RESEARCH ON THE IMPORTANCE OF SOILS ECOLOGICAL RECONSTRUCTION FOR THE OPTIMAL DEVELOPMENT OF FIELD CROPS ROOT SYSTEM IN THE BURNAS PLAIN

CERCETĂRI PRIVIND IMPORTANȚA RECONSTRUCȚIEI ECOLOGICE A SOLURILOR PENTRU DEZVOLTAREA OPTIMĂ A SISTEMULUI RADICULAR LA CULTURILE DE CÂMP DIN CÂMPIA BURNASULUI

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Abstract. *The purpose of this paper is to present the results of ecological research made on the soils from Southern Romania, in the Burnas Plain, and their effects on the field crops evolution. During the 3 agricultural years taken into study (2010-2012), due to registered variations among the abiotic factors (temperature, rainfall, humidity, evapotranspiration), we analyzed the evolution of plant roots, making comparisons from one stage of growth to another, from one year to another. Is going to be emphasized that the different tillage technologies, the crop rotations, the plant treatments, but also the variety have a bearing on how the plant develops, on its resistance to pathogens, but also on the production obtained. All these will rely on the data obtained from experiments carried out in plots, while for exemplification it will be used tables, graphs and photos made by the authors.*
Key words: *roots, ecological techniques, Burnas Plain, stage of growth*

Rezumat. *Scopul acestei lucrări este acela de a prezenta rezultatele cercetărilor de ecologizare realizate pe solurile din partea de sud a României, în Câmpia Burnasului, şi efectele acestora asupra evoluției culturilor de câmp. În cei 3 ani luați în studiu (2010-2012), pe fondul variațiilor înregistrate în rândul factorilor abiotici (temperatură, precipitații, umiditate, evapotranspirație), s-a urmărit evoluția rădăcinilor plantelor şi s-au realizat comparații de la o etapă de creştere la alta, de la un an la altul. Se va observa că diversele tehnologii ale pregătirii terenului, asolamentele, tratamentele efectuate, dar şi soiul îşi pun amprenta pe modul în care se dezvoltă planta, pe rezistența acesteia la agenții patogeni, dar şi pe producțiile obținute. Cele propuse se vor realiza pe baza datelor obținute în urma experimentelor făcute în parcele, iar pentru exemplificare se vor folosi tabele, grafice şi fotografii realizate de către autori.*
Cuvinte cheie: *rădăcini, tehnici de ecologizare, Câmpia Burnasului, etapă de creştere*

INTRODUCTION

Food, this amount of nutrients which is so necessary for every organism in order to live, has entered into the researchers' attention for years now, each one

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trying to find new solutions for agriculture. According to the analyzes made for the last two centuries, at the beginning of the XIXth century, for example, the registered yields on wheat and barley were around 1000 kg/ha (Farack, 2010). Thereby, it is noticed that so far the threshold of 8000 kg/ha in wheat has been reached and even exceeded, respectively 5000 kg/ha in barley, both at European level, which means an increase of 500-600%. The proportions are also similar for other crops (rice, maize, sunflower, soya, rapeseed, potato etc.).

The results obtained so far are due to the collaboration between several elements, among which we mention genetics (by varieties improving), inputs (fertilizers, pesticides, tillage), as well as abiotic factors that should be permanently taken into account (water, heat).

A performant ecologization management involves the limitation, as far as possible, of soil's losses through the conservation of nutrients level in organic form and of the one of microorganisms, by avoiding soil compactation and of the reduced capacity for water through cancellation measures of landslides and desertification (Berca, 2011) etc. For plants this requires a good development from sowing until harvesting and the first test is the one of roots formation, they offering them the opportunity to nourish, stability against winds or heavy rains, a larger capacity of water and nutrients storage, and therefore resistance to drought.

MATERIAL AND METHOD

Starting from these objectives and applying them to the pedoclimatic conditions that are characteristic for the Burnas Plain, could be demonstrated, using concrete examples, how the plants on these lands were influenced by the climatic conditions of the years 2010-2012, this aspect also being reflected by the yields obtained here in comparison with the ones from the conventionally worked soils.

The database that has been used includes photographs taken even by the authors during their visits made in the field in order to pursue the plants' development stage and the pathogens' incidence. Other scientific papers are going to be used in order to make some comparisons. In the same time will be provided information on soil conservation techniques, which were applied to each particular case: tillage, preceding plant, type of culture, treatments etc.

Another part of the paper will briefly review the yields obtained and how they evolved over the analyzed period.

It is mentioned that the experiments were conducted within the Teleorman Country area, in conditions of a cambic chernozem soil type, having as basic characteristics the values:

- humus: 3,0 – 3,6%;
- clay (in 0-45 cm profile): 45 – 48%;
- nitrogen (N): 224 ppm;
- phosphorus (P): 684 ppm;
- potassium (K): 388 ppm;
- pH: 6,3.

RESULTS AND DISCUSSIONS

In this paper there will be made references only regarding the winter crops, since the spring ones are much less common in Romania. It has been observed that the roots of winter wheat have reached even the depth of 2,2 m, while for the spring wheat the maximum depth was of 1,1 m (Thorup-Kristensen et al., 2009). The main condition is for the soils to be well maintained. Therefore, the deeper goes the root system, the better it will be able to use the reserves of water and nutrients that have been washed from soil's top layer.

Rapeseed is a good culture to be used before cereals, its roots having a beneficial effect on soil structure, that leaves it rich in nitrogen (Norton R. et al., 1999), out of here resulting the better harvests obtained in the following year. Another advantage is that it reduces the weed degree in the next autumn after the rapeseed harvesting.

In a study performed on wheat in Spain during 2003-2007 (Muñoz-Romero et al., 2010) better results of roots development have been achieved in no-tillage system, as compared to the conventional one, this being attributed to the soil's compaction reverse, but also to the rainfalls and to their distribution. The conclusions were, however, quite evasive, the authors seeming rather reserved in their enunciation.

On our own soils from the Burnas Plain, in the first year was done a raising work with the scarifier at the depth of 60 cm, its purpose being to remove the hardpan profile which was formed in the 30-45 cm layer. This work will be repeated in every third year. Until then only works with a hard disk for stubble-turning and some superficial works before sowing (with gruber, tiger or cultivator, at 10-20 cm) would be done. The traditional plowing was completely eliminated.

In Fig. 1 are presented the differences in roots plants architecture as a result of soils' reconstruction process and of hardpan layer destruction. Roots can penetrate into deep, not being forced to stagnate or to return to the surface. In most cases the growth differences at soil surface are not very visible, especially in the first vegetation stages, when plants have similar pedological conditions.

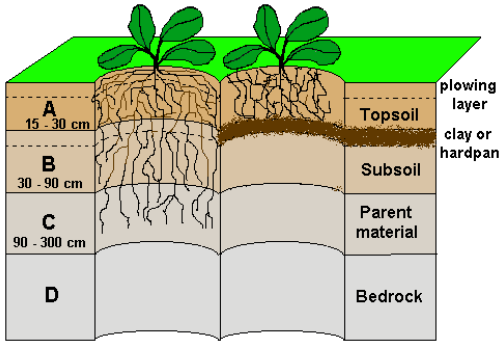

Fig. 1 - Roots development on the whole soil profile - conservation soil (left) compared to the non-ecologically soil (right) – original

For what happens underground there is no equipment able to show exactly how far the root system of each plant extends and to what resources it has access to that point.

The separation occurs throughout periods of growth, especially when the abiotic factors intervention (temperature, water) makes its presence felt. The results obtained on wheat and barley are shown in Fig. 2 and are conclusive to support the previous assertions.

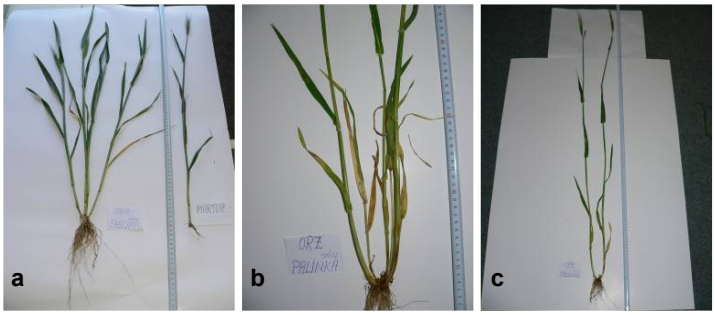

Fig. 2 - Differences in plants growth depending on soil tillage – Burnas Plain, May 2011 (photos of the authors)
a – Philipp wheat variety, parralel between ecologically (left) and conventional (right)
b, c – Palinka barley variety in ecological (b) and conventional (c) variant

In Table 1 are listed the main characteristics of the soil profile on which the research was conducted. Soil ecologization aims to improve the pedological features that are major influencing the productions, especially by slowing or even stopping the extent of plants root system up to the optimum depths.

Table 1

Soil conditions of the experimental plots from Burnas Plain

Crt.	Indicator	Depth	Range / Value
1.	Clay content	0-40 cm	42,8%
2.	Apparent density	0-40 cm	1,26 g/cm^3
		40-100 cm	1,41 g/cm^3
3.	Total porosity	0-40 cm	53,3%
4.	Soil aeration	0-170 cm	9,6 – 17,1 %
5.	Hydraulic conductivity	0-40 cm	11,1 – 15,7 mm/h
		> 40 cm	2,6 – 6,9 mm/h
6.	Penetration resistance	0-20 cm	19 kgf/cm^2
		20-50 cm	33 kgf/cm^2
		50-100 cm	48 kgf/cm^2

Drawing up a graph of roots depth is difficult to accomplish given that we can not take photos or make measurements at above 1 m into the ground. For wheat, according to the vegetative stages, variety and sowing depth, the pictures from Fig. 3 have been selected.

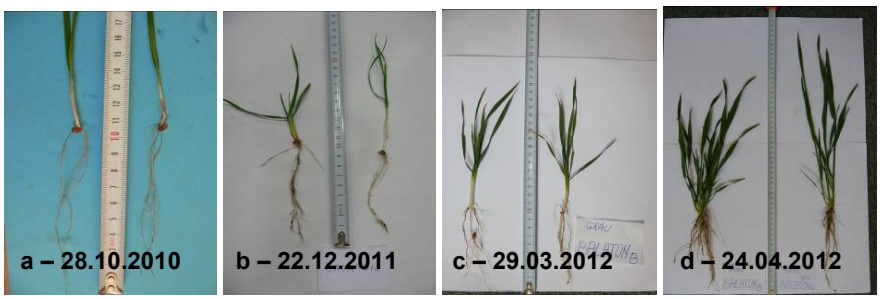

Fig. 3 - The Balaton wheat variety evolution along the biological phases – conservation plot by using the mentioned above methods (photos of the authors)
a – ecologically/non-ecologically parallel ⇒ similar increase in the first stage
b – sowing at optimum depth (left) and at 6 cm (right) ⇒ visible differences
c – sowing at 6 cm (left) and optimum (right) ⇒ different root system
d – Balaton Basis and Balaton C1, both in conservation system

It can be noticed that the differences are becoming more visible on roots. In the conditions of aridity recorded in 2012, the plants from ecological soil didn't suffered (Fig. 3d), managing to successfully pass over a hard winter and store the excess rainfall.

In a similar way it can be analyzed the behavior of studied barley varieties.

Fig. 4 - The evolution of Hanzi barley variety over the biological phases (authors photos)
a – sowing at optimum depth (left) and at 6 cm (right) ⇒ visible differences
b – sowing at 6 cm (left) and optimum (right) ⇒ different root system

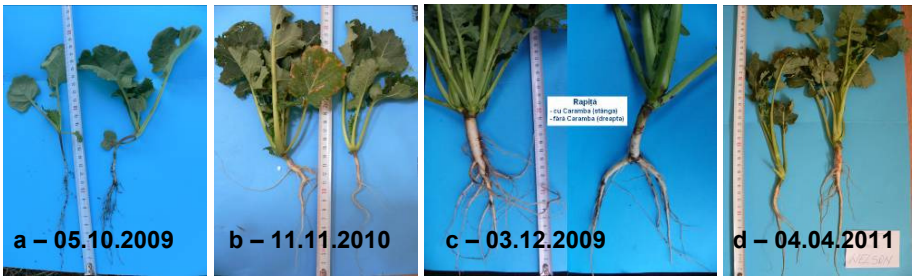

Fig. 5 - The evolutionary cycle of rapeseed crop (photos of the authors)
a – ecologically (left)/non-ecologically (right) parallel right after emergence
b – comparison between optimum (left) and with 2 weeks delay (right) sowing
c – roots to the plants treated with Caramba (left) and to the untreated ones (right)
d – non-ecologically (left)/ecologically (right) before flowering

Rapeseed has a special status, it is sown earlier and it must have 7-8 leaves until the onset of winter in order to survive to the cold period. The roots are going especially in depth, occupying a lateral area of only 20-30 cm.

Differences occur, as seen from the pictures that are composing Fig. 5, depending on the sowing period, on variety, on soil ecologization etc.

Finally, a comparison between the yields obtained from ecologically soils and the ones from conventionally worked soils has been made (Table 2). It can be seen that yields of the conservation soils are getting at least 30-120% more than the others, which leads us to believe that we are on the right track.

Table 2

Wheat, barley and rapeseed productions (kg/ha) in Burnas Plain, 2010-2012

Crop	Conventional (C)			Ecological (E)			Differences E – C %		
	2010	2011	2012	2010	2011	2012	2010	2011	2012
Wheat	3350	3150	2960	4900	6880	6582	+46	+118	+122
Barley	3660	3720	3240	5010	6910	6830	+37	+85	+111
Rapeseed	1790	2020	1650	2590	3120	2200	+45	+54	+33

CONCLUSIONS

1. The roots have a very important role in the development of plants during the entire growing cycle.

2. Maintaining the soils in optimum parameters can increase the production and, most importantly, can ensure a continuous flow of its, the action of abiotic factors being proportionally reduced.

3. By soil conservation the natural soil inputs can be exploited at maximum, especially those that were previously inaccessible, being stored to a higher depth than the one to which the roots could reach.

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REFERENCES

1. Berca M., 2011 - *Agrotehnica, transformarea modernă a agriculturii*. Ed. Ceres, Bucureşti

2. Farack E., 2010 - *Nachhaltige Sicherung der Bodenfruchtbarkeit unter Beachtung des Klimawandels*. Simpozion Düngungstagung Sachsen, 26.02.2010

3. Muñoz-Romero V. şi colab., 2010 - *Monitoring wheat root development in a rainfed vertisol: Tillage effect*. European Journal of Agronomy nr. 33 (2010), p. 182-187

4. Norton R. şi colab., 1999 - *Canola in rotations, Chapter 5, Canola in Australia: The first thirty years*. PA Salisbury

5. Thorup-Kristensen K. şi colab., 2009 - *Winter wheat roots grow twice as deep as spring wheat roots, is this important for N uptake and N leaching losses?*. Plant Soil (2009) 322, p. 101-114, DOI 10.1007/s11104-009-9898-z