LIMITING FACTORS FOR FRUIT-GROWING PLANTATIONS IMPOSED BY PEDOLOGICAL CONDITIONS IN THE SÂRCA FRUIT-GROWING BASIN

FACTORII LIMITATIVI PENTRU PLANTAŢIILE POMICOLE IMPUŞI DE CONDIŢIILE PEDOLOGICE DIN BAZINUL POMICOL SÂRCA

BORONIA Gabriela
"Alexandru Ioan Cuza" University of Iaşi, Romania

Abstract. *Soil properties (texture, mineralogical- geochemical composition, humus content, reaction, volume of soil, gleyzation, salinization) exert a determinative influence in the mechanical support, the mineral nutrition, the water supply and the ensurance the unfolding place of the processes physiological at the interface of the root/soil elementary particles (by ion exchange, respiration etc.), and the tree, in turn, through the processes of life, produces changes in soil. Soil properties manifest interdependent with other conditions and ecological factors, that may potentiate or inhibit the favourable or unfavourable action of these qualities. To establish the pedological factors that restrict the fruit-growing use, agri-environmental assessment was done of the main soil types (calculation of the evaluation notes) for the main fruit-growing species: apple, pear, plum, cherry, apricot, peach. Thus, it was found that the soil restrictions are related to texture, the $CaCO_3$ content, the reserve of humus, pH, the gleyzation and the salinization.*

Key words: limiting factors, pedological conditions, fruit-growing plantations

Rezumat. *Însuşirile solului (textura, alcătuirea mineralogică - geochimică, conţinutul de humus, reacţia, volumul de sol, starea de gleizare, de sărăturare – alcalizare) exercită o influenţă determinantă în susţinerea mecanică, nutriţia minerală, aprovizionarea cu apă şi asigurarea locului de desfăşurare a proceselor fiziologice la interfaţa perişorilor radiculari/particule elementare de sol (prin schimbul de ioni, respiraţie etc.), iar pomul, la rândul lui, prin procesele de viaţă, produce modificări în sol. Însuşirile solului se manifestă interdependent cu celelalte condiţii şi factori ecologici, care pot potenţa sau inhiba acţiunea favorabilă sau defavorabilă a acestor însuşiri. Pentru stabilirea factorilor pedologici ce impun restricţii utilizării pomicole, s-a realizat evaluarea agroecologică a principalelor tipuri de sol din bazinul pomicol Sârca (calculul notelor bonitative) pentru principalele specii pomicole: măr, păr, prun, cireş, cais şi piersic. Astfel, s-a constat că restricţiile solurilor sunt legate de textură, conţinutul de $CaCO_3$, rezerva de humus, pH, starea de gleizare şi cea de sărăturare – alcalizare.*

Cuvinte cheie: factori limitartivi, condiţii pedologice, plantaţii pomicole

INTRODUCTION

The relations established between soil and tree is a complex reciprocity. The systemic analysis of the ecometric function of each soil properties, in relation to specific physiological requirements of different fruit-growing species, defines

the manner in which the soils should be selected and improved for fruit-growing plantations to succeed and give high and steady yields (Teaci, 1985).

Through the analysis of the soil characteristics and the relations between them and the trees in the Sârca fruit-growing basin, it aims the manner in which each fruit-growing species should be placed in territory, considering this fruit-growing basin may extend to west, near the Târgu – Frumos town.

MATERIAL AND METHOD

The study is based on the analysis of the fruit-growing species requirements towards the pedological conditions. To establish the pedological factors that restrict the fruit-growing use, an agro-ecological assessment of the main soil types has beesn performed (calculation of the evaluation marks) for the main fruit-growing species: apple tree, pear tree, plum tree, cherry tree, apricot tree and peach tree. The agro-ecological assessment soils in the Sârca fruit-growing basin for the fruit-growing plantations represents the result of interpreting data assumed from the complex pedological studies performed by OJSPA - Iaşi (1995, 1999), on a 1:10000 scale, for the Bălţaţi şi Târgu-Frumos communees.

RESULTS AND DISCUSSIONS

The restrictions imposed by soils in the Sârca fruit-growing basin are related to texture, calcium carbonate content, the humus reserve, reaction (pH), the gleyzation and salinization – alkalization state.

The soil texture determines the manner of root of the trees, this process having consequence on the whole vigor of the trees, as well as the fruit production. In the Sârca fruit-growing basin, 87.78% (3045.56 ha) of soils have fine texture (clay loam) in the first 20 cm, which is a limiting factor for the planting of cherry tree, apricot tree and peach tree, because of clay content over the optimal, determining a reduced value of the free space of soils and a tendency to compaction. The 2497.32 ha of these soils are included in cernisols class, representing 81.16% of soils characterized by fine texture (fig. 1).

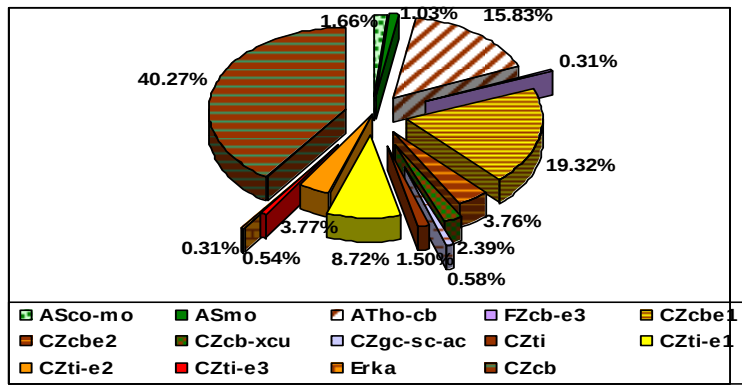

Fig. 1. The distribution of the soils with fine texture in the Sârca fruit-growing basin

Because of the high content of clay, the radicular system has the tendency to move towards the superficial horizons of the soil; the superficial radicular system (determined by soil properties) is affected by the climatic stress and the trauma caused by the annual works of the soil in the orchard. The climatic stress is brought about the high thermal and hydric variations, which are felt to a depth of 20 – 30 cm.

Aproximately 94% of soils present the same texture on entire thickness of the profile, the fine texture owning the highest part (86.90%). The texture contrasts appear in the soils formed on textural unhomogeneous materials consisting of layers with defferent textures, such as the parental materials of alluvial origin which the gleyosols and most alluviosols have developed; the 6.35% of soils present textural contrasts.

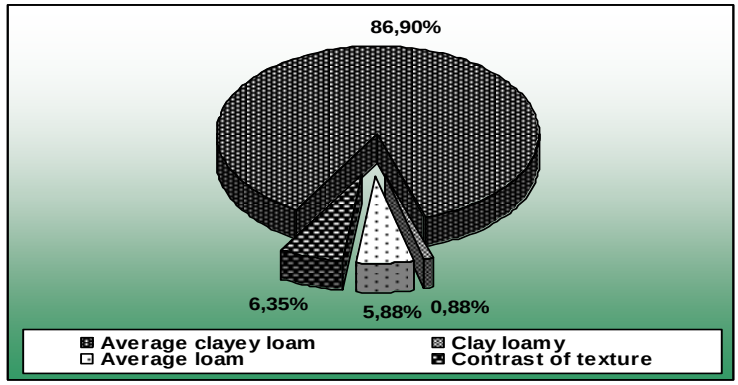

Fig. 2. The distribution of the soils in the Sârca fruit-growing basin depending on texture

The content of calcium carbonate of the soils plays an important role in the trees growth. In the Sârca fruit-growing, the soils, that do not present carbonates on profile, occupy an area of 2509.83 ha, representing 59.78% of pedological charted area; these soils are represented by the cambic chernozems and the cambic hortic anthrosol.

For an average content of calcium carbonate between 2% and 8%, no penalties aplly to any fruit-growing species, while a content of 9 to 12% (moderate), the penalties appear for apple and peach trees, the values of the evaluation coefficients being 0.9 in both cases. The soils with moderate content of carbonates occupy an area of 922.73 ha (9.53 ha of this area have a calcium content between 9% and 12%), respectively 21.98% of entire pedological charted area. These soils are represented by typical chernozems, the typical chernozems with low and moderate sheet erosion, the gleyic chernozems, as well as the hortic and gleyic hortic anthrosols. All soils from protisols class have an average content of calcium carbonate.

The increase of the calcium carbonate content penalizes all fruit-growing species. The soils with high content of carbonates (13 to 25%) own only 1.72% (72.13 ha of entire pedological charted area). These soils are represented by the

calcaric and marling erodosol and the typical chernozems with strong sheet erosion.

The cherry tree, the apricot tree and the plum tree are the most tolerant fruit-growing species to calcium carbonate content, while the apple tree, the peach tree and, especially, the pear tree are less tolerant (fig.3).

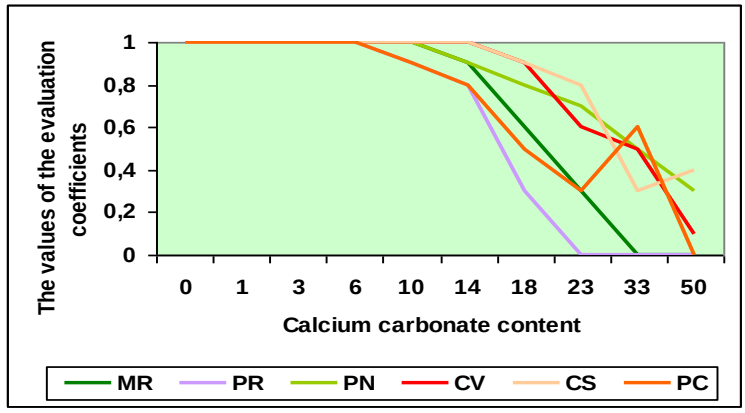

Fig. 3. The correlation between carbonate the calcium content and the values of the evaluation coefficients for the main fruit-growing species in the Sârca fruit-growing basin

One of the important properties of the soil, with a large influence on the growth trees, is the soil reaction, which expresses largely the real condition of unfolding of the phenomena of plant nutrition. The values of pH are included in the low acid – neutral domain in the Sârca fruit-growing; this reaction is the most favourable for the growth and development of the fruit-growing plantations.

The soils characterized by low – alkaline reaction, which penalizes all fruit-growing species, excepting apricots, are spread on an area of 341.04 ha. The apple tree has the least resistance to low – alkaline reaction, the evaluation coefficient being of 0.8.

A considerable influence about the growth and production trees is exerted by the reserve of humus. The soils with very low reserve of humus (31 to 60 t/ha) occupy an area of 146.42 ha, being represented by the typical chernozem with strong sheet erosion (CZti-e_3), the cambic phaeozem with strong sheet erosion (FZcb-e_3), the calcaric erodosol (ERka), the marling erodosol (ERxma) and the salinic – cernic gleyosol (GSce-sc). The sodic – salinic – gleyic aluviosol (ASgc-sc-ac) presents a low reserve of humus (61 – 120 t/ha), occupying 95.25 ha, representing 2.26% of entire pedological charted area and 49.87% of protisols class. The penalties for these soils, following the evaluation operation, are not big (table 1).

Table 1

The penalties (the values of the evaluation coefficients) imposed by „reserve of humus" indicator for the main fruit-growing species in the Sârca fruit-growing basin

Soil type	Surf. (ha)	Ind. Name	Ind. Cod	Framing limits (t/ha)	Evaluation coefficients					
					AP	PR	PM	CR	CT	PC
CZti-e_3	23.06	Humus reserve (0 -50 cm)	045	31–60	0,8	0,8	0,8	0,8	0,8	0,8
FZcb-e_3	9.5									
ERka	38.25									
ERxma	20.34									
GSce-sc	55.26									
ASgc-sc-ac	95.25	Humus reserve (0 -50 cm)	090	61 –120	0,9	0,9	0,9	0,9	0,9	0,9

Because of the low depth of the phreatic water (in the first 200 cm), the formed soils present in their profile horizons affected by the gleyzation process. The gleyzation state determines definitely the favorability of the soil for all fruit-growing species. Generally, for the trees, the gleyzation is one of the most restrictive factors. All six studied species grow normally in conditions of soils without gleyzation. Among fruit-growing species, the pear tree extends the optimum in the gleyzation domain , but low gleyzation, and the apricot tree is the most sensitive to this process. When the gleyzation is increased, the penalties are higher for all fruit-growing species (table 2).

Table 2

The penalties (the values of the evaluation coefficients) imposed by „gleyzation" indicator for the main fruit-growing species in the Sârca fruit-growing basin

Soil type	Indicator name	Ind cod	Framing Limits	Evaluation coefficients					
				AP	PR	PM	CR	AT	PC
ATho-gc	Gleyzation	3	Moderate gleyic	0.9	0.9	0.9	0.9	0.9	0.9
CZgc-sc_2-ac_1	Gleyzation	4	Strong gleyic	0.7	0.8	0.7	0.7	0.7	0.7
GSce-sc	Gleyzation	6	Excessive gleyic	0.4	0.4	0.4	0.4	0.3	0.4

In the Sârca fruit-growing basin, the gleyzation occupies an area of 238.53 ha, being distributed in Bahluieţ field (the gleyic chernozems, the gleyic aluviosols), on the route of the beginning valleys that cut off the river terraces of Bahluieţ (the hortic gleyic anthrosols, the colluvic aluviosols), at contact of the field with the slopes, where there is springs (the cernic gleyosols). The process

intensity is very strong for 23.17% of soils affected by this process (1.32% of entire pedologic charted area, without soil complexes), strong for 41.81% (2.38 of charted area), moderate for 35.03% (1.99% of entire area). The areas affected by very strong gleyzation are occupied by gleyiosols.

The fruit-growing species have a high sensibility at salinization and alkalization processes; practically, the trees grow only on terrains without salinization and alkalization. Even if the terrains are low salinized or low alkalized, the fruit-growing use is excluded. Among fruit-growing species, only the pech tree and pear tree present a certain tolerance to salinization and alkalization. These processes are often encountered in the soils of Bahluieţ and Valea Oilor fields (aluviosols, colluvic aluviosols, soil complexes), occupying an area of 302.63 ha of entire fruit-growing basin.

CONCLUSIONS

The pedological conditions in the Sârca fruit-growing basin are generally favourable for all pomicol species.

The pear tree is the most tolerant fruit-growing species to the pedological conditions in the Sârca fruit-growing basin.

The clay-loam texture of the soils represents the main limiting factor for the cherry (sour cherry), apricot and peach species (87.78% of Sârca fruit-growing basin area), the high content of clay determining a reduced value of the free space of soils and a tendency to compaction of these.

The gleyzation and salinization/alklization processes that impose severe restrictions to all fruit-growing species, occupy 12.89% of Sârca fruit/growing area and are often encountered in the soils of Bahluieţ and Valea Oilor fields (aluviosols, colluvic aluviosols).

REFERENCES

1. Florea N., Munteanu I., 2003 – *Sistemul Român de Taxonomie a Solurilor*. Ed. Estfalia, Bucureşti

2. Teaci D. şi colab., 1985 – *Influenţa condiţiilor de mediu asupra creşterii pomilor în România*. Ed. Ceres, Bucureşti

3. ***, 1994 – OJSPA. *Studiu pedologic- scara 1:10.000. Teritoriul Târgu - Frumos, jud. Iaşi*

4. ***, 1995 – OJSPA. *Studiu pedologic- scara 1:10.000. Teritoriul Bălţaţi, judeţul Iaşi*

5. ***, 1987 - *Metodologia elaborării studiilor pedologice,* Vol. II, III, ICPA, Bucureşti.