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EVOLUTION OF GRAY FOREST SOILS UNDER ARABLE USE IN THE CENTRAL PART OF REPUBLIC OF MOLDOVA

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Abstract

The paper aimed to present the evolution of gray forest soils used as arable land after forest deforestation in the Central part of Moldova named Codri area. Was used the comparison method between gray soil (grayzems) under the forest, gray arable soil used in agriculture around 100 years and gray arable soil that had a long period of development under steppe before was used in agriculture. As a result of use in agriculture first three horizons of forest soils (AEhț, AEh and BEhtw) was mixed in one. Framing in agricultural use also led to the decreasing humus content, decreasing of the iluvial-eluvial and cambic processes intensity, soil acidity reducing, soil compaction and worsening of soil structural condition. As a conclusion, arable gray soils need soil-improvement techniques targeted to increase soil organic matter content and improving their physical properties in plowed layer to make them more suitable for plant grow.

***Key words**: soil evolution, forest, Moldova, grayzems.*

INTRODUCTION

The grayzems (gray soils) in Moldova was formed under the forest vegetation during the end of Pleistocene and early Holocene when the climate was colder and more humid that favored forest vegetation growth (Adamenco et al, 1996). But now they are evolving in semiarid climatic conditions corresponding to the chernozems area. Due to their specific peculiarities in this area grey soils from Republic of Moldova are one particularly interesting research object on the one hand in point of view of their development under the forest and on the other hand as a farmland.

Thus now in the forests continues to evolve gray forest soils due to the biological factor, but under the climate regime typical for chernozem area. It gives them some characteristics that distinguish them from other regions (Grati, 1977). In addition during the subatlantic period at the end of Holocene, when soils have reached maturity, anthropogenic factor started his influence on this area, influencing this territory during more than 3000 years, and led to massive clearing of forests to get wood or to use released land for crops grow (Adamenco et al., 1996). Once forest were cleared, there is established steppe vegetation, because are no longer the conditions to return the forest. And the gray forest soils little by little started to get some chernozems features (Cendeev, 2005). But it is interesting that is happen and how is preceding their further development if the cleared land was introduced, immediately or after one period of evolution under the steppe, in the agricultural use. In this context, the paper presents an analysis of the evolution of gray forest soil from Moldova under the climatic conditions characteristic for cernozem formation and agricultural use.

MATERIALS AND METHODS

In order to characterize the evolution of the greyzems in Moldova as the object of study were selected gray soils from the forest and those which were employed in agricultural use on the village Ivancea, Orhei district, in the Central part of Codri area from Moldova that are evolved on clayey-loamy loess deposits placed on the the pliocene alluvial deposits. The central part of Codri area in Moldova is located on the height between the 150-250 m, in the warm and semihumid climatic area.

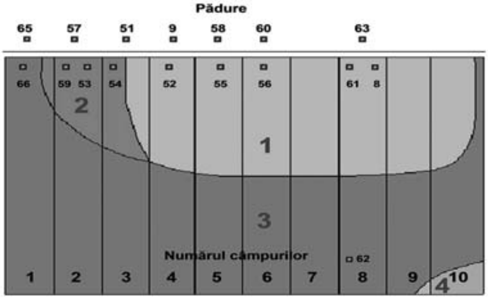

Figure 1. Sole distribution scheme of investigated areas in the experimental field

Legend:
1 –gray arable soil semimoderately humiferous with semiprofound humus profile (used as arable land about 100 years);
2 - gray arable soil semimoderately humiferous with moderately profound humus profile
3 - cambic arable chernozem moderately humiferous with deep profound humus profile
4 –eroded arable leached chernozem with moderately profound humus profile

For research and comparison have been chosen three groups of the soil profile:

- gray soils from primary forest;
- gray arable soil with semiprofound humus profile (used as arable land about 100 years after the deforestation);
- gray arable soil with moderately profound humus profile (free from the forest vegetation much more than 100 years).

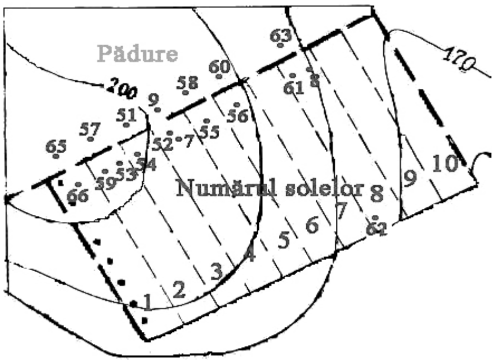

Figure 2. Topographic map of the soil profiles location to study the evolution of gray soil as the result of human impact in central part of Moldova

RESULTS AND DISCUSSIONS

Conducted research (Grati, 1977; Lungu, 2010) has shown that gray soil from the forest is characterized by a clear differentiation of the profile. During the depth 0-31 cm is outlined three genetic horizons: AEhț, AEh and Behtw with medium texture and low compaction, under which is located iluvial very compacted horizon. It was established that the loss of clay (90 t/ha) from eluvials horizons (AEhț, AEh, BEh) of gray forest soil are about nine times smaller than its accumulation in iluvial horizons (835 t/ha), what confirm the leading role of alteration “in situ" processes in the textural profile differentiation of these soils in conditions of Moldova. Forest soils are characterized by good structural state and hidrostability of soil aggregates in 0-20 cm layer. Humus profile of forest soils is characterized by thin fallow horizon on surface (8±2 cm) with 8.52±0.56% average humus content. With the deep humus content decreases sudden and is equal to 2.93±0.20% in AEh horizon. Average value of hydrolytic acidity for 0-34 cm layer of gray forest soil is 6.9±2.9 me/100g.

A common feature for both gray forest soils as well as the arable land is comparatively small depth (about 80 cm from surface) of occurrence of iluvial carbonate horizon extremely highlighted; the maximum carbonate content varies within 20-28%. Carbonates are shaped in massive accumulation of carbonate veined concretions. This is a consequence of contrast warmly hydrothermal regime under which influence soils were formed. It should be noted that in forest soils carbonate accumulations are more expressed than in arable soils. A hydrothermal change to a more humid on arable gray soils has led to a more homogeneous distribution of carbonates in the all parental rock.

Arable layer of the gray soil permanently used in agriculture around 100 years consists from mixture of genetic material from three forest soil surface horizons AEhț, AEh şi BEhtw. This layer has lost initial favorable structure and became rough and highly compact, texture has changed from the middle to middle-fine and the color from gray to reddish brown. Arable and postarable layer (0-30 cm) practically lost its ability to keep the loose state after basic processing. Balanced bulk density (Figure 3) of the arable layer at 10-30 cm depth (below the periodic tillage layer) to midsummer reach values equal to 1.50 to 1.55 g/cm³, and the degree of compaction - 17 - 18%. As a result, the state of physical quality of this layer becomes unfavorable for crop plants growth.

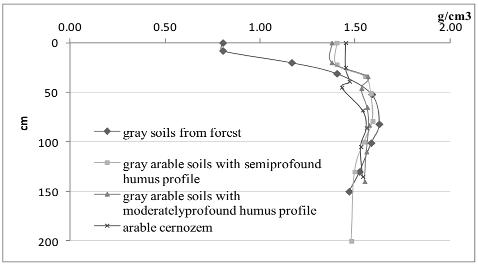

Figure 3. Values of soil bulk density of forest and arable gray soils (average data)

Under arable layer is placed iluvial horizon highly compacted identical to the the same horizon of the forest soil.

As a result of use in agriculture the hydrolytic acidity (Figure 4) in arable soils decreased with more than 2 times (from high to low), which in contrast with hydrothermical regime conditions stopped the eluvial-iluvial processes.

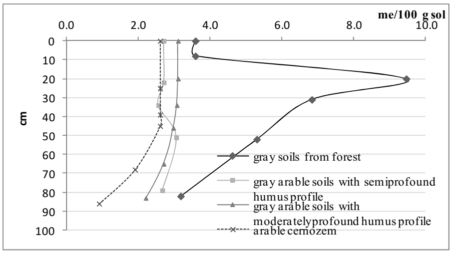

Figure 4. Hydrolytic acidity values of researched soils (average data)

As a result of use in agriculture humus content (Figure 5) in arable land has decreased in the profile section 0-34 cm on average by 1.43% or about 38% (about 70.5 t / ha) of initial humus content in this section of forest soil, having values of 2.33±0.07%. Humifer profile thickness increase is not accompanied by changes in humus quality.

The weighted average content of humus in the arable and postarable layer (0-34 cm) of gray arable soil with moderately profound humus profile is 2.61±0.09%. In the profile of these soils humus content decreases with depth more slowly than the other two.

Arable gray soils with moderately profound humus profile are very similar to those with semiprofound humus profile but differ from them by: thicker and darker humus profile and the presence of more structured and less compact AB horizon.

Because as we found what gray forest soils employed in agricultural production shall be subject to dehumification, and in the forest soils humus is concentrated in the first 0-8 cm and became easily mineralized after grubbing, we consider that gray arable soil with moderately profound humus profile have passed a long stage of development under steppe in its development.

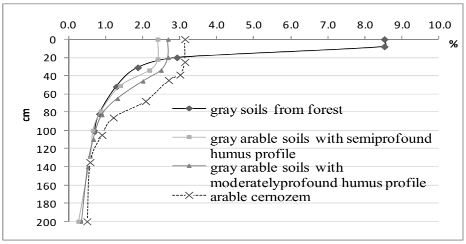

Figure 5. Humus content of researched soils (average data)

Gray arable soils throughout the profile are low in total phosphorus content, unlike the gray forest soils which is characterized by high content of total phosphorus in AEhț horizon as a result of biological accumulation of this element from litter and other organic debris.

But also all this three type of gray soils is characterized by common features as the proof of their common past such as:

- comparatively small depth of carbonates leaching (80-90 cm from ground surface) followed by formation of a highlighted iluvial carbonate horizon very compact when is dry;
- strong argilization in the middle part of the profile;
- the similar way of the clay distribution on the profile;
- existence of the special formation inherited from pedogenesis stage in forest vegetation (holes of the former roots of trees, Fe_2O_3 and MnO_2 cutan on the walls of these holes).

Gray soils of primary forest. | Gray arable soil with semiprofound humus profile (used as arable land about 100 years). | Gray arable soil with moderately profound humus profile (free from the forest vegetation more than 100 years).

Figure 6. Soil profiles of forest and arable grazems

CONCLUSIONS

Gray soils used in agriculture are characterized by following changes in morphological characters and properties:

- formation of the arable layer with average thickness 34 cm from the genetic material of the former three horizons of gray forest soil (AEhț + AEh + BEhtw);
- increasing in arable layer by about 6.0% of clay content compared with the analog section of the forest soil as a result of increasing "in situ" weathering process that led to the mitigation of the textural differentiation on the profile;
- decreasing of humus content in arable layer 0-34 cm on average by 1.74% (43 percent of initial content) compared to the humus content in the same section of the forest soil;
- losing the resistance to compaction of arable layer, balanced bulk density achieve values to the 1.55 - 1.57 g/cm^3 (strong compaction) and poor physical condition as the result of dehumification and weaker structure;
- 2 or 3-fold reducing of hydrolytic acidity values in arable layer and stopping the eluvial-iluvial processes and textural differentiation of the profile (positive change).

The remediation of the properties of these soils should be directed towards increasing the content of organic matter in arable layer and improving the unfavorable structural condition in plowed layer.

ACKNOWLEDGEMENTS

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