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MODIFICATION OF SOME INDICATORS OF THE PRODUCTION POTENTIAL IN PLUM, UNDER THE INFLUENCE OF EDAPHIC CONDITIONS SPECIFIC TO SATURATED SOILS

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Abstract

The favorability evaluation of a field for the fruit growing culture is performed taking into account not only the climatic conditions of the field and the soil conditions. For the industrial cultivation of fruit species on saturated soils, the factor which conditions the production potential can be ordered into four groups: soil carbonates and the phyto-toxicity of calcium, the aero-hydrical regime, the probability of the appearance of secondary compacting and the risk of the starting of calcic chlorosis. The research led to the identification of limiting factors specific to saturated soils, and distinguished the fact that the nutritional unbalances induced by the presence of these in the soil, do not manifest just at the roots level through the modification of the root system distribution and the appearance of dead roots but also at the upper part of the trees through the decrease of trunk thickness growing, a steady indicator of the production potential.

INTRODUCTION

The trunk thickness of trees in an orchard is induced by age and soil conditions, the climatic influence is evenly in the frame of limited surface which it is covered in an orchard. The research led to the identification of limiting factors specific to saturated soils and they have distinguished the fact that the nutritional unbalances induced by the presence of these in the soil do not manifest just at the roots level through the modification of the roots system distribution and the appearance of dead roots but also at the upper part of the trees through the decrease of trunk thickness growing, steady indicator of production potential [1]. Recent research reveals that from the 227,200 hectares of orchards and fruit growing nurseries of the Romanian fruit growing resources (2003), 52% are located on saturated soils (figure 1) characterized through the prevalent saturation of the clay-humic complexes with calcium and magnesium ions.

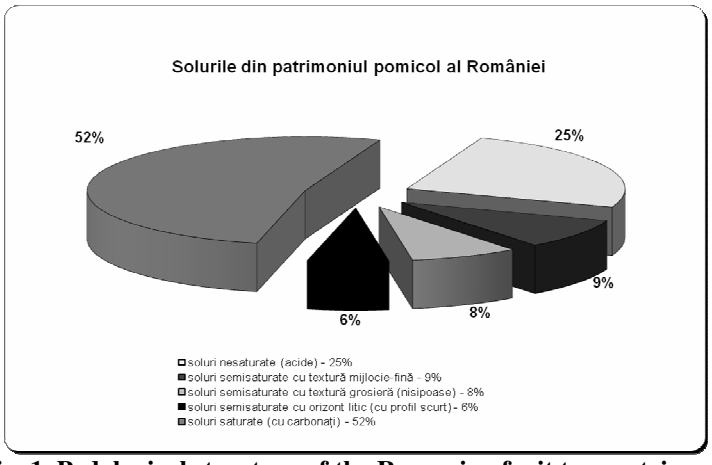

Fig. 1. Pedological structure of the Romanian fruit tree patrimony

MATERIAL AND METHODS

For the relevance of the information regarding the nutrition condition of fruit species on saturated soils, the properties of soil established according to the ICPA [4] methodology they have grouped in three categories: physical properties, soil fertility and the properties of cationic change.

In plum, the studies were performed on the cultivars Busuioaca and Stanley, on antrosoil at Dragoieni, Gorj county and in the cultivar Vanat romanesc at a typical regosol at Zalau, Salaj county, and for the comparison of the results on eutricambosol at Balota, Mehedinti in optimum ecological conditions considered.
The revealing of limiting soil factors upon the root system was realized in graphic form through the synthetic root system indicators: surface of root section (SSR); surface section of dead roots (SSRM); root frequency (FR); root distribution index (IDR). These three indicators react to the presence in soil of limiting factors inducing modifications opposite of normal distribution of the fruit trees root system [2].

RESULTS AND DISCUSSION

Between the trunk thickness and the production potential of fruit trees there is a direct link, every decreasing of the truck thickness opposite the normal values for the counted age is followed by the proportional decreasing of the production level, with major effects upon the economic efficiency of the orchards.

The root system as the first organ of the fruit trees, which are in contact with the soil reacts at the specific conditions of nutrition, modifying their distribution under the effect of concerted factors [3].

The effects of the unfavourable soil conditions act on the root system distribution are visibile in the cultivar plum Busuioaca grafted on Myrobolan, 6 years old, on the calcic argic antrosoil from Dragoieni, Gorj county (figure 2).

pH (H_2O)	DA (g/cm^3)	PA (%)	Clay < 2μ (%)	$CaCO_3$		Name and thickness
				Total (%)	Activ (ppm)	
8.1	1.42	11	49.8	17.4	1.75	Ap 25 cm
8.1	1.53	5	45.0	20.1	1.37	Cpr_1 35 cm
7.8	1.36	15	40.2	19.3	1.25	Cpr_2 10 cm
5.2	1.63	3	42.3	0	0	Bt 30 cm

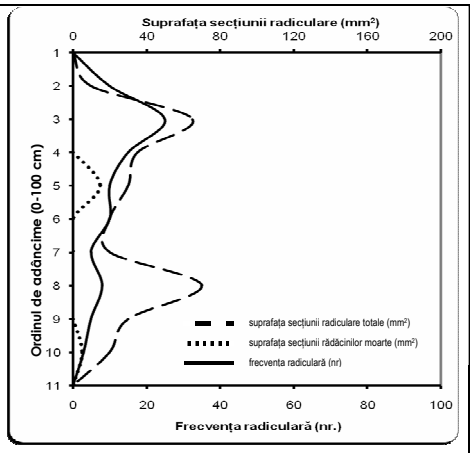

Fig. 2. Modification of the root system distribution under the concerted effect of the appearance density, airing porosity and the $CaCO_3$ content in the plum Busuioaca/Myrobolan at the age of 6 years, on calcic argic antrosoil at Dragoieni, Gorj county

The small values of the root cross section area and the root frequency from the Cpr and Bt horizon are due to unfavourable aero-hydric condition induced by the air porosity and the high dry bulk density.

The curve of the root cross section area distribution is correlated in this case, with the values of the dry bulk density, air porosity, and penetration resistance, registering bigger values in the the Ap and Cpr_2 horizon and lower in Cpr_2 and Bt horizon. The unfavorable condition from the Cpr_1 and Bt horizon, had as effect the appearance of dead roots.

Once with the depth it can be observed the decreasing of the root frequency values and the increasing of the root cross section area which indicates the presence at this level, mostly of the dead base roots with a great diameter, frequently over 10 mm.

The effect of this nutritions condition is reflected in the growing in thickness of the trunk, which at age of 6 years has a diameter of just 6.37 cm (79.43%) opposite of the potential of 8.02 cm in normal nutrition condition (table 1).

The decreasing effect of the unfavorable soil condition can be observed also in the case of the Stanley plum cultivar grafted on myrobolan on calcic argic antrosoil from the same zone.

In this conditions induced by the soil properties, the fruit tree realizes at 6 years old, a trunk circumference of only 19 cm, according to a diameter of 6.05 cm opposite of the diameter 7.7 cm wich it could be realized in optimum conditions.

The same data analysis methodology has also been applied in the case of a field planted with plum, Vanat romanesc cultivar, grafted on myrobolan, 8 years old, on a tipical regosol at Zalau, Salaj county, placed in the superior one third of a slope with 10 % gradient and SV exposition.

Although this will not present major restriction factors with the exception of the fertility one, which can be improved, from the root distribution analysis it can be observed a lax modification in the sense of quartering of the major root mass in the median zone of the soil profile and the presence of little amount or the absence of roots in the Ao and C3 horizons (figure 3).

pH (H_2O)	DA (g/cm^3)	PA (%)	Clay < 2μ (%)	$CaCO_3$		Horizon
				Total (%)	Activ (ppm)	
8.48	1.25	20	38.6	9.4	4.5	Ao 20 cm
8.65	1.55	28	25.8	8.0	3.6	C_1 30 cm
8.50	1.54	12	27.0	2.1	1.2	C_2 40 cm
8.68	1.35	19	24.5	11.6	5.1	C_3 10 cm

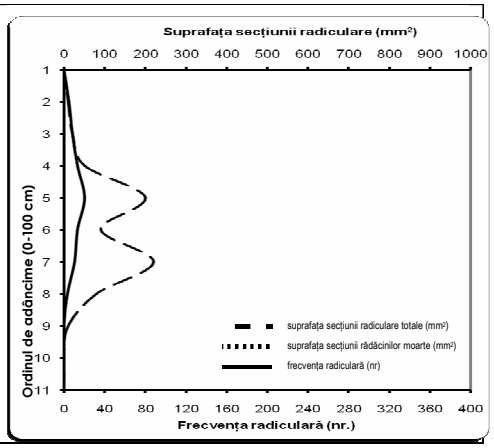

Fig. 3. Modification of root system distribution unde the effect of increased quantity of $CaCO_3$, in Vanat romanesc cultivar/Myrobolan at the age of 8, on a typical regosol in Zalau, Salaj county

This movement induced by the presence of some increased quantity of calcium carbonate in the Ao and C3 horizons. As it results from the analytical data and the distribution curves of the root system, although in this levels the amount of active calcium carbonate do not reaches the toxicity threshold which could induce the appearance of dead roots, this has an inhibition effect upon the growing and development of the roots.

Simultaneously with this, on the decreased fertility content of the soil it can be ascertained also a decreasing regarding the number of active roots which is maintained on the whole soil profile, this aspect is revealed by the little amplitude of the root frequency curve.

This leads to a decreasing of the soil volume explored by the roots and the quantity of the nutrition elements available for the tree.

Table 1

Effect of nutritions condition act on the trunk growing thickness

No.	Location	Soil type	Eclogical conditions	Cultivar/ rootstock	Age	Trunk indicators			
						Circumf. (cm)	Ø realized (cm)	Ø normal (cm)	% realized
1	Dragoieni/ Gorj	calcic argic antrosoil	Critical	Busuioaca/ Myrobolan	6	20	6.37	8.02	79.43
2	Dragoieni/ Gorj	calcic argic antrosoil	Critical	Stanley/ Myrobolan	6	19	6.05	7.7	78.57
3	Zalau/ Salaj	typical regosoil	Critical	Vanat rom/ Myrobolan	9	28	8.92	18.96	47.05
4	Balota/ Mehedinti	stagnic preluvosoil	Optimum	Vanat rom/ Myrobolan	10	51	16.24	15.80	102.8

- semisaturated soils with medium fine texture - saturated soils (with carbonates)

The data present in table 1 are reveal the fact that in optimum nutrition conditions, the tree could realize a trunk diameter of 18.96 cm. The unfavorable nutrition conditions which is offered by the presented soil, had a strong inhibition effect upon the thickness growing of the trunk, therefore at age of 9 with a diameter of only 8.92 cm, this realizes only 47.05% from the potential.

The characteristics of these soils and the effects of these on soils, were compared with the properties of a stagnic preluvosol from a plum plantation Vanat romanesc/Myrobolan, in the age of 10 at Balota, Mehedinti county.

Compared with the above mentioned situations in the lack of limiting edaphic factors, the root system has a normal distribution on the soil profile, characteristic for this cultivar/rootstock combination (figure 4).

The distribution curves of the root system reveal a profound rooting with a high index of root distribution of 4.59. The analysis of root distribution curves shoes that a great amount of the active roots are billeted in the superior part of the soil profile, at the level of Ao and A/B.

The good nutrition conditions have as effect an adequate development of the airy part, which could be appreciated through the trunk thickness.

Data from table 1 reveal the fact that at age of 10 the tree realizes a trunk circumference of 51 cm proper to a diameter of 16.24 cm (102.8%) opposite to the diameter of 15.8 cm, normal at the optimal ecological conditions.

pH (H_2O)	DA (g/cm^3)	PA (%)	Clay < 2µ (%)	$CaCO_3$		Horizon
				Total (%)	Activ (ppm)	
5.60	1.38	20	22.7	-	-	Ao 33 cm
5.60	1.39	18	24.3	-	-	A/B 12 cm
5.37	1.40	14	36.6	-	-	Btw_1 35 cm
5.43	1.40	14	49.7	-	-	Btw_2 20 cm

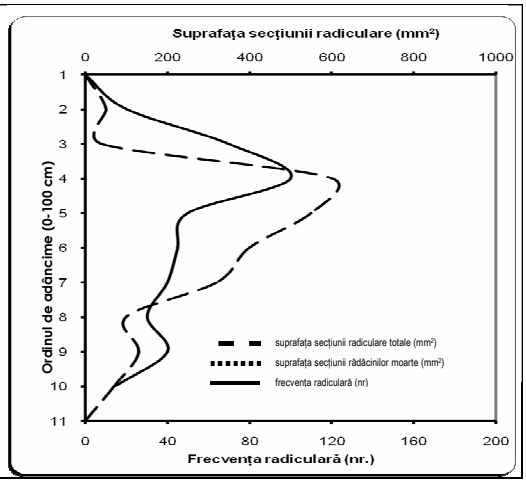

Fig. 4. Normal distribution of root system in the Vanat romanesc cultivar/myrobolan at the age of 10, on a stagnic preluvosoil at Balota, Mehedinti county

CONCLUSIONS

1. In some condition the calcium carbonate from the soil can be limiting factors having as an effect a diminishing tree vigour and a reduction of trunk thickness of these.
2. The intensity of decreasing effects upon the root system and implicit upon the airy part of the trees is induced by the repartition of carbonates on the soil profile, the appearance depth of the level with carbonates and the amount of active calcium carbonate.
3. The compactness of soil induced by the great number of mechanized works scheduled by the actual technology of fruit tree orchards, hard to effectuate always at the optimum humidity contributes as well as to the reduction of the absorbing capacity of the iron by the root system also through the mechanical effect upon the roots but also through the poor airing conditions.

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