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Conference Paper

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THE EVOLUTION OF CHEMICAL PROPERTIES OF SOIL UNDER THE INFLUENCE OF TILLAGE SYSTEMS AND FERTILIZATION AT THE CULTURE OF WHEAT IN THE PERIOD 2007-2016 AT ARDS TURDA

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Abstract

Through the experiment realized at ARDS Turda in 2007, was monitored in comparativ, the evolution the soil under the influence of the tillage system, the crop plant, and the level of fertilization. Increasing the reserve in the macro-elements is much more significant in the case of the conservative system compared to the classic system, especially at the depth of 0-20 cm. The production data registered at the variety of autumn wheat Ariesan in the period 2007-2016, indicates the suitability of cultivation in the "no tillage" system, the difference in production between the two systems, the classical (5535 kg/ha) - "no tillage" (5435 kg/ha) being only 100 kg/ha.

Keywords: *clime, fertilization, no tillage, macro-elements, yield.*

Classification JEL: Q 01, Q 15, Q 16.

INTRODUCTION

Soil tillage, if properly applied, favors self-repairing processes and those that lead to increased soil productive potential (Chetan et al., 2011; 2015,). These processes include increasing the content of organic matter, improving the water and air regime, increasing biodiversity, slowing soil erosion etc., ensuring soil sustainability. An appropriate crop rotation is obligatory, alternating plants with strong rooting with plants with superficial rooting, the legumes having a favorable effect on the succeeding cultures, improving the soil in nitrogen and contributing to the development of the root system of the plants (Chetan, 2013; Chetan et al., 2012). Integrated plant protection management leads to reduced use of pesticides (Malschi et al., 2013), giving priority to agro-technical and biological measures, bio-pesticides, the use resistant varieties and hybrids.The main pests present in wheat crops every year at SCDA Turda, are combated by agrotechnical methods (rotation of crops, soil works) and chemical (seed treatment and used insecticides applied in various stages of grain growth) are *Lema melanopa, Oscinella frit, Haplothrips tritici, Eurygaster intergripes, Agriotes lineatus.* Diseases frequently occurring in wheat crops in the Turda (*Helminthosporium gramineum, Ustilago tritici, Septoria tritici, Puccinia recondita, Erysiphe gramminis, Fuzarium culmorum*) area must be known and monitorized to prevent their installation and attack on crop plants. From the research carried it is recommends at least two treatments with fungicides in two moments: at the blossoming and bellows. In the unconventional agricultural systems, the weed control (for dicotyledonated and monocotyledonated) it is realized used herbicides (do not presented a retention in the soil), (Chetan et al., 2013; 2015).

The choice of the unconventional system variant should take into account the technological features of the soil, depending on the texture, humidity, structure, humus content, clime etc.

MATERIALS AND METHODS

Through the experiment set up within SCDA Turda in 2007, the evolution of soil properties under the influence of the working system, the cultivated plant and the level of fertilization was monitored. The biological material was represented by autumn wheat Arieșan variety.
Experimental factors:

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Factor A - system of work with two graduations: a_1-conventional with plowing; a_2- the no tillage (direct sowing);

Factor B - two-stage fertilization: b_1- the basic fertilization with $N_{40}P_{40}$; b_2- the basic fertilization with $N_{40}P_{40}$ + N30 on vegetation;

Factor C- experimental year: c_1-2007, c_2-2008, c_3-2009, c_4-2010, c_5-2011, c_6-2012, c_7-2013, c_8-2014, c_9-2015, c_{10} -2016.

The method used for pH determination was the Potentiometric method, for the humus the Walkley-Black method was used, the nitrogen was determined by the Kjeldhal method, the Colorimetric method was used for the phosphorus, and the potassium content was determined by the Flamfotometric method (OSPA Cluj). The results were statistically analyzed by ANOVA test.

The meteorological conditions in the years tested (Turda Meteorological Station, longitude 23°47', latitude 46°35', altitude 427 m) are presented in Table 1.

Table 1. The thermal and rainfall regime, ARDS Turda, 2007-2016

Year	Average annual (°C)	Annual amount (l/m^2)
2007	10.3	655.3
2008	10.1	630.6
2009	10.3	493.4
2010	9.7	739.8
2011	9.4	433.0
2012	10.4	504.4
2013	10.4	523.2
2014	11.1	741.5
2015	10.7	641.2
2016	10.0	816.8
Average 60 years	9.1	518.6

RESULTS AND DISCUSSION

Of the 10 years analyzed, from the point of view of the thermal regime, five years have been warm, three years have been litlle warm and only 2 normal, and for precipitation, 4 years of excessive rain, 2 very rainy years, 3 years normal and only 1 year dry. Annual mean values refer to multi-annual averages of 9.1°C and 518.6 l/m^2. In these years, the thermal values are also deviating by 2°C higher, as in the case of 2014, compared to the 60-year multiannual average. Also during this period the rainy year was 2016, respectively, with 816.8 l/m^2, a deviation of + 303.2 l/m^2 but with a non-uniform distribution of precipitation and excessive October (Table 1). The physical properties of the soil directly influences its fertility, which in turn has a strong influence on the water, air and soil nutrition regime. At the same time, chemical and biological processes are intensified, seed germination, rooting into the soil, soil erosion is prevented, all of these data being provided by the literature of speciality. The experience has been founded on a fertile soil but also with a susceptibility to rapid compaction at the passage of large agricultural aggregates or when working mechanically in high humidity conditions. The evolution of soil chemical attributes under the influence of soil and fertilization systems is presented in Table 2.

As can be seen from Table 2, in the classical system + 1 fertilization $N_{40}P_{40}$ compared to the initial values of the main agrochemicals, we can see, first of all, the increase by 10.79% of the weak acid pH (6.30) at (6.98) on a depth of 0-20 cm and a change of 20-40 cm depth (pH 7.11). If we refer to loamy-clay texture and a apparent density of 1.2, the humus content remained small, recording a decrease of 5.44% on the 0-20 cm depth and a 19% increase on the depth 20-40 cm. As regards the macro-elements content, the most important change was observed in the case of phosphorus, recording an increase of 300 ppm, from a small content (5 ppm) to a medium content

(20 ppm), an increase in potassium by 83, 57% ppm on the 0-20 cm (middle) depth and 57,14% on 20-40 cm (from medium to good supply).

Table 2. The influence of works system and fertilization on soil fizico-chemical properties, ARDS Turda, 2007-2016

Work system/year /fertilization		Depth of soil sampling	Name analysis/UM				
			pH	Humus %	Total Nitrogen %	P ppm	K ppm
2007	Classic $N_{40}P_{40}$	0-20 cm	6.30	2.94	0.162	5	140
		20-40 cm	7.00	2.21	0.124	9	126
2016	Classic $N_{40}P_{40}$	0-20 cm	6.98	2.78	0.183	20	257
		diference %	10.79	- 5.44	12.96	300	83.57
		20-40 cm	7.11	2.63	0.123	9	198
		diference %	1.57	19	-0.80	0	57.14
	No tillage $N_{40}P_{40}$	0-20 cm	6.79	3.44	0.220	74	291
		diferența %	7.77	17	35.80	1380	107.85
		20-40 cm	7.14	1.96	0.125	11	162
		diference %	2	-11.31	0.80	22.2	28.57
	Classic $N_{40}P_{40+}N_{30}$	0-20 cm	6.66	2.60	0.186	43	255
		diference %	5.71	-11.56	14.81	760	82.14
		20-40 cm	7.11	2.25	0.128	10	171
		diference %	1.57	1.80	3.22	11.1	23.10
	No tillage $N_{40}P_{40+}N_{30}$	0-20 cm	6.89	3.49	0.229	54	246
		diference %	9.36	18.70	41.35	980	75.71
		20-40 cm	7.16	2.51	0.143	8	214
		diference %	2.28	13.57	15.32	-11.1	69.84

In the classical system + 2 fertilizations $N_{40}P_40 + N_{30}$, pH changes are less pronounced, on the 0-20 cm depth (6, 66), increases by 5,71% and on the 20-40 cm depth there was an increase of 1.57%. The humus content decreases by 11.56% in the first 20 cm, remaining almost unchanged on the 20-40 cm (rising 1.80%). As expected, there were significant increases in total nitrogen content (by 14.81%) and especially phosphorus by 760%, from very low (5 ppm) to good (43 ppm) on the 0-20 cm and on the 20-40 cm depth with only 11.1% growth, it remains weak. In the case of the "no tillage" + 1 $N_{40}P_{40}$ fertilization, it resulted in a slight increase in pH, remaining weakly acidic on 0-20 cm and neutral on the 20-40 cm depth. This system shows the highest increase of the humus content in 0-20 cm, respectively by 17% in the variant with fertilization and by 18.7% in the case of the two fertilization variant.The increase in the macro element reserve is more important in the case of the "no tillage" system than the classic system, especially on the 0-20 cm depth. Thus, the nitrogen content recorded the highest increase (+ 35.80%) in the case of the "no tillage" system with fertilization and with 41.35% in the variant with two fertilizations, the phosphorus content registered the highest increase in case of the variant with one fertilization (+ 1380%) from very low to very good on the depth of 0-20 cm, respectively (+ 980%) from weak to good on the same level of fertilization. On the 20-40 cm depth the phosphorus content remained weak, from 9 ppm to 11ppm (+ 22%) in the variant with the basic fertilization and dropped from 9 ppm to 8 ppm (-11.1%) in the two-fertilization variant. Potassium increased by 107.75% in the first 20 cm from the good (140 ppm) to the very good (291 ppm) in the variant with the base fertilization and maintained good (+ 75.71%) in the two-fertilization variant. On the 20-40 cm depth, the potassium value increased from medium to good (+ 28.57% with fertilization and + 69.84% with two fertilizations).

The different climatic conditions in 2007-2016 have influenced wheat production differently. The lowest productions were registered in the non-conventional system (NT) in the variant with a fertilization (2974 kg/ha) and in the variant with two fertilizations (3062 kg / ha) in the

dry year 2009. Also this year, low production was also achieved in the classical system (SC) 3468 kg ha with basic fertilization, respectively 3584 kg/ha in the variant with additional fertilization. Slightly and unevenly rainfall in the years 2011, 2012 and 2013 led to small production ranging from 4597 to 4893 kg/ha (fertilization) and 4587-5076 kg / ha (two fertilizations) in the classical system (CS) compared to no tillage system (NT) - the recorded productions ranging from 4602-4845 kg/ha (fertilization) and 4876-5232 kg/ha (two fertilizations). It seems that the "no tillage" system preserves the rainwater better. The abundant rainfall of the last years (2014, 2015 and 2016) led to the faster dissolution and solubilization of applied mineral fertilizers, the wheat culture benefited to the maximum of the intake of these minerals, resulting in the production of over 6800 kg/ha, in the both systems in both basic fertilization and base fertilization variants plus additional nitrogen fertilization in spring to resumption of the wheat vegetation. The average production achieved in the 10 years experimental was 5445 kg/ha in the fertilization version and 5625 kg/ha in two fertilizations from the classic system compared to the "no tillage" system with a production average of 5342 kg/ha in the variant with fertilization and 5528 kg/ha in the variant with two fertilizations (Table 3).

Table 3.The interaction factors tillage system x fertilization x year on winter wheat yield, 2007-2016

System/fertilization /year		Yield kg/ha	Difference	System/ fertilization	Yield kg/ha	Difference
Classic + $N_{40}P_{40}$	2007	4911^{Mt}	0.00	No tillage + $N_{40}P_{40}$	4721^{000}	-191
	2008	5512^{Mt}	0.00		5329^{000}	-183
	2009	3468^{Mt}	0.00		2974^{000}	-494
	2010	5247^{Mt}	0.00		5064^{000}	-183
	2011	4598^{Mt}	0.00		4602^{-}	4
	2012	4807^{Mt}	0.00		4845**	38
	2013	4893^{Mt}	0.00		4714^{000}	-180
	2014	6971^{Mt}	0.00		7064***	93
	2015	6988^{Mt}	0.00		7027**	39
	2016	7066^{Mt}	0.00		7093**	27
Classic + $N_{40}P_{40}$ + N_{30}	2007	5066^{Mt}	0.00	No tillage + $N_{40}P_{40}$ + N_{30}	4939^{000}	-128
	2008	5786^{Mt}	0.00		5522^{000}	-264
	2009	3584^{Mt}	0.00		3062^{000}	-522
	2010	5498^{Mt}	0.00		5232^{000}	-267
	2011	4588^{Mt}	0.00		4824***	236
	2012	4928^{Mt}	0.00		4904^{00}	-25
	2013	5076^{Mt}	0.00		4876^{000}	-200
	2014	7155^{Mt}	0.00		7193**	39
	2015	7246^{Mt}	0.00		7341***	95
	2016	7329Mt	0.00		7399**	70

LSD (p 5%) = 4; LSD (p 1%) = 12; LSD (p 0,1%) = 79.

CONCLUSIONS

Chemical fertilizers should be applied as a complement to existing soil reserves, rationally and differentiated, depending on soil characteristics and cultivated crop, while protecting the environment.

In order to establish accessible and mobile reserves of nutrients for agricultural crops, it is absolutely necessary to study the agrochemical of the soil.

The study of climatic factors helps us to form a picture of climate change and adaptation of some technologies that are suitable for the reference area, in the unconventional systems of soil works the accumulation and preservation of water is easier compared to the classic system where the reduced the large number of works,the water is conserved in the soil better.

The increase in the macroelement reserve is more important in the case of the "no tillage" system than the classic system, especially on the 0-20 cm depth.

The humus content is higher than the initial values in most "no tillage" variants.

The production data recorded on the Arieșan Autumn wheat variety during the period 2007-2016 indicate the cultivation pretability in the "no tillage" system, the difference in production between the two classic systems (5535 kg/ha) and "no tillage" (5435 kg/ha) being only 100 kg/ha.

The fractional fertilization: autumn at sowing + spring at the resumption of vegetation, ensures a production increase of 180 kg/ha in the SC and 186 kg/ha in the NT.

The production is influenced by the climatic conditions, the years 2014, 2015 and 2016 they was with thermic and pluviometric favorable conditions and has a positive influence on the expression of the wheat variety production potential of the experiment (over 7000 kg/ha).

The soil conservation system has the following advantages: the small number of land crossings and the reduction of the risk of destroying the crop; soil rich in clay is not brought to the surface; organic matter accumulates in the superficial layers, thus ensuring a better soil structure.

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*** Meteorological Station Turda, longitude: 23º47', latitude 46º35'; altitude 427 m

*** ANOVA statistically program