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THE BEHAVIOUR OF CERTAIN PEACH TREE CULTIVARS TOWARDS THE ATTACK OF THE MAIN PATHOGEN AGENTS

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Abstract

The purpose of this paper is to highlight the cultivars which are the most resistant to disease and pests and which have adapted the most efficiently to the pedo-climatic conditions of Dobrogea. The research took place during the period 2008-2011 at the RSFG Constanta in a peach tree culture planted in 1991 and it involved the following cultivars: 'Springold', 'Springcrest', 'Cardinal', 'Collins', 'Redhaven', 'Jerseyland' and 'Southland'. Observations were recorded concerning the attack of several fungi (Taphrina deformans, Cytospora cincta, Monilinia laxa and Monilinia fructigena) following the application of phyto-sanitary treatments with insecticides and fungicides administered at the right moment and in optimum quantities. Among the studied pathogens, the blistering of the leaves caused by the Taphrina deformans Berk et Tull. fungus is by far the most damaging foliar pathogen agent. Its attack has serious consequences both upon fruit production as well as upon the physiological balance of the trees, resulting in their degradation. Within the pedo-climatic conditions of the south-eastern part of the country, this disease is quite frequent in cultures which causes severe damage. The majority of the studied cultivars manifested and elevated resistance towards the attack of the Taphrina deformans pathogen. In 2011, the 'Springold' and 'Springcrest' cultivars were sensitive towards this pathogen agent. As far as the latter is concerned, we must mention the fact that the sensitivity of the cultivar is also influenced by the environmental conditions specific to each studied year. The most resistant cultivar (basically, without attack) towards the Cytosphora Cincta is 'Redhaven', while the most sensitive was 'Collins'. As far as the Monilinia laxa and Monilinia fructigena fungi are concerned, all the studied cultivars proved to be tolerant. Following this study, the most valuable genotypes can be extended in demonstrative allotments and commercial plantations.

Key words: *resistance, blistering, natural infection, Prunus persica*

INTRODUCTION

In our country, Dobrogea is the region that offers the most favourable conditions for the peach tree culture. Unfortunately, however, this area is also favourable for the development of certain extremely harmful pathogen agents, such as: *Taphrina deformans*, *Cytospora cincta*, *Monilinia laxa* and *Monilinia fructigena*. The diseases caused by the attack of pathogens are frequent when spring is cold and humid and cloudy for long periods of time. Under these conditions the attack is strong and the quality of the production diminishes considerably.

The peach tree is the third most import fruit-growing species in our country, after the apple tree and the plum tree and is cultivated in warmer areas, with an average annual temperature of 10-11.5 °C. The soil needs to be deep, aerated, with a pH varying between 5.7 and 7.5; also, the content of active limestone must not surpass 7% when using the franc parent stock and 15% when the parent stock is an almond tree (Stănică and Branişte, 2011).

The peach tree is widely spread, in Europe (43% of the annual production, 18,000,853 t in 2008), Asia (23%), Central and North America (17%), South America, Africa, Oceania. 4,203,800 t were produced in Europe in 2008, the most productive country being Italy (1,720,000 t), followed by Spain (1,149,000 t), Greece (700,000 t), France (401,000 t), etc. Romania produced 16,400 t in 2008 (Stănică and Branişte, 2011). Both in our country as well as worldwide the aim is to obtain fruits of a superior quality, with an increased and constant productivity of the trees which should be resistant and/or tolerant to the main diseases specific to the species. The importance of knowing the pathogen agents and the pests which could attack the peach tree is correlated

with the practical necessities which occur in the orchard and storage period, taking into account the fact that the quality standards of the material for cultivation whose purpose is the creation of new plantations, as well as the quality standards of the fruits can be achieved only if the pathogens and pests are known so that their attacks can be controlled.

Trandafirescu (1998, 2007) has studied the resistance to the *Taphrina deformans* within the peach tree and nectarine tree species, detailing the research for each cultivar from the national peach tree collection planted in 1981.

The purpose is to highlight the cultivars which are the most resistant to diseases and pests in order to be extended in demonstrative allotments and commercial plantations, thus occupying a good place in the structure of the peach tree assortment from the South-Eastern region of Romania.

MATERIAL AND METHOD

The research took place in the period 2008-2011 at the R.S.F.G. Constanţa, in Valu lui Traian, Constanţa district, in a peach tree plantation planted in 1991, the planting distance is 4/4m (625 trees/ha) and the shape of the trees is a free flat palmette. The studied cultivars have different ripening periods and are the following: 'Springold', 'Springcrest', 'Cardinal', 'Collins', 'Redhaven', 'Jerseyland' and 'Southland'. Given the fact that the region is semi-arid, the peach tree culture developed under an irrigated regime. The soil is a calcareous chernozem (CZka), with a claylike texture, a low alkaline pH (8.2) in its entire profile. The behaviour of the peach tree cultivars towards the attack of pathogens (*Taphrina deformans*, *Cytospora cincta*, *Monilinia laxa* and *Monilinia fructigena*) was observed under conditions of natural infection. From a technological point of view, 6-8 insecticide and pesticide treatments were applied against the main disease and pests. The system concerning the maintenance of the soil was black ground between rows and herbicided on the rows of trees (a strip of 50 cm). Observations were carried out concerning the behaviour of certain peach tree cultivars towards the attack of the main pathogen agents, as well as observations regarding the phenology of the studied cultivars (the swelling of the flowering buds period and the ripening time). Observations were also carried out concerning the evolution of the disease on the leaves, fruit and sprouts following the applying of phyto-sanitary treatments with insecticides and fungicides, treatments administered at the optimal moment and dosage.

The research was carried out under conditions of natural infection, according to the test created by Crossa (1968). The evaluation technique consisted in assessing the frequency of the attacked organs and the intensity with which the symptoms manifested themselves, these being the aspects according to which the behaviour was assessed.

The observations were performed by ranking the intensity of the attack on a scale of 0-4, as follows:

W.A.= cultivars without attack (F%=0 and I=0)

T=tolerant cultivars (F%=0.1-5% and I=0 $^{\pm}$ +)

We.A.=weakly attacked cultivars (F%=5.1% - 10% and I=+)

M.A.=moderately resistant cultivars (F%=10.1%-25% and I=+)

S=sensitive cultivars (F%=25.1–50% and I=+ ^{2} 4)

V.S.=very sensitive cultivars (F%=50.1%-100%, I=+ ^{4} 4)

In order to determine the development of the main vegetative stages under the conditions of the R.S.F.G. Constanta, phonological observations were carried out concerning the trees both in the resting period, as well as during the vegetative phase.

Fructification phenophases

As far as the genesis of the flowers is concerned, the start of vegetation in spring represents the continuation of the process of flower creation which has been interrupted by the biological resting period.

- The swelling of the flowering buds;
- The beginning of blossoming.

Similar to the other vegetative stages, the blossoming of the trees is influenced by the evolution of the climatic conditions. The beginning of the blossoming in the period 2008-2011 was recorded for all the studied cultivars.

Intensity

The intensity of the blossoming is appreciated on a scale of 0 to 5, the specific moment of

appreciation being the mass blossoming stage. The grade 0 is considered when the cultivar has no blossoms whatsoever, while the grade 5 is when the cultivar displays a large amount of blossoms.

- The ending of the blossoming;

The blossoming can last a longer or shorter period of time depending on the maximum temperatures during the day and the intensity of the wind, correlated with the degree of differentiation between the trees (meaning the quantity of blossoms per tree).

- The hardening of the core;

The hardening of the core is determined by piercing the fruit with a needle at regular intervals, usually of two days. When the needle has difficulty piercing the fruit it is considered that the hardening of the core has begun. The operation was performed in a progressive manner, according to the calendar, in the same day for all studied cultivars.

- The ripening of the fruits;

The ripening of the fruits is highly influenced by a series of climatic and agro-technical factors, such as the temperature, the drought, the quantity of fruit per tree, the shape of the crown, the density of the trees, etc.

Taking the calendar into account, each ripening period has large variation limits from one year to another, depending on how the climatic factors influence the vegetation to be early, late or extra-late.

RESULTS

In the period 2008-2011, the phenophase of the flowering buds swelling at the peach trees (Table 1) underwent between the following limits:

Between 20.03 and 29.03 at the 'Springold' cultivar;

Between 22.03 and 29.03 at the 'Springcrest' cultivar;

Between 24.03 and 30.03 at the 'Collins' cultivar;

Between 18.03 and 30.03 at the 'Cardinal' cultivar;

Between 22.03 and 03.04 at the 'Redhaven' cultivar;

Between 03.03 and 29.03 at the 'Southland' cultivar;

Between 22.03 and 03.04 at the 'Jerseyland' cultivar;

Basically, the swelling of the flowering buds occurred between 03.03 and 03.04 (one month).

The beginning of the blossoming

Similar to the other vegetative stages, the blossoming of the trees is influenced by the evolution of the climatic conditions. For all the studied cultivars the beginning of the blossoming in the period 2008-2011 was recorded, the differences between cultivars being very small (a few days), meaning that mutual pollination was ensured. Thus, the limits for this stage were 26.03 and 10.04.

The duration of the blossoming depends on the maximum temperatures during the day and the intensity of the wind, correlated with the degree of differentiation between the trees (meaning the quantity of blossoms per tree).

The scaling was carried out when the petals of the last blossoms fell from the trees. The duration of the blossoming (average for the four studied years, 2008-2011) expressed in number of days (Table 1) varied between 8 days ('Springold', 'Redhaven' and 'Southland' cultivars) and 22 days ('Springcrest', 'Collins' and 'Southland' cultivars in 2011).

The intensity of the blossoming

In 2010 a weak intensity was recorded by the 'Springold' and 'Springcrest' cultivars (2 and 3, respectively, upon blossoming). The 'Collins', 'Cardinal', 'Redhaven', 'Southland' and 'Jerseyland' cultivars displayed a significant intensity upon blossoming, of 4 and 5.

The hardening of the core

This phenophase occurred in the first ten days of June (04-16.06).

The harvesting maturity

Its variation limits were June 21st ('Springold') and August 10th ('Southland'), this phenophase being genetically influenced.

At Valu lui Traian the pathogens of economic importance for this specie under the conditions of the studied period 2008-2011 were the following mycoses: *Taphrina deformans* Berk et Tull (blistering of the leaves), *Cytospora cincta* Sacc (perennial cancer of the sprouts), *Monilinia laxa* and *Monilinia fructigena* Aderh Ruhl Honey (rotting and mummification of the fruit).

Table 1. The development of the main fructification phenophases at the peach tree in the period 2008-2011

No.	CULTIVAR	Year	Swelling of the flowering buds	Blossoming			Intensity	Hardening of the core	Harvesting maturity
				Beginning	Ending	Duration (days)			
1	SPRINGOLD	2008	20.03	28.03	18.04	21	5	04.06	29.06
		2009	25.03	08.04	23.04	15	5	10.06	27.06
		2010	29.03	5.04	12.04	8	2	12.06	21.06
		2011	27.03	02.04	10.04	9	4	07.06	29.06
		Limits	**20.03-29.03**	**28.03-08.04**	**12.04-23.04**	**8-21**	**2-5**	**04.06-12.06**	**21.06-29.06**
2	SPRINGCREST	2008	22.03	29.03	16.04	19	5	04.06	03.07
		2009	29.03	08.04	30.04	22	4	08.06	07.07
		2010	20.03	05.04	16.04	12	3	10.06	09.07
		2011	28.03	07.04	17.04	11	5	09.06	12.07
		Limits	**22.03-29.03**	**29.03-08.04**	**16.04-30.04**	**12-22**	**3-5**	**04.06-10.06**	**03.07-12.07**
3	COLLINS	2008	24.03	29.03	12.04	18	4	04.06	08.07
		2009	29.03	08.04	30.04	22	5	10.06	11.07
		2010	30.03	09.04	21.04	13	4	07.06	12.07
		2011	26.03	07.04	18.04	12	5	16.06	17.07
		Limits	**24.03-30.03**	**29.03-09.04**	**12.04-30.04**	**13-22**	**4-5**	**04.06-16.06**	**08.07-17.07**
4	CARDINAL	2008	18.03	26.03	10.04	16	5	04.06	13.07
		2009	26.03	08.04	23.04	15	5	10.06	18.07
		2010	30.03	10.04	18.04	9	5	08.06	15.07
		2011	25.03	04.04	15.04	12	5	05.06	19.07
		Limits	**18.03-30.03**	**26.03-10.04**	**10.04-23.04**	**9-16**	**5**	**04.06-10.06**	**13.07-19.07**
5	REDHAVEN	2008	22.03	28.03	16.04	19	5	04.06	21.07
		2009	28.03	08.04	23.04	16	5	10.06	28.07
		2010	03.04	10.04	17.04	8	4	07.06	23.07
		2011	27.03	05.04	16.04	12	5	05.06	16.07
		Limits	**22.03-03.04**	**28.03-10.04**	**16.04-23.04**	**8-19**	**4-5**	**04.06-10.06**	**16.07-28.07**
6	SOUTHLAND	2008	24.03	29.03	13.04	14	5	05.06	04.08
		2009	29.03	08.04	30.04	22	5	08.06	10.08
		2010	03.03	10.04	17.04	8	5	07.06	07.08
		2011	25.03	09.04	20.04	12	5	14.06	09.08
		Limits	**03.03-29.03**	**29.03-10.04**	**13.04-30.04**	**8-22**	**5**	**05.06-14.06**	**04.08-10.08**
7	JERSEYLAND	2008	22.03	28.03	16.04	19	5	07.06	20.07
		2009	28.03	08.04	23.04	16	5	10.06	18.07
		2010	03.04	10.04	19.04	10	4	07.06	13.07
		2011	26.03	06.04	20.04	15	5	04.06	15.07
		Limits	**22.03-03.04**	**28.03-10.04**	**16.04-23.04**	**10-19**	**4-5**	**04.06-10.06**	**13.07-20.07**

The resistance to diseases is one of the most important problems of the peach tree culture. Research have shown that, 20 years after planting, certain cultivars display a resistance towards the attack of pathogen agents (Table 2).

The analysis of the data in the table reveals the fact that most of the studied cultivars manifested an increased resistance towards the attack of the harmful pathogen *Taphrina deformans*, the exception being the 'Springold' and 'Springcrest' cultivars in the years 2010 and 2011 (Figure 1), years in which they proved to be sensitive.

In the case of this pathogen we must mention the fact that the sensitivity of the cultivar is

also influenced by the environmental conditions of each studied year. Among the pathogens which constituted the object of this paper, the blistering of the leaves caused by the *Taphrina deformans* Berk et Tull. fungus is undoubtedly the most harmful foliar pathogen agent. Its attack has serious consequences both upon the fruit production as well as upon the physiological balance of the trees, causing their debilitation.

The perennial cancer of the peach tree caused by the *Cytospora cincta* Sacc fungus is, together with the blistering caused by the *Taphrina deformans*, the most important pathogen which diminishes fruit production.

Figure 1. The 'Springold' cultivar attacked by the *Taphrina deformans* in May 2011

According to the intensity (I) of the attack the studies cultivars were classified as follows (Table 2):

Taphrina deformans - 6 resistance classes

- Cultivars without attack (W.A.) – two cultivars, the intensity (I) of the attack being zero: 'Redhaven' and 'Cardinal' (in the studied years 2008, 2009, 2010).
- Tolerant cultivars (T) – 'Collins', 'Jerseyland', 'Southland';
- Weakly attacked (We.A) – no cultivars;
- Sensitive (S): 'Springold' and 'Springcrest';

None of the studied cultivars entered the moderately attacked and very sensitive classes.

As far as the attack of the *Cytospora cincta* Sacc is concerned, the observations revealed the fact that the sensitivity and the resistance of the cultivars towards it depend exclusively on the soil. The studied cultivars were classified as follows:

- Cultivars without attack (W.A.) – only 'Redhaven';
- Tolerant cultivars (T – 'Cardinal' (2008, 2010, 2011) and 'Springold';
- Weakly attacked (We.A) – 'Southland' (2009, 2010, 2011), 'Springcrest' (2008, 2009, 2010) and 'Jerseyland';
- Sensitive (S) – 'Collins'.

None of the studied cultivars entered the moderately attacked and very sensitive classes.

As far as the attack of the *Monilinia laxa* and *Monilinia fructigena* Aderh et Ruhl Honey fungi is concerned, all studied cultivars proved to be tolerant (T), both the frequency (F%) as well as the intensity of the attack (I) being graded with zero.

The introduction within cultures of peach tree cultivars with an increased resistance towards the attack of the most harmful pathogen agents has numerous economic advantages, such as, among which the diminishing of production losses and the reduction of expenses regarding pesticides and fuels. These are correlated with the protection of the environment – reduction of the battering of the soil due to the fact that the tractor rarely crosses the orchard, the reconstruction of the soil's structure, the reduction of the pollution of both the environment and the fruit, as well as the protection of the consumers' health.

Table 2. The behaviour of the peach tree cultivars towards the attack of the main pathogen agents in the period 2008-2011

No.	Cultivar	Year	*Taphrina deformans* Resistance class / Intensity of attack (grades*)						*Cytospora cincta* Resistance class / Intensity of attack (grades*)						*Monilinia* *laxa* Intensity of attack (grades*)	*Monilinia* *fr.*
			WA	T	We A	S	MA	VS	W A	T	We A	S	MA	VS	T	T
Cultivars planted in 1991																
0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10	11	12	13	14	15.	16.
1.	SPRINGOLD	2008														
		2009														
		2010														
		2011														
2.	SPRINGCREST	2008														
		2009														
		2010														
		2011														
3.	CARDINAL	2008														
		2009														
		2010														
		2011														
4.	COLLINS	2008														
		2009														
		2010														
		2011														
5.	REDHAVEN	2008														
		2009														
		2010														
		2011														
6.	JERSEYLAND	2008														
		2009														
		2010														
		2011														
7.	SOUTHLAND	2008														
		2009														
		2010														
		2011														

* Grade Intensity of the attack

CONCLUSIONS

- Most of the studied cultivars manifested an increased resistance towards the attack of the harmful pathogen agent *Taphrina deformans*, being either without attack (W.A.) or tolerant (T).
- The 'Springold' and 'Springcrest' cultivars proved to be more sensitive.
- As far as the attack of the *Cytosphora cincta* fungus is concerned, the sensitivity and the resistance depend exclusively on the soil. The 'Collins' cultivar proved to be sensitive, whereas the 'Redhaven' cultivar proved to be resistant.
- As far as the attack of the *Monilinia laxa* and *Monilinia fructigena* fungi is concerned, all studied cultivars proved to be tolerant (T).
- The cultivars from Valu lui Traian which manifested an increased resistance towards the attack of pathogens of economic importance will be recommended for usage in works of improvement, as well as for extension in production.

These cultivars which are resistant to the *Taphrina deformans* will simplify the peach tree's crop technology for small areas and will ensure a biological production towards which all cultivators aim.

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