evapotranspiration will be accomplished using CAD techniques, without leaf cutoffs and induced stress to plant development. Considering the fresh water worldwide reserves and their rationalization, capillarity irrigation systems will assure optimum plant development, strictly related to plant needs.

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## ARTA TOPIARĂ ŞI CONIFERELE

***V. Bucățel***

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***Summary.*** *The paper presents a synthesis of topiary art history. The conifers plants assortment adapted for topiary art in climatic conditions of Moldova was proposed.*

Arta grădinilor şi parcurilor reprezintă un criteriu de evaluare a bunăstării şi nivelului de dezvoltare culturală a societății în ansamblu. Tradițiile horticulturii se transmit, din generație în generație, deseori transformându-se, devin un tezaur național. Horticultura ornamentală este o parte integrantă a istoriei arhitecturii peisajului, care ne fascinează prin perfecțiunea naturii, dar şlefuită grație experienței umane. Cel mai potrivit dicton latin, care poate să redea perfect arta topiară se conchide în: ”Natura incipit, ars dirigit, usus perficit” (Natura începe, arta dirijează, experiența perfecționează).

Cuvântul topiar (engl. *topiary*) este de origine latină – *topiaries*, ceea ce înseamnă *horticultor*. Topiarele sunt nu altceva, decât sculpturile verzi predestinate pentru decorarea peisajelor de landşaft.

În sens clasic arta topiară reprezintă un cuplu de forme geometrice, naturale, fantastic de extraordinare şi sublime, obținute prin modelarea sau stilizarea unui arbore sau arbust cu frunzele mici, după model-tip, sub frânghie sau la ochi.

Grădinile topiare create prin arta topiară, propriu-zisă, reprezintă unele dintre cele mai străvechi genuri de artă. Măiestria modelării prin figuri a arborilor şi arbuştilor sub diverse forme topiare, extraordinar de perfecte, naturale, a penetrat în Europa din Mediterana de Est şi Asia. Spre sfârşitul primului secol al erei noastre, grădinile sub forme topiare devin un obiect de lux ornamental, popular, pentru Beau Monde.

După căderea Imperiului Roman, estetica vieții cotidiene şi artele de meserii au degradat, realizările civilizațiilor antice au fost date uitării. Numai în mănăstiri arta de peisaj arhitectural s-a consolidat.

Epoca Renaşterii a revitalizat arta topiară. Multe dintre capodoperele create de maeştrii italieni din epoca Renaşterii au ajuns până în zilele noastre, şi anume: grădinile conacului Lante din Baja, vila Garzoni din Toscana, parcul castelului Baldini etc.

Cea mai celebră chef-d'œuvre de artă topiară a devenit grădina de la palatul Versailles, situat în apropierea Parisului (Franța), care a fost creat de André Le Notre (André Lenôtre) pentru regele Louis al XIV-lea. Stilul de Versailles, în timpuri, a devenit un model demn de urmat. În mod deosebit, cei mai iscusiți şi talentați, maeştri ai artei topiare, au devenit grădinarii britanici. Grădinile şi labirinturile engleze au devenit, pe drept cuvânt, capodopere unice ale artei topiare [4].

Parvenită şi existentă până în zilele noastre, arta modelării şi stilizării arborilor şi arbuştilor – arta topiară, supraviețuind "suişuri si coborâşuri" multiseculare, nu şi-au pierdut relevanța, dar astăzi în epoca înaltelor tehnologii cunoaşte o nouă zămislire, continuând să câştige o mare popularitate.

Arta topiară este una dintre domeniile cele mai interesante ale arhitecturii peisagistice.

În designul peisajer modern şi arhitectura de landşaft a Republicii Moldova modelarea plantelor după anumite forme se utilizează puțin, aceasta intervine doar la decorarea gardurilor vii, bordurilor si pereților verzi.

În prezent multe centre horticole, timp de mai mulți ani, livrează pe piața Moldovei diverse forme de plante topiare de origine europeană. Pepinierele din Moldova fac, de asemenea, primele încercări de formare ornamentală a arborilor şi arbuştilor confieri (S.R.L. "Floribel", S.A. "Codru-Nord", or. Bălți) – *Pinus nigra*, *Platicladus orientalis*, *Juniperus communis* 'Hibernica', *J. sabina*, J. *scopulorum* 'Sky Rocket', *Thuja occidentalis* 'Ericoides', *Th. occ.* 'Fstigiata' etc.

Interesul față de plantele modelate, inclusiv conifere, în Republica Moldova datează timp de veacuri. Astfel, în prima jumătate a secolului al XIX-lea, primul model, în domeniul construcției parcurilor, care a apărut în Moldova, a fost parcul Miciurin din raionul Drochia [1, 3], reprezentat de aleea din biotă orientală, care despărțea livada de pomi fructiferi de grădina de zarzavaturi, iar aleea din biotă şi corcoduşi se extindea spre construcțiile auxiliare. Inițial, biota şi corcoduşii se tundeau, formând pe părțile laterale nişte pereți compacți. Alei din biotă orientală sunt şi în parcurile din Ivancea, Orhei (1980) şi Bucovăț, Călăraşi (sfârşitul secolului al XIX-lea) care, de asemenea, se tundeau [2].

În construcția verde urbană arta topiară este practic absentă, se poate spune că nu se aplică, dar şi îngrijirea adecvată a plantelor se efectuează de specialişti necalificați.

Arta topiară în Republica Moldova trece printr-o nouă etapă de interes, din partea arhitecților de landşaft (horticultorilor). Acum putem spune că arhitectură peisagistică urbană trebuie să includă neapărat modelarea prin tundere după formă a arborilor şi arbuştilor. Formele geometrice, în combinație cu compozițiile libere, reglementează peisajul de landşaft, oferă o nouă percepere şi sesizare estetică a peisajului urban.

Gradina Botanica a Academiei de Ştiințe a Moldovei are menirea de a revigora această artă extraordinară şi de a o aproba în arhitectura peisajului modern al republicii.

Asortimentul de plante care se pretează pe larg artei topiare deja este cunoscut în Europa pe parcursul secolelor. Dintre conifere, cultura cea mai populară pentru sculpturile verzi de teren deschis este Tisa (*Taxus baccata*). Tisa prezintă un interes excepțional nu numai pentru construcția verde a Republicii Moldova, dar şi ca plantă clasică pentru garduri vii modelate, borduri, compoziții de figuri geometrice, plantări grupate şi solitare. Începând cu epoca Renaşterii până în prezent, tisa continuă să rămână cel mai bun material pentru arta topiară.

Cu regret, solul şi condițiile climatice ale Moldovei nu permit utilizarea integrală a sortimentului european, cel mai pretat pentru aceste scopuri. Totodată, în asortimentul clasic adaptat din arbori şi arbuşti ornamentali, există multe specii şi cultivaruri, care pot fi folosite cu succes, acestea destul de bine tolerând modelarea (stilizarea), unde între acestea sunt diverse specii de conifere (tabelul 1).

*Tabelul 1*

**Asortimentul de bază a plantelor conifere pentru arta topiară**

| Specia | Tipurile posibile de formare a coronamentului |
|---|---|
| *Chamaecyparis lawsoniana* (varietăți) | Conuri, piramide, sfere, coloane, spirale, garduri vii |
| *Chamaecyparis obtusa* | Bonsai de grădină, sfere, conuri, semisfere, modelare combinată cu altoire pe tulpină |
| *Chamaecyparis pisifera* | |
| *Chamaecyparis thyioides* | |
| *Juniperus chinensis* | Figuri topiare nu prea înalte, bonsai de grădină, borduri |
| *Juniperus* x *media* | |
| *Juniperus sabina* | |
| *Juniperus communis* | Coloane, spirale, garduri vii |
| *Juniperus scopulorum* (varietăți) | |
| *Juniperus virginiana* | Figuri geometrice simple şi compuse, garduri vii |

| | |
|---|---|
| *Larix decidua* | Figuri geometrice simple şi compuse, sculpturi verzi, spaliere, arcade, gherete, garduri vii, modelare combinată cu altoire pe tulpină, bonsai de grădină |
| *Larix sibirica* | |
| *Larix kaempferi* | |
| *Picea abies* | Piramide, cilindre, sfere, figuri geometrice necomplicate, bonsai de grădină, forme topiare etajate |
| *Picea pungens* | |
| *Pinus mugo* | Figuri geometrice necomplicate (sfere, cuburi), semisfere, bonsai de grădină |
| *Pinus nigra* | Bonsai de grădină, forme lat-eliptice şi umbelate |
| *Pinus strobus* | |
| *Pinus sylvestris* | |
| *Platicladus orientalis* | Figuri geometrice simple şi compuse, spaliere, arcade, gherete, garduri vii |
| *Taxus baccata* (varietăți) | Figuri geometrice simple şi compuse, sculpturi verzi, garduri vii, borduri, labirinte, bonsai de grădină |
| *Thuja occidentalis* (varietăți) | Garduri vii, spaliere, borduri, spirale, coloane, modelare combinată cu altoire pe tulpină, sculpturi verzi, forme topiare etajate |
| *Thuja plicata* | Garduri vii, spaliere |

Pentru arta topiară cele mai pretate sunt acele specii de plante, care formează contururile geometrice ale coroanei destul de regulate şi fără modelare, au o creştere uniformă şi compactă. Acest lucru este important, dacă vorbim despre tot felul de garduri şi borduri.

Un alt factor important îl constituie textura foliajului. Desigur, plantele cu frunze mari, de obicei, în garduri decorative nu arată atât de impresionant din acest punct de vedere. Coniferele cu cetină uniformă compactă, cât mai bine posibil se pretează creării sculpturilor verzi. Coniferele, modelate sub formă de figuri geometrice (sfere, conuri, piramide, coloane, cuburi, spirale), constituie elementul compozițional important al grădinii care deseori redau chintesența compozițională a grădinii, totodată, reglează simetria spațiului. Plantele modelate cu măiestrie şi cu acuratețe reproduc în ambianța spațială a grădinii multă eleganță, linişte, relaxare şi armonie.

Coniferele constituie un element foarte important al grădinii regulate, formulând acea unică esență de bază a designului intuit, perceput, prevăzut şi sesizat, lăsând urme adânci pe timp de secole. Grădina regulată se caracterizează prin linii drepte si unghiuri, cele mai simple figuri geometrice, alei drepte şi poteci, simetrie, abundență de sculpturi, florării. Grădinile regulate sunt identice, semnificative şi severe, iar scopul plantării plantelor în aceste grădini se conchide în a sublinia şi de a consolida importanța lor, semnificația şi, dacă doriți, chiar oficialitatea. În grădinile de stil regulat, nu putem ezita prezența coniferelor de talii mari, care se caracterizează printr-o densitate constantă, geometrică şi regulată a coronamentului. În grădinile regulate nu mai puţin persistă frecvent gardurile vii, labirinturile şi pereţii vii horticoli din conifere.

Coniferele modelate (stilizate) nu pretind a fi acel element excepţional al unei grădini regulate. Acestea pe larg se folosesc în grădinile de diverse stiluri: in stil japonez – modelarea sub formă de bonsai; în grădina de stil Art Nouveau (modern) – coloane verzi şi spiralate; în grădinile de stil avant-garde – cuburi, sfere şi piramide.

Bonsai Garden este un gen distinct în arta topiară. Această tradiţie a venit la noi din Japonia şi China. În Europa, în arhitectura peisajului de landşaft, predomină motivele orientale. Actualmente, plantele modelate bonsai se folosesc în grădini stilizate japoneze ori se amplasează chiar înaintea edificiilor, ca Solitaire.

Grădina japoneză, fiind construită în conformitate cu canoanele strict clasice, are atribuţie directă la plantele conifere încă de pe timpuri. Fără plantele conifere, grădina în stil japonez nici nu ar putea, probabil, exista sau ar putea fi construită, în general; totodată, anume în grădina japoneză folosirea coniferelor este foarte strict reglementată şi limitată pentru anumite specii, forme şi cultivaruri. Prioritatea, în grădina japoneză, aparţine pinului. Acesta este un simbol al longevităţii, curajului şi voinţei. În general, alegerea pinilor pentru plantarea în grădina japoneză depinde de dimensiunile lor. În Japonia, terenuri arabile horticole sunt extrem de reduse, de atâta, de mult timp, au fost luaţi pentru modelare arborii şi arbuştii, cu ritmul de creştere decelerat, ceea ce oferă coroanei o formă foarte expresivă.

Bonsai clasici se cresc, în special, din conifere care, de obicei, posedă frunze mici sempervirescente şi care sunt remarcabile prin longevitatea lor. Cele mai frecvent sunt răspândite speciile: *Pinus densiflora*, *P. parviflora*, *P. pumila*, *P. thunbergii*, *Chamaecyparis obtusa*, *Ch. pisifera*, *Ginkgo biloba*, *Juniperus chinensis*, *Larix kaempferi*, *Metasequoia glyptostroboides*, *Taxus cuspidata* etc.

În gradina stil Art Nouveau preferinţă li se acordă acelor plante conifere, care au o îndoitură interesantă a ramurii ori posedă o coroană expresivă (de ex., *Pinus mugo*, speciile genului *Larix* Mill. etc.). Particularităţile caracteristice ale Art Nouveau sunt simbolismul, individualitatea pronunţată, ritmicitatea şi liniile fluide ale designului. Stilul modern a întrunit tradiţiile artistice europene şi orientale. Grădina, la prima vedere, are opţiunea de stil de landşaft, dar mult mai concis. Plantele sunt selectate după densitatea şi structura distinctă. Modelarea plantelor persistă, dar nici într-un caz, nu ar trebui să fie pretenţioasă şi prea complicată. Tunderea se subordonează aceloraşi definiţii, precum sunt expresivitatea, simplitatea, laconismul şi fineţea.

În grădini stil avant-garde persistă elemente inerte, adesea artificiale, joacă acelaşi rol ca şi plantele. Grădina avant-garde este una dintre denumirile multor modele neobişnuite ale designului de landşaft. Gradina de tip similar, la fel considerat actual, propriu modernismului, este şi grădina în stil high-tech (Hi-Tech). A determina exact ceea ce creează imaginaţia designerilor, în natură, este destul de dificil. O trăsătură distinctivă a grădinilor avant-garde este faptul că plantele, de regulă, nu joacă rolul de lider. Plantele ar putea servi drept fundal ori ar putea să devină detaliile unei sau altei compoziţii. În grădinile stil avant-garde vor arăta excelent coniferele stilizate (cuburi, sfere, piramide), deseori în containere.

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# GUIDANCE IN BOTANICAL GARDENS. ASPECTS OF THE IMPROVEMENT OF THE COMMUNICATION PROCESS TO THE PERSONS WITH SPECIAL NEEDS

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**Botanical Garden "Anastasie Fătu" Iaşi*

**Summary.** *The article is a part of the training program "Differentiated educational strategies for different categories of populations (different age levels, people with special educational needs, gifted people etc.)" developed within the Cross-border initiative for developing playful topiary art for education and leisure (TOPART) trans-border project. The purpose of this paper is information acquiring in order to improve the guidance in botanical gardens by finding the best communication methods to people with special needs, very marginalized in the recent years.*

The right of the citizens to have access to environmental information [8, 9] is one of the strongest mechanisms of natural capital conservation. The environment education implies information and communication regarding the environment issues, these two instruments being absolutely necessary in order to communicate in a professional mode [3, 4, 5].

Information on the environment, communication and education are interdependent. The first step is the information process realized by data, commentaries and books. The mostly used information on the environment belongs to mass-media and includes: printed material (articles, brochures, books, posters etc.), data bases and networks, music, poetry, demonstrative activities etc.).

Communication regarding the environment issues refers to the specific modalities to transmit messages on the environment and associated problems to the target public. Communication supposes the existence of four fundamental components: a transmitter, a communication channel, information and a recipient. In a botanical garden can be realized the next types of communication: interpersonal, in groups, public and mass communication.

**The channel** of communication represents the physical way of message transmission, also called the "*hypothetical way*" or the way followed by the message. There are many types of channels which can be used depending on the situation:

- *Technological channels*: telephones, cassettes, computers, video, radio;

- *Written channels*: letters, reports, boards, books, reviews, papers;

- *Face to face channels*: conversations, interviews, meetings, presentations, courses, lectures;

The dimensioning of the educational services is realized taking into account the needs, preferences, tastes, expectations and qualitative exigencies of the visiting public.

The educators (the guides) must be aware by a series of tasks which must be assumed in order to implement an efficient communication strategy: public motivation, didactical material realization, conflicts mediation among different groups, surveillance and coordination of the actions for the improvement of the environment quality [3, 4].

For a better communication, especially to the persons with special needs, the guide must find various modalities to motivate and imply the audience, elements for attention capture in order to make himself listened, the best ways for information transmission and also to find some alternatives leading to actions which must have as result the change of the practical behavior, most of the times unfavorable to the environment.

Any communication process begins with the identification of the ideas and needs of the target group and can be realized only respecting the condition to exist interaction among educator-guide and target group (bi-directional communication). The message addressed to the target group must be expressed in a positive language, must include clear and concrete information, information must be adapted to the recipient. Also the guide must be careful with the language characteristics, its significance and its use possibilities.

Efficiency of communication in education process within a botanical garden present the next characteristics: the elaborated message must be transmitted to the target group and those who receive the message must have a series of fundamental knowledge; the advantages and disadvantages of an unfriendly behavior to the environment must pre clear highlighted and the person who transmit the message must present credibility and be receptive to the feed-back information.

As a conclusion, the message must be received, understood and accepted before the inducement of the behavior change. The understanding of the message depends on the values, standards, believes, interests and personal knowledge. In certain circumstances, may appear differences among the meanings communicated by the guides and the interpreting realized by the receivers, especially in the case of persons with special needs.

The most usual communication modalities refer to the **unidirectional** transmission of information (publicity, popularization etc.) or as a form of information offered as a part of a dialog – **bidirectional** – or education (long term process of transmission of knowledge, values and attitudes).

**Transmission of messages** related to nature conservation is confronted with a series of obstacles as: the tendency to ignore the individuality of the persons or target groups, choosing unidirectional methods for message transmission in detrimental of interactive methods or communication with groups and persons who have not the same aims and objectives. In the case of the persons with special needs is recommended: *avoiding the specialty language, avoiding transmission of some negative messages or choosing of an instrumental approach* as public campaigns of information dissemination. Also, the direct dialog and interaction with the interested groups are recommended. Very important is the message understanding, realized only in the moment when exist symmetry among the codification realized by the transmitter and the decoding realized by the recipient. **But how can be facilitated communication among a normal person and a handicapped person or one presenting a certain disability so the message to be received and understood and the possibility of a feed-back to be real?**

It is recommended that the educators to formulate clear objectives and to present them to all persons in such a way so all persons, with or without disabilities or special educational requests to feel a safety and comfort state, to develop themselves as persons, to be able to make their own decisions, to communicate, to bring contributions which can be valorized by all members of the community. Educational strategies can be applied differently both within an activity including all pupils and in a smaller group or even individually [2, 6, 7, 10].

Depending on the disability type or special requests, the educators (the guides) could consider the next alternatives:

- The simplicity of verbal communication, reformulating or repeating (if the persons have not understood), the use of a simple language and the linguistic transformation of text in an accessible language – this measure helps those with intellectual disabilities, of those with learning or acoustic disabilities.
- Computers offers flexibility and are really helpful to persons with sight disabilities or even blind persons (they can print information on a large paper sheet, they can read from the screen using a software for an increasing of information, they can listen using a vocal synthesizer or can convert in Braille language etc.).

- Tactile images can be realized on Braille paper.
- Presentations can be registered using a report phone.
- The pupils presenting writing difficulties can register information on cassettes (in the libraries from botanical gardens can be presented audio variants of some books or different presentations related to plants in video or audio format).
- Text increase.
- Use of some materials on video support with translations (etc.).

The setting up in the botanical garden of a chamber with the equipment necessary for develop some lessons and some specific activities of rehabilitation and recovery where the persons with special needs to feel respected and safe would be a good start for the ecological education.

The quality of communication depends on the naturalness, talent and efficiency of the guide to comport himself around visitors, especially children, letting the didactical spirit to combine with the normal, usual one. A good guide must have capacity of analyze the educational situation and must learn the next aspects: visual acuity, voice range, attention volume, memory quality etc.

**Communication with persons with handicap**

The main communication types refer to:

1. *Verbal communication*;
2. *Para-verbal communication* (tone, rhythm, voice intensity);
3. *Non-verbal communication* (mimics, gestures by signs, actions, mimics-gestures language etc.).

The specific of the communication is focused on the handicap type and the factors facilitating the efficient communication: conflicts avoiding, intimal personal distance and social distance (very important in autistics cases) etc.

How do we communicate with a person presenting a handicap?

Most of the times people are embarrassed or reticent to communicate with a person presenting a handicap; other times to this kind of persons the necessary support is not provided because of an insufficient knowledge of their needs or limits or because of an unknown fear and preconceived ideas. To realize a successful guidance within a botanical garden we present some recommendation:

1. **Communication with persons presenting mobility deficiencies**

- Placement in the visiting areas of chairs for the guide who present the green areas in order to assure a better physical and psychical relaxation of the visitor and to not dominate him with guides' height;
- The lack of the ramps or other facilities for persons with locomotor

handicap can be easily resolve by their welcome, relaxing discussion of peers and according the necessary assistance but only having the person's permission because the wheelchair is a part of the personal space of the person who uses it;

- Walking in educative purpose (guidance) near the persons with mobility problems (crutches, prostheses, sticks or lent walk) must be realized by adaptation to their rhythm, without rush and without touching the areas which helps the locomotion (wheelchair);
- Presentation are relaxing and if at these presentations are present also the attendant persons, the positions adopted by guide must be chosen in a way that the person with disabilities to not be excluded from the discussion of from the visual range;
- If the presentations are realized in closed spaces (greenhouses, other buildings) where all necessary comfort is provided, the wheelchair is never moved away from its user and the distance at which the guide is placed is differentiated; is recommendable to choose before the visiting areas (with large access ways).

**2. Communication with persons presenting sight problems**

*Verbal communication*

- The guide starts by presenting himself, speaks loud and clear (without scream) and directly to the auditory. This persons are in a great disadvantage because they do not see the gesture, mimic, pantomimic of the person who talks but they will be able to feel better the attitude and the voice undulations of the person who realize the guidance. A positive attitude is needed; practically, a sightless person perceive (in the start) the plants through the guide or educator eyes;
- The persons are questioned if they need help and what kind of help;
- If in the group there are elderly persons and they want to sit, clear verbal indications must be provided (chair in the left, right etc.) and the hand of the person is put on the backrest of the chair so the person to become aware of its presence;
- At the end of the conversation, the guide announces the finishing of the presentation, question the persons with sight deficiencies about their future intentions, taking into account that the visitation areas are situated both inside and outside and diverse dangers can appear;
- The entrance of the attendance dogs must be announced and admitted in the botanical garden (also in closed spaces); these dogs are very well trained and they must be not touched, fed, spoiled or called without their master's permission (do not hurt, scare or play with these dogs).

*Written communication. The written material, in order to be accessible to the persons with sight deficiencies, must respect the next recommendations*:

- The material must be realized in an accessible mode, without many information on pages;
- A considerable space must be present around all subjects and themes;
- The charged backgrounds must be avoided because it will become obscure. The backgrounds too colored in dark or shiny colors are not recommended;
- A bigger contrast among text and background is preferred;
- Case letters or too big letters must not be used;
- The Braille language alone or near the language in usual alphabet for normal people must be used.

**3. Communication with persons presenting speaking deficiencies**

- Very important is the establishment of the visual contact; attention and patience are needed with the people presenting speaking deficiencies that use assisting technique (various devices helping them to communicate);
- A quiet area must be chosen; the questions from the person is listened and expected and the answers must be short and clear;
- If something is not understood, the question must be repeated.

**4. Communication with persons presenting hearing deficiencies**

- The person is questioned about the communication methods which he prefer to use;
- Due to the fact that at the majority of the deaf persons the signs language represents their maternal language and preferred communication mode, an “translator”, if is possible, must be present and the guidance is scheduled realized;
- If the group of deaf persons have its “translator”, the guide must address not to this person but to the group;
- Presentation begins, after the visual contact, on a normal tone and an usual voice range;
- If communication difficulties appear, written notes can be used.

*Lips reading*

If the deaf person know how to read on the lips, the guide must look directly at that person, must speak clear without screaming. In this situation is recommended the use of gestures, facial expressions and body language in order to accentuate the presentation (only 3 of 10 words are visible by lips movement). The guide must not have a beard or mustache because the accentuate pilosity of the face makes difficult the lips reading.

5. **Communication with persons presenting autistic deficiencies**

- Unlike other types of persons with disabilities, the autistic persons are not feeling well when they have to look or to be seen in the eyes directly because they are intimidated;
- If the persons seems to be absent or indifferent, the guidance must be continued without futile commentaries about their deficiencies;
- Presentation must be clearly realized, without ambiguities, with short phrases; practically, each plant is shown one by one;
- Smiling and metaphors must be avoided, also the expressions with more meanings;
- Facial expressions, gestures or exaggerate body language must be avoided; presentation must use at minimum these aspects because they can be differently understood (threat, violent intentions etc.);
- Touching autistic persons must be avoided, a very important aspect in this case (autism) being the social distance (some persons do not suffer touch);
- Presentation must be realized in very well previously chosen places; these places must be quiet because the persons are noise sensible;
- At the end of the presentation the autistic persons are kindly questioned if the material has been understood.

6. **Communication with persons presenting understanding / learning deficiencies**

- The guide must be natural, benevolent, polite, friendly but mot in a exaggerate mode;
- Simple and precise phrases must be used;
- For the persons with Down syndrome must be used: short sentences (subject-verb-object) and gestural communication or by images of the objects, events, information;
- The guide must be empathic and answer to all the questions in order to increase the participation of these persons to all activities, but, under any condition, more attention than is the case must not be granted; there is I frequent mistake because the adults presenting these kinds of problems must be treated as adults and not as children.

7. **Super doted persons**

Education of the super doted children and integration of super – doted young people and adults become, in time, a global priority. These children exist in all social environments and can be discovered in any type of cultural community, being generally exposed to the social risk and rejection of the social group [1]. Because the super doted persons presents needs of affection, group relations, interdependence and auto-determination, joy and culture etc., the communication must be realized at a high level of guide's training. As a result of participation to the cultural life, by consuming its products, the taste its products, the super doted person is developing her taste for certain kind of spectacles, literature, and, finally, the aesthetic taste and feel. The guides can favor the development of the high critic spirit and need for fun in the practical – action plan.

**8. Gypsy children**

It is necessary that the persons who guides the gypsy children to understand their life style, their distinctiveness, in order to realize the successful educative action and to create, through communication modality, the bridge between gypsies and other children [2].

**Communication of educative messages**

In order to achieve an efficient communication through the transmitted messages, very important are the motivation, focalization of visiting public's attention and overcoming the critical factor generated by the understanding difficulties of the persons with special needs. Few principles which are facilitating the messages transmission are: syntactical complexity, semantic complexity, vocabulary, writing style, etiquettes presentation, literary technique and conflict messages.

The visitors will be receptive to the educational messages if they are written on etiquettes which need a minimum mental effort and contribute to the attention focalization for a facile understanding of information.

**Communication barriers**

Communication can be difficult because the existence of some barriers. These barriers can be:

- *Physical*: verbal deficiencies, acoustic deficiencies, placement, light, temperature, the time of the day, meeting time etc.;
- *Semantic*: vocabulary, grammar, syntax, emotional connotations of some words;
- *Perception differences*: depending on age, nationality, culture, education, sex, temperament;
- *Stereotypes*: we deal with different persons as they are one person because we learn from our previous experiences;
- *Lack of knowledge*: is difficult to communicate with a person having an education different from ours;
- *Lack of interest*: one of the most important barriers which must be overcome is the lack of interest of the interlocutor vis-à-vis by the transmitted message. In this case it must be acted with ability in order to direct the message, so to correspond to the needs and interests of the recipient;

- *Emotions*: the emotiveness of the transmitter or of the recipient may block the communication process.

Attention focalization in the exhibition space needs motivation. The friendly tone can bring an increase of the satisfaction of visitors; very important is also the motivation and the information degree of the visiting public. Motivation of visitors in order to concentrate on plants and etiquettes is the most provocative aspect of the exhibition design.

There are three factors which determine the motivation of the visitors and *attention focalization on the exhibits*: minimize the efforts for information acquiring, the increase of degree of cognitive-behavioral approach and minimize the factors of attention distraction.

Communication of information must be realized on a familiar, closed tone, often with humor and not formally, elitist. Encouragement of the visitor's phantasy or their projection in a concrete situation – as is realization of the topiary area – represents a first, very important step especially for the persons with special needs.

Sensorial distractions as sounds originating outside the exhibition can diminish the attention's concentration on plants and, consequently, on the etiquettes, having as result the decrease of the quality of communication process. Once interrupted, the visitors do not return on the information from the etiquettes and go to other exhibits. Here are few examples which must be considered in order to minimize attention's distraction:

*Sounds*, of any kinds, can distract visitor's attention, disturbing the all categories of persons, especially categories with special needs. This is the case of the end of the year visits or different playing activities, concourses which are not allowing a quiet visit especially in the interior spaces. Ideally would be that these visits to be scheduled by phone especially in the closed exhibition spaces.

*Competition among the exposed elements* – frequently, two elements of the same exhibition competes for the visitor's attention: an object competes with etiquette or a plant etc. It is right, in these cases, that exhibition to be presented by a guide and the etiquettes to refer strictly to what is original, different or new within the exhibition space (the case of the annual flowers exhibitions).

*The novelty of the circumstances* – at least for the groups of children and for all persons with special needs, distract their attention; the presence of a good orientation system (guides, direction signs etc.) will minimize these distract.

To provide a good guidance within a botanical garden more aspects must be considered; among that, the *limitation of the attention capacity*, mostly in the case of persons with special needs. Because the attention resources are limited, the guide must take into consideration *the reserve's dimension, the exhaustion rate and renewal rate*.

*Reserve's dimension*: the guide must realize a differentiated guidance being aware of: physical energy of each individual, the health state, the mental altitude, interest etc.

*The exhaustion rate*: the guidance must be realized depending on: the mental effort of different persons, the number and intensity of the distraction from the environment or of the social distraction, transmitted information, cognitive-behavioral implication, physical fatigue, time pressure and speed among exhibits.

*The renewal rate*: is very important (especially for the persons with special needs) and consist in taking time for a snack or lunch; this will have as result the reorganization of the attention resources.

The guides will try to make a different interpretation of etiquettes depending on the person interested of guidance; in the care of total disinterest, the guide's implication would be a counter-action. That's why inside botanical gardens there are special resting places or restaurants, cafes etc. in relaxation purposes.

We recommend the establishment of a feed-back in order to achieve long time changes of some behaviors and attitudes.

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## MODALITIES TO USE THE BOTANICAL GARDEN'S PATRIMONY IN ORDER TO MAXIMIZE (EFICIENTIZE) THE BENEFITS FOR THE PERSONS WITH SPECIAL NEEDS

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**Botanical Garden "Anastasie Fătu" Iaşi*

**Summary.** *Romania's EU integration requires the solving of some social integration problems of different population groups, among them the people with disabilities which are limited to the specific needs of: building access ramps, audio-visual signals and socio-economic support. On this line are also situated the botanical gardens, institutions which are pursuing the accessibility of physical environment and information and are promoting the concept of "access for all" or "society for all". This paper is focused on the finding of the best ways of using the heritage of the botanical gardens in order to achieve the accessibility of the social environment for any member of the community.*

The botanical Garden is promoting the physical, cognitive and psychological recovery in an environment favoring the health, prosperity, self-respect, dignity and autonomy of the individual. In this institution are stimulated the personality, skills and creativity of the persons with disabilities and also of their mental and physical abilities at maximum potential.

By the active assistance and intermediation modalities, as the guides and active personnel from different sections, the botanical gardens facilitates accessibility inside buildings and outside for all visitors categories and joins to the concept of "*Design for all"* by conceiving, developing and promoting products, services, systems and ambient for a public as diverse as possible [2, 5, 7].

The European concept of accessibility appeared in the last decade of the past century. Because it is based on the principles of universal design it became a typical example of the integrated approach. In order to speak and have an accessible environment we should eliminate the idea of standardization no matter in any direction would be conducted the analysis of the human needs and promoted the ideas which reflects in the ordinary activities of the individuals (to look, to listen, to touch, to recognize, to understand, to appreciate, to move, to work, to breath) the human diversity, and, depending on these, the environment should be adapted or projected.

Botanical Gardens, by all of their patrimony accumulated in time (plant collections, buildings with historic value, monuments of architecture, libraries, herbariums, museums etc.) represents for humanity a very valuable scientific and cultural heritage. In this context this institutions have the responsibility to keep, enrich and transmit to the next generation information referring to: the value of their patrimony, the value of the collections in herbariums, museums and libraries, the touristic and recreational value [3, 4, 5 8, 9]. Information's dissemination should be realized in various forms (electronically, publications, significant celebrations, exhibitions, symposia, collections) both by specialists and un-specialists, to various categories of public.

In the process of opportunities equalization for the persons with disabilities in all aspects of daily life it should be provided nondiscriminatory access to education, information, culture, transport, leisure. Some aspects of properly use of botanical gardens patrimony, in order to maximize benefits for people with special needs are:

- **Accessibility to the physical environment / transport** – can be achieved as follows:

- the buildings (teaching and administrative hall) and the greenhouses will be designed and arranged as to allow full access for people with special needs: rails, toilet seat properly arranged including for small children change, doors wide and over 77 cm opening, smooth and slippery slopes, large areas of movement and well-lit, rumble strips, strips etc.).

- the etiquettes must be easy to read and understand by all persons and for the blinds persons they must be written in *Braille language*; for the persons with deficiencies in hearing, speaking and for the blind persons, the free access with specialized guiding dogs must be permitted.

- all repairing work, reconstruction of roads or buildings shall be conform to the provisions in art. 49; special leaflets for the people with various disabilities in which are marked the easiest routes to go and ideal way of visiting, preferable with a guide or even with no guide, must be edited.

- parking spaces for disabled persons will be arranged, reserved and marked by the international sign (minimum 4% of the total number of parking spaces); audible and visual warning systems for the pedestrian crossings of the streets at the entrance to the botanical gardens must be present.

- **Access to education, culture, information and communication**

- the informational material must be presented in short phrases, must be clear and written with large characters.

- in the library must exist a "section for the sightless persons" with books in Braille alphabet; also, can be organized a sound mini-library for the sightless and ambliop persons, on compact disks or in electronic format, including various subjects on their adaptation and re-adaptation and the presentation must be realized differentiated, depending on age and disability degree.

- in order to improve the public image of the Botanical Garden, the population can be aware by the realization of a *site with indication of use in the audio mode*, in order to inform the persons with disabilities of every events of public interest. Few pages destined to the sightless persons exist.

- by the floral exhibitions, can be created opportunities for the persons with disabilities to participate to a free society and to other various events organized in the botanical garden and the capitalization of their activity would bring a greater recognizance to this category (mostly) marginalized. The design and realization of new sections as "*The section for the sightless persons*" or "*The section for the persons with loco motor handicap*" and their promotion by explicative papers (in Braille language) would bring a plus of originality to the botanical garden.

**Orientation and circulation in the exhibition space**

For most of the visitors important are:

- *conceptual orientation*: knowledge about what they will see and haw the visit will go on.
- *identification way*: discovery of the access ways to the exposition, wardrobe, toilette, cafeteria, restaurant etc.

**Conceptual orientation**

Information about what should be done, the visit alternatives, visitation direction etc. must be provided through a printed guide, by clear, well-marked orientation signs and by guiding staff. Some of the applied methods and rules are:

- visitors orientation by a guide (for persons with the same handicap type) or a team of guides (when the groups are formed by persons with various handicap types).

- maps of "*you are here and you can access the next directions*" type used for the conceptual orientation of those who wants to know where are localized the elements of the exhibition and *who wants to visit alone*.
- combination of the guide for visitors with a slides presentation in the access hole in order to improve the orientation and reduce the questions from the public.

**Identification mode**

The identification mode is the most important element from the starting of the visit in the botanical garden, mostly for the persons with special needs that are hardly moving. The *hand maps* (usually printed guides for visitors), the "*you are here and you can access the next directions*" maps, the clear directions signs, the guiding teams are, all, methods of confusing avoiding.

- The guide's intervention can increase the time spent by the visitors within exhibitions, which can lead to the increase of their satisfaction degree and easiness of their movement in the unknown zones (at the first visit).
- The identification with the help of the maps and the supplementary use of some directions signs offers to the visitors the sentiment of security and give them the possibility to choose only certain area to visit; there are many botanical gardens in the world where the persons with disabilities can visit alone, without help, the exhibitions areas.
- The maps must be simple and clear; they must help the visiting public to localize itself in any moment; some visitors prefer the hand maps which assures sufficient modalities of identification of the objectives.
- The "*you are here and you can access the next directions*" maps must include generally accepted symbols.
- Tactile map – can be used in public buildings as banks, railway stations, hospitals, botanical gardens etc.; it offers general information about the place, inclusive references on the obstacles or exit areas. The map, realized from plastic and metal can help the individuals with sight difficulties to orient themselves due to the chromatic contrast and can help also the blind persons by the presence of some rough, uneven surfaces.
- Providing reliable information and objectives regarding the accessibility and touristic facilities, taking into consideration all handicap types: physical, visual, acoustic, mental; information on the identification mode of some exhibits must be placed on the map.

**The access ways**

The correct identification of the access ways is primordial to all the visitors of a botanical garden and more important for the persons with special needs. This kind of persons should not go alone in areas that they do not know; especially when the place is totally inappropriate and the experience related to the orientation can put serious adaptation issues. The public need more information regarding: the best route, the names of the buildings and spaces, the parking places, the access ways in the buildings, destinations; they want visible signs and exact answers related to a certain destination and direction. Some errors in the projection of the access ways are:

- *For exterior areas*:

- The main entrance in the building or the main entrance in the botanical garden is not visible and cannot be easily identified.
- There are not any clear direction signs for vehicle and walking persons regarding the placement in the area of the main building or for the main entrance (*which is the main entrance when many gates are present on the same alignment*?) in the botanical garden.

- *For interior spaces*:

- The corridors presents angles too sharps or too obtuse in order to facilitate the access of the persons with disabilities.
- The illumination of the corridors, entrances, intersections is not appropriate.
- Correct information regarding the entrances, access ways and toilet position is not provided.

- *For indications signs*:

- The signs and indications can be read only if the visitor stays at a certain distance.
- Clear directions signs are missing.

Many plants species are ignored because of the impropriate access ways. There are rare the cases when the visitors see all the exposed plants and, even rare at the persons with sight disabilities. The factors influencing the visualization depending on access ways are:

- *Isolation*: the plant which must attract the attention of the public is placed more isolate.
- *Attraction of the objective's prominence*: the visitors are attracted by the bigger plants comparing with the small ones which are ignored most of the times. In this way the bigger plants will influence the traffic by the public's tendency to groups itself preponderant around them.
- *Objects arrangement*: plants arrangement should be realized with a logic which take into account the avoiding the blocking of the access ways.
- *Inertia*: the visitors will follow the indicated access way. If there is

not any established access way, then they will go chaotically or will go on the shortest distance between entrance and exit. If the exit door is closed, the visitors will have the tendency to go out on the same door by which they entered, blocking in this way the circulation flux.

**The exhibits**

Caption of the visitor's attention is the first communication step of the educational message. The visitors must be careful at the etiquette before receive any kind of message. There are two obligatory factors in order to assure attention's caption: *prominence* and the *message's access way*:

*The stimulus* (highlighting, distinction)

- Something less pleasant will be always avoided.
- Smaller plants are ignored most of the times if they don't have visible flowers.

*The size* - bigger plants (usually) receive more attention comparing with the smaller ones; exception – the bonsai.

*The contrast with the exhibition background* - the plants confounding with the background are ignored for the reason that the power to attract the viewer attention is decreasing; this fact is also happening in the greenhouses with cramped plants, plants with different dimensions, with plats presenting very like colors etc.

*Multi – sensorial features* - the presence of the *olfactory stimuli* or the permission to touch the exhibits are methods allowing the caption of attention on a certain plant, mostly for the persons with sight deficiencies. The presence of the *hearing stimuli* as music or presentation of the compartments with the help of cassettes (in Romanian or other foreign languages) would help more the persons with special needs.

*Lighting* - the lighting level is very important. The contrast among the environment, plants and lighting degree can be realized by the placement of some lighting spots which have the role to increase the visualization degree of some species interesting in shape, use, perfume or dimension, mostly in the winter when the days are short and the light intensity is low.

*The marked area* - the placement of a plant in a marked area makes it easier to be observed; this aspect must be aware of in both closed and opened exhibition spaces. Very important is the distance from the floor at which the exhibit is presented. The plants exposed at 1,80-2,00 m from the floor are often ignored by the visitors due to the fact that they don't have the tendency to look up (loco-motor handicappers). In the moment when the height of the walls which will sustain the plants presented to the public is projected, the designer must account of the height at which the plants are or will be in the moment when they will be presented to the public. If the etiquette is not arranged near the exhibit and at an appropriate height, it will be ignored and will remain unread; most of the times it is not visible for the person presenting a loco-motor handicap.

*Collections of conserved vegetal material* - the herbarium occupies a separate zone together with the library; there can activate under guidance all the persons that want to identify plants species (super doted persons, loco-motor handicapped persons etc.).

*The informatics system - the library*. In the patrimony of the botanical garden there are some very old books presenting scientific and historic value, consulted for a plus of information by specialists and not only. Introduction of an informatics system as a data base maximize the benefits for the interested persons.

The data base within this institution is very important; it includes information about the collection from the greenhouses and outside sections and also on the seeds collections; a continued improvement would attract a more efficient activity.

**Educational infrastructure**

*Visiting the living plants collections*: the park and a part of the collections can be opened to the all categories of visiting public, without ticket, a day per year as "*the open gates day*" or "*the persons with disabilities day*" and the special collections can be visited in the presence or absence of the guide; for each collection printed explicative brochures are needed. The guides who accompany the persons with disabilities must be very collaborative. For this issue, the botanic garden must develop programs for guides training and extension of their services and also to accord assistance in the instruction of persons who wants to learn about plants as a hobby or in order to cultivate them.

*Exhibitions*: Every year are organized educative exhibitions on various themes. Also special places can be dedicated to the plats species which have flowered in a certain moment of the year, with explications which must attract the visitor's attention. Meetings and debates on specialty issues for an auditorium as diverse as possible can also be organized. In order to achieve this aim, qualified personnel must be trained capable to prepare an ecological education plan addressed to well defined target groups.

*Educational publications* as the guide of the botanical garden, brochures presenting species from the garden's collections. Dissemination of the researches results in reviews, communications in conferences and congresses, in press, on the internet and by thematic exhibitions represents a way to maximize the transfer of science to different public categories. The informative materials (at the garden's entrance, in special designed places) presenting periodical or permanent character, the informative frames installed in each section of the garden, the seeds and spores catalogue are other educative publications. The guide must be realized in a manner closed to the visitors and must make the visit more agreeable. It must contain succinct and attractive information about the botanical garden and the research activity developed there in order to gain the respect of all public categories with long term effects in the environment education of the next generation (the gifted person's case [1, 6]).

*Services and expertise*: besides the numerous pure botanical services, the specialists of the botanic garden are consulted in other various issues related to plats (cuttings, diseases, consultancy in vegetal therapy domain, qualification trainings in landscape design etc.). The educational services are: seminaries, conferences, communication sessions, cultural activities (in libraries), musical evenings or educative courses, permanent exhibitions, extracurricular activities [10] etc. All educational services must be dimensioned in consensus with the needs, preferences, tastes, expecting and qualitative requirements of the public and also with the principles of the educational policy.

*Scientific and horticultural research activity*: botanical gardens can represent in interface between the public that love plants and plants. The public interested of the special collections of the garden, of the research laboratories etc., does not have access in all compartments of the garden especially in those destined to the research activity, and, from this reason it can informed in an accessible way about all these (the guide of the botanical garden, traditional publications – explicative frames, thematic exhibitions, informative sheets, conferences etc.

The increase of the responsibility to keep the inherited patrimony and to transmit it to the next generations can be realized only by the accentuation of the role of the botanical garden have in the development of botany, by promoting the architectural inheritance and of the landscape design style of the garden, by recognition and promotion of the libraries, herbariums, museums and other collections and by promotion of the garden as a touristic attraction.

Indirectly, the botanical garden intervenes in public's education by providing its spaces to some scientific reunions. The dissemination of the information referring to ornamental plants and standards for their cultivation supports their value and represents an important step in the environment education.

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# EQUAL OPPORTUNITIES TO EDUCATION: ASPECTS ON ECOLOGICAL EDUCATION OF CHILDREN WITH SPECIAL NEEDS

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**Summary.** *The examination of nature by different categories of visitors, allows them to increase the level of knowledge, broaden the scientific horizon, identify networking between phenomena, how they interfere and influence each other, and also it allows formation of a healthy thinking about world and universe. In this respect, a decisive role have the specialists who organize activities within or outside the Botanic Garden. In a botanic garden, the problem of environmental education* *has a double aspect: on the one hand the one of education of all categories of visitors in order to conserve biodiversity, on the other hand, the training of professionals able to successfully complete it. In this context, this article brings up features of children with special needs as a starting point in selecting appropriate environmental education strategies in botanic gardens.*

## Introduction

Botanic Gardens as part of nature, by the beauty they offer to the public, represent ways to get more directly to understanding the conservation action of nature, as long as they are important educational centres for environmental protection [8, 9].

Environmental education carried out in botanic gardens is preparing for life all types of public. Benefits of introducing environmental education, regardless the chosen method of application, are obvious, both for teachers and for students, because it involves several advantages: it presents attractivity for students involving current, critical and relevant issues; it allows an interdisciplinary or sectorial approach of issues (on subjects such as biology, chemistry, geography); it stimulates teamwork; it contributes to the development of creativity and thinking (by identifying and solving problems); it encourages participation in real civic, social activities, and taking decisions according to conceptualized moral values [3, 4].

In the conditions of modern society, when we witness the disharmony between society and nature, it is required imperiously to form a green conscience, a wise and rational attitude toward the natural conditions of life.

Between green conscience and ecological culture there is an intimate, inseparable, interdependent relation. Ecological culture is the foundation of individual's green conscience. Activities developed in botanic garden aim at developing ecological culture through operative and systematic information of population related to the environment, by setting up responsibility and respect for the ambient, forming a green conscience to the young generation, in all educational institutions, the final result consisting in awareness of the coexistence with nature, because tourists are often the greatest enemies of nature [5, 8, 9].

*People with disabilities* are people to whom the inadequate social environment to their physical, sensory, psychic, mental deficiencies blocks them totally or limits their access to equal opportunities in society, according to age, gender, own material, social and cultural factors, requiring special protective measures to support their social and professional integration. Disability occurs when they meet cultural, physical or social barriers, which impede people's access to various systems of society and which are available to other citizens; practically there is a loss or limitation of opportunities to take part in community life, equally with the others.

Integration of people with disabilities in educational activities for work and leisure time represents major objectives of European countries. But in this case, we should be aware that people with disabilities can not be approached as a group, by category of disability (sensory, physical, mental, etc.) because disabilities and disadvantages are different to different people, and there is not an appropriate common approach for the whole group. Disability is seen as a result of a complex relation between the problems of deficiency, health and personal factors of an individual (age, gender, upbringing, adaptation way, occupation, psychical characteristics) on the one hand and environmental factors (physical, social and altitudinal where the person is leaving) on the other [7].

***Special social needs, necessities and interests of the person with disabilities***

In Europe and Romania, the concepts related to the principle of social solidarity and social needs are special needs. The term *needs* was used with different meanings and significance, sometimes mixing the sociologic plan with the social assistance one, with the psychological and pedagogical one. The hierarchy of needs, according to Maslow, has five levels: 1. *Elementary biological needs (physiological ones)* 2. *Security, protection needs*; 3. *Social needs, needs of belonging to a group*; 4. *Needs of uniqueness, esteem and recognition* 5. *Needs for self-actualization*.

There is a dependency between these five levels. As long as the inferior hierarchical needs from the first and second level are not fulfilled, the motivational system of the third, fourth and fifth level will not be accessible.

The pyramid provides only a general overview on the human needs and motivations in general. Everyone is different and behaves differently, depending on the inherited genetic potential and the environmental influences they are living in. When all requirements are met by a high genetic potential and an appropriate environment for personal development, the individual is likely to become an authentic leader. When the needs are not met, they cause suffering and they are known as social needs [10].

The needs of the disabled person related to basic needs, to development of psychical activities (communication, play, work, learning, creativity) and participation in all areas of normal life (life in their own home, education, active life / professional activity, leisure) *become specific* if there is not an adequate support in the environment.

In the category of people with special needs are included: people with various disabilities (mental, sensory-visual, auditory, physical, behavioural, linguistic, multi-deficiencies); abandoned children, street children; abused people (physically, mentally, emotionally and sexually), regardless of age and gender; pregnant and puerperal women; people with mental dysfunctionalities; emotionally / psychically traumatized people; different substances addicts (alcoholics, drug addicts, smokers); people released from detention; elderly people; children from different ethnic groups (for example, Rroma people), "genius" children.

***The child with hearing disability***, with hearing impairments, needs that the communication necessity to be educated and supported through the mimic-sign language. But because this language is useful only in certain situations and it is insufficient to form concepts, words being those that support data acquisition and development of thinking, the hearing impaired child has to be trained in total communication (lip-reading, oral communication, writing, reading, using signs) and included in the complex un-muting process.

*The need to communicate* orally is fulfilled based on the results of the un-muting process, success in lip-reading, and pronouncing of words. Gradually, the hearing impaired child and adult realize the advantages of oral communication, very necessary in the environment of the ones who hear, and in this way the frustration due to misunderstandings of others' language is reduced and it is ensured the transition from thinking in images to the rational one. Thus, ensuring the need of communication has a critical importance in the development of ecological thinking, but the presence of a mimic-sign language interpreter is recommended at the first visits at Botanic Garden, for explanations to be better understood.

The ***visually impaired child*** has needs related to learning Braille writing, a complex process that involves the participation of four analysers: auditory, verbose-kinesthesis, tactile and kinesthesis. In this case, the child does not need necessarily access to technology; ensuring an appropriate labelling in Braille language would be a good start to reduce numerous disadvantages and the isolation of these people. Visually impaired people need to participate in actions through which they understand and develop skills of perception and orientation in space, plant recognition by touch and smell (even tasting some tea, chewing leaves) and executing simple operations in their planting (for the partially impaired people).

To ***the adult and child with physical disability***, the natural need to communicate becomes a special need, even if this capability is not affected and even if the performance in communication is similar to the one possessed by the others of the same age. This happens because there are not facilities to access roads, means of transport, spaces; therefore the person can not arrive at public places, to a meeting, presentation or exhibition.

***The child with severe / profound or associated mental disabilities*** needs the necessity of learning even if it is hard to acquire it. They need encouragement, support to become understood and to avoid potential self-closing. It is inappropriate to talk about knowledge interest arisen spontaneously to the child with severe mental disabilities, but the discovery of own body and outside world becomes a priority for increasing adaptability, for developing the personal autonomy and social skills and for understanding and perceiving correctly the world they live in.

The scientific knowledge of the environment gives to children the opportunity to think and learn, to develop curiosity and interest in certain aspects of the world around them, through direct action, exploration and observation.

The explanations provided in the Botanic Garden ensure the scientific nature of empirical knowledge acquired in everyday life, thus they become functional knowledge, efficient in adaptation to the social environment. The scientific concepts acquired by people with severe mental disability have a sensory coverage, based on the direct contact with objects and images from nature. The practical-applicable feature of the experience of knowing in which the person is introduced allows understanding of relationship between organ and function (ear-hearing, eye-seeing etc.), body and environment.

To the child with severe / profound or associated mental disabilities, the cognitive education is specific, following a different process of learning than the common child's one. Mobility and sensory stimulation enable the child's development on the following major axes: communication, cognitive skills, social and personal autonomy. In sensory development, some life experiences, such as those involving space, time and quantity, have goals related to mathematics, and here the organization of areas with geometric topiary art would be of great help.

Thus children can: develop interest in the environment and to themselves; use their own senses to observe and investigate the environment; broaden the field of direct experience; understand the concepts of cause and effect; apply knowledge learned in everyday life (knowing the plants, they can consume healthy food, etc.); know the rules of a healthy life; operate with measuring instruments (thermometer, meter, clock) and significant units; experience simply the changes of matter's status; be aware of day / night and seasons' alternation.

In the category of children with special needs (exceptionalities) are included gifted and / or talented children, children with sensory, physical or mental disabilities, geographically, culturally, socially or economically disabled children, children of immigrants or emigrants, other categories that need to benefit from specialized education programs to supplement or replace their basic education.

Guides must ensure them the appropriate environment (presentation area) for a differentiated development up to individualization, by discovering and developing personal skills, of own traits, of an individual cognitive style, a visualization and assimilation rhythm tailored to each one. This view is supported psychologically by the statement that the subject is distinguished by behaviour and activity, by reactivity and style [6].

In the environmental education of children with disabilities "any differentiation act of training must always start from the notification of common features, but also of the differences between subjects, differences regarding the dominant superior neural processes, intellectual development, learning ability, rhythm of work, interest, tendency, etc.; knowledge and respect for individual and age psychophysical peculiarities are a sine qua non condition for the interventions of the trainer or specialised guide in environmental education and who have a well specified purpose.

Effective learning is based on understanding, active discovery by the learner of approaches related to the researched field, on solutions finding and problem solving, on repeated exercise, following information storage and accumulation of experience, in the perspective of their updating and application in practice for all children but especially for gifted children.

The educational process for children with *multiple sensory impairments* may be very difficult to attain. The problem is not where to start but when and how to convey this information to create effective learning. Since every child, young or adult, has their own personality, a certain level of skills' development, a certain learning style and specific needs, the interventional strategies should be considered from an individual perspective; focus on specific needs is very important to enable them to develop some skills and talents.

To children / young people with multiple sensory impairments should be given opportunities to develop *social relationships*. A proper guide, carefully structured, based on careful observations on the quality and quantity of social interactions of the child, can help them to develop their social skills; it is recommended to use social integration activities and group games, where older people are involved to mediate social skills training to the children with multiple sensory impairments, to mediate the negotiation and to train their physical skills (body language) and their capacity of assertiveness.

*Gifted people*. The education of gifted children and social integration of young and gifted adults are becoming increasingly global priorities. These children come from all social environments and they can be found in any cultural community, being generally exposed at social risk and social group rejection.

The prodigy people are included in the category of children with special needs, like other children with mental retard or artistic skills; they have needs of information, socialization, integration into the community, use of native and formed potential, creative expression and recognition of personal values. Gifted people have needs related to affection, group relationships, independence and self-actualization, amusement and enlightenment, achievement [1, 6].

*Rroma children*. It is necessary that people who guide Rroma children to perceive their lifestyle, their distinctiveness, to fulfil the educational action successfully and create the bridge between Rroma and other children.

A botanic garden, by its activity may mitigate individual differences arising from various causes (genetic, familial, influenced by the region or the socio-cultural environment etc.) and it allows the maximum development of each individual's potential. The concept of "education for all" leads to the elimination of discrimination, inequality and manipulation observed in the contemporary society. It is a call for solidarity and especially for gathering and concentration of forces to achieve tangible results, regarding a school of future, where no differences or discrimination exist [2].

Among the extra-curricular activities developed in time to fit on each personality, **hobbies** are designed to maintain certain psychological aspects under control, while they are helping to develop others. Developing the environmental education in a botanic garden, may make a person become more assertive, more attentive, more patient or involved more in various projects.

## Conclusions

The botanic garden offers to the visitors, especially to the little ones who, by games, adapt themselves for the first time to the external environment, the first guidelines for the development of hobbies that provide the same benefits as toys, except that the positive feedback, received on the account of what will be achieved, will improve the vocabulary and ability of expression; thus the visitors' performance will increase, regardless of age or needs. The hobby develops the sense of responsibility, attention, creative talents and people become able to focus more on issues; *gardening* as a hobby is creative and it stimulates certain aspects of personality.

In early childhood, playful behaviours have a manipulative, exploratory and creative feature. In adolescence, they become sports, competitions, rituals and hobbies. At maturity, behaviours related to social gaming increase in importance. In old age they become the major manner of the existential occupational behaviour that helps them to mix the others.

Many normal or with special needs children have *free time as completely free time*; that is why it occurs the monotony, boredom and disinterest for academic activities and, as adults, they will orient to other harmful activities which often turns them from normal people to people with special needs of different types.

The most accessible types of hobbies that can be developed into a botanic garden are related to: birds and animals (their salvation, etc.), crafts (different wood carving etc.), gardening, outdoor activities, photography, trips, etc. and they may become career goals for people and especially for people with special needs.

In a botanic garden people can develop their imagination, creativity; it is the place where the visitors develop perception, experiencing, understanding, assimilation and creating beauty. By the awareness of aesthetic emotions, there are gradually reached the highest forms of experiencing beauty, namely aesthetic feelings, profound and lasting sentiments, specific to the human being.

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# THE KEY ROLE OF HIGHER EDUCATION INSTITUTIONS IN IMPLEMENTING EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

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**Summary.** *The present paper aims to contribute at the implementation of the United Nation Decades of Education for Sustainable Development (**ESD**) aside other global and European initiatives as: Millennium Development Goals, Earth Charter and Lisbon Strategy, aligning to the humanity efforts to solve the serious global problems generated by the unbalances from the socio-economic development and the biosphere that host it. It is general accepted that the principles of sustainable development (**SD**) can't be reached without education, public awareness and training. In this regard, the present proposal consolidates and develops the vital leadership role of universities in reaching the ESD's objectives.*

## Introduction

*The contemporary world is threaten by complex and global problems as:* degradation of the environment's quality, over-exploitation of natural resources, reducing the biodiversity, climate changes, demographic expansion, proliferation of ethnic and religious conflicts, amplifying the poverty, famine, unemployment, social exclusion phenomena etc.

*The only alternative* for solving these problems is *sustainable development*, whose implementation supposes that, the humanity, in its socio-economic development, has to respect a series of criteria and settlements: protect and develop the natural capital; replace the pure industrial systems with hybrid ones, eco-industrial ones; use recycling and bio-degradable materials; monitor systematically the ecosystems' integrity and health; realize ecologic reconstruction of damaged areas; promote a biosphere compatible way of living [1]. From the UN Conference on Environment and Development) - Earth Summit that took place at Rio de Janeiro, in 1992, sustainable development became a frequent issue on the political worldly agenda.

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development concept consists of totally forms and socially economic methods, with the main goal of establishing a balance between these socially economic systems and elements of the natural capital. Sustainable development follows and tries to find a stabile theoretical frame for taking decisions in any situation in which a human environment connection is involved, either we are speaking about surroundings, economical or social.

The transition to SD may be approached by: social cohesion, efficient institutions, innovative techniques and *education*. *Education for sustainable development* (ESD) was detailed for the first time in Chapter 36 of Agenda 21, where 4 goals were identified [3]:

*Improving the access to quality basic education.*

*Reorienting the present education for aiming SD.*

*Developing public understanding and awareness.*

*Providing training programs for all private and public sectors.*

In the same Chapter 36 of *Agenda 21,* the nations are called to *cooperation at experts' level*, in order to prepare *the national training and education strategies for Sustainable Development* [3].

Since the WSSD – (World Summit on Sustainable Development), from Johannesburg, in 2002, there have been launched various initiatives for strengthening the ESD role, including Global Higher Education for Sustainability Partnership (GHESP) and Global Virtual University (GVU). Within WSSD, the declaration from Ubuntu was signed in order to strengthen the collaboration between research and education, for a *better integration of science and technology in the educational programs for SD, in all fields and levels, and for strengthening the cooperation among formal, non-formal and informal education* [5, 6].

## Discussions

The lack of progresses occurred in the SD and ESD's implementation is due mostly to the *lack of institutional instruments*. Progresses, when occurred, are due essentially to individual efforts of very motivated people.

As following, there is the need to *strengthen the institutional part and coherent train of trainers programs* in this field. Within the institutions that implement ESD, it must be a *complementarity between the organizational and curricular strategy.* When these two strategies are in conflict, ESD will not reach its targets.

Since 2005, United States Organization launched the Educational Decade for Sustainable Development, following the implementation plan from Johannesburg. Ulterior, UNESCO developed an international implementation scheme of this decade. In this regard, it is promoted the idea of gathering responsible factors on *Regional Centers of Expertise on Education for Sustainable Development* (RCE - SD). Each Center should provide a favorable framework for collaborations among the ESD partners: educational institutes, NGOs, business environment, authorities, centers for nature protection, museums, public heath institutes, training centers for adults and companies as well as other decisional factors from the region. (www.ias.unu.edu).

The high education institutes are initiation and development cores of RCE-SD. They ensure the integration of the most adequate and updated knowledge from the field of natural, social and human sciences in ESD programs, at all levels and sectors, realizing stable correlations among *science, technology and education.*

Their role can be expressed in following objectives:

Development of the implementation capacity of ESD at the level of non-formal sector

Accordingly to the objective 3 of ESD (Chapter 36 of Agenda 21, as specified above), it will be needed to act for *public awareness in general, and of decisional factor, in particular*, regarding the role of ESD in ensuring a sustainable future, as well as for *supervising the environment quality, efficient use of the limited resources social justice and improving the life quality.* For reaching these objectives, representatives of NGOs will have to be trained by the university professors, in the field of development of non-formal ESD educational programs. They will act as connectors between the university core of RCE-SD, population, decisional factor and business environment. Further, they will provide training programs for private and public sectors assisted by university representatives.

Expertise valorisation of the university professors for implementation EDS at the level of civil society

Universities, through its employees (within RCE–SD) could contribute at content conceiving training programs for NGOs training, as well as provide modern strategies in training methodology and pedagogy. This transformative education imposed by SD need experts training from the university environment, who will provide consulting and support for training elaboration that aims to SD attributes. Creating an experts group in this area of inter-university partnership will be one of the training reorienting premises necessary for the transition to SD, at the level of non-formal educational system.

Integration of capacities developed within the project in the European and global implementation system of ESD

In the United States Organization, RCE–SDs from the whole world will form a Global Learning Space for Sustainable Development - GLSSD. GLSSD will be coordinated by the Global Service Centre fro promoting ESD (GSCESD). This Global Centre will use many instruments that support RCE-SD to reach its goals.

In this approach, we can identify two target groups:

- Primary target group: NGOs representatives of non-formal education system. They can develop abilities and competencies for the ESD non-formal educational programs development and SD implementation at the level of civil society.

- Secondary target group: university professors: representatives of formal higher education sector. Due to their double professional background – researchers and teachers – they represent the key element for transferring the most relevant scientific information to the teaching-educative field. They will develop training resources aiming to sustainable development, in flexible frameworks, adequate to different educable categories that are includes in different educational national contexts.

A training curriculum in ESD developed by universities should take into account some aspects required for successful transition to sustainable development, according to the following guidelines [2, 4]:

- Combine individual and collaborative learning;

- Rely on human behaviour studies (as related to use of natural resources, social and economical activities);

- Stir motivation from the part of students, by provoking interest;

- Education should aim at developing a reflex of judging immediate economic gains in the context of long-term effects on our ecological-social-economic systems;

- Emotional appeal: stress the sustainability idea of intergenerational fairness;

- Moral issue: edify values; intergenerational fairness (appeal to youth); belonging to a cultural community – nourish social-cultural representations – refer to traditional wisdom and historical knowledge related to sustainability;

- Stimulate positive personal ambition: ecological/environmental literacy. This must be done in parallel / in relation with technological literacy

- Personal involvement: learning by doing – active learning by finding solutions to small environmental problems in each ones life;

- Flexibility and critical thinking: not being afraid of controversy: on the contrary, controversy is needed for the well development of a problem.

## Conclusions

The essential constructive intervention instrument suggested of this paper consists in the development of competencies for trainers (both in University and NGOs sectors) in order to project and develop curricula aiming to *the attributes of sustainable development*.

This intervention can have as the impact - reorienting the educational systems towards SD; implementing SD will become reality only with an appropriate support from the part of responsible institutions and factors. This goal will be reached through submission of implementation plan proposals of the new curricular vision at the level of each institutions as well as an inter-institutional collaboration, at the level of a Regional Centre of Expertise on Education for Sustainable Development (RCE – SD that can be furthering integrated in a worldly RCE-SD network, as a part of the Global Learning Space for Sustainable Development – GLSSD.

The Partnership universities – NGOs will ensure: an appropriate scientific fundament of curricular reorienting for universities and its dissemination in the formal and non-formal sectors (universities and NGOs), as well as realization of a real social cohesion for ESD implementation in all society sectors.

Training the university professors, curricular reorienting and institutional support from the university's management will have multiplying intra and inter - sectorial effects (a snow ball type) regarding the implementation of ESD. The relationship academic environment-society as well ensuring the social cohesion needed for approaching the long term objectives of ESD will be mediated and realized by the NGOs representatives.

This proposal valorize the innovative experience of the previous Leonardo da Vinci pilot project implemented in "Alexandru Ioan Cuza" University - European Curriculum for Methodological Training in the field of EE, RO/05/B/P/PP175010, 2006-2007. On the basis of the innovative products elaborated within the previous project and the expertise gained within this proposal we can be involved in the future collaborative projects aiming to ESD implementing.

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# METHODS OF ECOLOGICAL EDUCATION IN BOTANICAL GARDENS CASE STUDY: BOTANICAL GARDEN "D. BRANDZA" BUCHAREST

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*Botanical Garden "D. Brandza" Bucharest*

**Summary.** *For many people living in urban environments, botanical gardens offer a window to nature. Visitors go there to enjoy plants, but how many of them are actually aware that many plants also have a fascinating history and are often used for amazing practical purposes? Nowadays, botanical gardens play a fundamental role in education by enhancing people's interest in nature and its protection. This paper aims to share our experiences made during our journey in the attempt to develop the ecological education activities at the Botanical Garden "D. Brandza" Bucharest.*

## Introduction

Environmental education is now incorporated in all major international strategies for biodiversity conservation and sustainable development (World Conservation Strategy 1980, The Botanic Gardens Conservation Strategy 1989, Convention on Biological Diversity 1992, International Agenda for Botanic Gardens in Conservation 2000, Global Strategy for Plant Conservation 2002).

Throughout the world, botanical gardens are starting to assume greater responsibility for educating the public about global environmental change and conservation issues (Mintz & Rode 1999, Willison 1997).

The botanical gardens are ideal places to teach people about (Bramwell 1993, Willison 1993, Stirton 1998):

- the richness and diversity of the plant kingdom,
- the intricate relationships that plants have developed with their environment,
- the ways in which human beings use plants - economically, culturally and aesthetically,
- what the major threats to plants and the consequences of plant extinction are,
- what we can do to prevent the destruction of the natural world.

Environmental education focused on children and youth is a particularly important strategy because it is an opportunity to intervene at a key developmental stage of life, and because children can be an important influence on the behaviour of their parents in what regards the environment.

Many gardens across the world are closely associated with universities and have a very strong formal education component in their work. In many gardens, this traditional, specialized, higher education role has been complemented by a more popular, public education component. The Botanical Garden "D. Brandza" has a long history and tradition in the field of education. Since 2002, it has become a leading environmental education institution, offering a wide range of activities, guided tours, workshops, exhibitions and learning materials. Most of them are designed for young people. The most important resource, which constitutes the basis of all the programmes and activities at the Botanical Garden "D. Brandza" Bucharest, is the living plant collection.

The aim of our work is to use the resources of the botanical garden to inspire and enable people to take responsibility for their environment.

Our objectives are:

1. To develop effective environmental education programmes

which respond to international and national environmental policies and legislation;

2. To make our Botanical Garden more educationally relevant and accessible to all teachers and learners, particularly those who in the past did not have the opportunity to visit;

3. To develop the interest of children in plants and their life;

4. To promote the educational value of botanical gardens in schools.

**Environmental educational programmes and activities**

Most programmes for education in botanical gardens are specifically designed to meet local means, requirements and social circumstances. For this reason, our education programmes and activities have many different components:

**Informative panels**

Each of the sectors in the Botanical Garden "D. Brandza" Bucharest has an informative panel where there are presented the role and the structure of each of them. This way, visitors can easily learn about the representative species.

As others botanical gardens, our botanical garden display plant labels to inform visitors about the species on show. Such passport data provides information about plants such as the local name, scientific name, family, origin. Some of the labels, especially for trees and shrubs, are bigger and give more information about the morphological characters of species, its habitat, range of distribution, uses and culture.

Since 2000, the Botanical Garden "D. Brandza" Bucharest has witnessed great development, enjoying improvements in its layout, a restoration and rebuilding of the greenhouses, consolidation of the library and education facilities and generally a maximisation of the potential of this important resource. Improvement of these components has led to the revitalising of educational activities, and thus education has become one of the garden's main strategic directions.

**The Museum of the Botanical Garden "D. Brandza" Bucharest**

The displays in the museum of the Botanical Garden "D. Brandza" Bucharest tell a story using words, pictures and botanical objects in a way that is interesting and stimulating both to the general public and to biology students. They are rich treasure houses containing timbers and resins, fruits and seeds, fibres and textiles, paintings, photographs and models and much more (Figure 1).

Figure 1. The Museum of the Botanical Garden “D. Brandza” Bucharest

**Guided tours**

A guided visit to the gardens, museum and greenhouses can help young people learn more about nature and compel them to appreciate more profoundly the value and importance of plants. It can also help them discover whether a career as a botanist or horticulturist is suited for them or inspire them to become volunteers in the Botanical Garden. All the collections provide an exceptionally rich resource for educational visits.

**Events**

Every year events are held at the Ecological Education Centre, with different themes that focus on art and biodiversity and include exhibitions and ecological education activities. The Floral exhibitions (“Flowers for… Flowers”), seeds and fruits exhibitions (“Autumn colours”, “Autumn fruits”) are accompanied by workshops with children (Figure 2, Figure 3, Figure 4). These events are held in order to develop awareness amongst the general public, and especially children, about the importance of protecting the environment and keeping the green areas clean. Moreover, such workshops help young children discover the beauty of the world of plants and helps them familiarise themselves with the great variety of seeds, flowers and leaves that can be found in nature. Through fun and practical crafting activities children get to work directly with all of these elements and are thus given the chance to build their knowledge of plants and the environment in an informal manner.

Figure 2. “Flowers for … Flowers” - workshops with children

Figure 3. “Autumn colours” - workshops with children

Figure 4. “Autumn fruits” - seeds and fruits exhibitions

The Botanical Garden “D. Brandza” Bucharest has also been the host of major events, created for special days such as World Environment Day and International Children’s Day (Figure 5, Figure 6). These events provide great opportunities for involving large numbers of children and families in a relatively short time framework. Thus, several times a year, pupils from various schools in Bucharest have the chance to take part in informal learning activities such as games, quizzes, drawing competitions, photography exhibitions. Moreover, every year, the student-led organisation Team Work prepares with the help of the experts at the Botanical Garden a ‘treasure hunt’ event for both children and parents (Figure 7). With the help of a map, the participants in the treasure hunt go in the search of a treasure hidden somewhere in the premises of the Botanical Garden. Throughout the adventure the participants gather clues regarding the location of the treasure, only if they are able to answer to questions about plants. Every participant is a winner in the end, as everyone leaves home with at least one little treasure – a plant in a pot.

Figure 5. World Environment Day 2010

The main purpose of all of the abovementioned events is to develop the interest of children in plants and their environment, and to bring nature closer to their hearts, by making it more accessible and fun.

Figure 6. World Environment Day 2011

Figure 7. International Children's Day - a 'treasure hunt' event for children and parents

**Environmental Consultants**

Another service that the Botanical Garden "D. Brandza" provides is support and advice to schools, concerning their environmental work. There are in Bucharest numerous schools and nurseries which have large gardens or green play areas. These spaces have a great potential from the point of view of environmental education. Thus, we help such schools that have requested our support by identifying, labelling and providing detailed information about all the trees and shrubs found in their gardens.

We also coordinate a variety of other educational programmes for schools and nurseries (Figure 8, Figure 9). The activities of these programmes are in line with the school curriculum and are held both in these institutions and in the Botanical Garden ("The Little Nature Detectives", "The Friends of Nature").

Figure 8, Figure 9. “The Little Nature Detectives” an educational programmes for nurseries

**The Nature’s School Programme**

An interesting environmental education programs has been developed in the Botanical Garden over the past ten years. This programme was set up with the aim of using the garden as a teaching resource for children living in the city. The programme supports primarily informal education, with an emphasis on exciting, hands-on activities that engage learners with indigenous and exotic plants, ecological conditions and other issues related to the sustainable use of these plants. Previous themes included: Extreme Adaptations, Botanist for a Day, The Journey of Senses, Personal Encounter with a Plant, Botany on a Plate, What Plants Need in order to Grow, Plants: from the Root to the Fruit, Plants’ Detectives.

**Educational projects**

Another important tool we use in our efforts to promote environmental education is constituted by long-term, ongoing, educational projects. Thus, in 2011 the Botanical Garden obtained a grant for the creation of ‘Grandma’s Garden’, a project designed precisely to serve educational purposes (Figure 10). This project was rooted in two core beliefs:

- Botanical gardens should play a vital role in raising awareness about the current environmental crisis, of which the loss of genetic diversity is a part.
- An increasing number of children, especially among those living in cities, have an alarmingly limited knowledge of vegetables and fruit, and their ability to recognise or name these vegetables and understand the environment they grow in is even poorer.

Figure 10. The ‘Grandma’s Garden’, a project designed precisely to serve educational purposes

The aim of the project was to arrange in the Botanical Garden a traditional Romanian garden (kitchen garden/potager and orchard) so that visitors, especially children, can come in direct contact with a variety of plants, usually grown in countryside gardens, a space less and less familiar to children and adults living in the city. A large number of volunteers were involved in the development of this project and so far over 200 pupils have taken part in activities related to this project.

**Activities for children with special needs**

Because we strongly believe that ecological education should also be made available to children with disabilities, we have in recent years also included activities and events aimed precisely at disabled children. During one such event, our experts helped visually impaired children to feel a range of textures and smell the most subtle scents and rich fragrances This event was a very enriching and touching experience, and it helped us better understand that in order to fully appreciate our surroundings, we have to learn to close our eyes. As Antoine de Saint-Exupéry’s Little Prince discovered, “what is essential is invisible to the eye”.

## Conclusions

- Every botanical garden can play a vital role in the process of environmental education. Botanical gardens can set up environmental education programmes within the framework of their infrastructure facilities and must be specifically designed to meet local means, requirements and social circumstances. These programmes can include various informal learning activities.

- In the past 12 years, environmental education activities have improved. We started with guided tours in the garden and reached comprehensive environmental education programs.
- The aim of ecological education in botanical gardens is to encourage the community, especially children, to observe, love and protect their environment. Therefore the Botanical Garden of Bucharest has focused on environmental education for children, considering that many children in Bucharest are unable to have contact with nature in everyday life. For this reason, it was necessary to create a new sector, for helping learn children more about vegetables: the Grandma's Garden.
- The key principle in our environmental education programme is to get the children out of the classroom and bring them into the Botanical Garden where they can experience and study the diversity of life, directly.
- All engineers and biologists from the botanical garden are involved in environmental education activities, thus ensuring its quality.
- For the future, we envisage that our educational programmes will also focus on providing training for teachers on updating and reforming the traditional environmental educational techniques, on science teaching and learning practices, and on enhancing the quality of science education in schools.

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