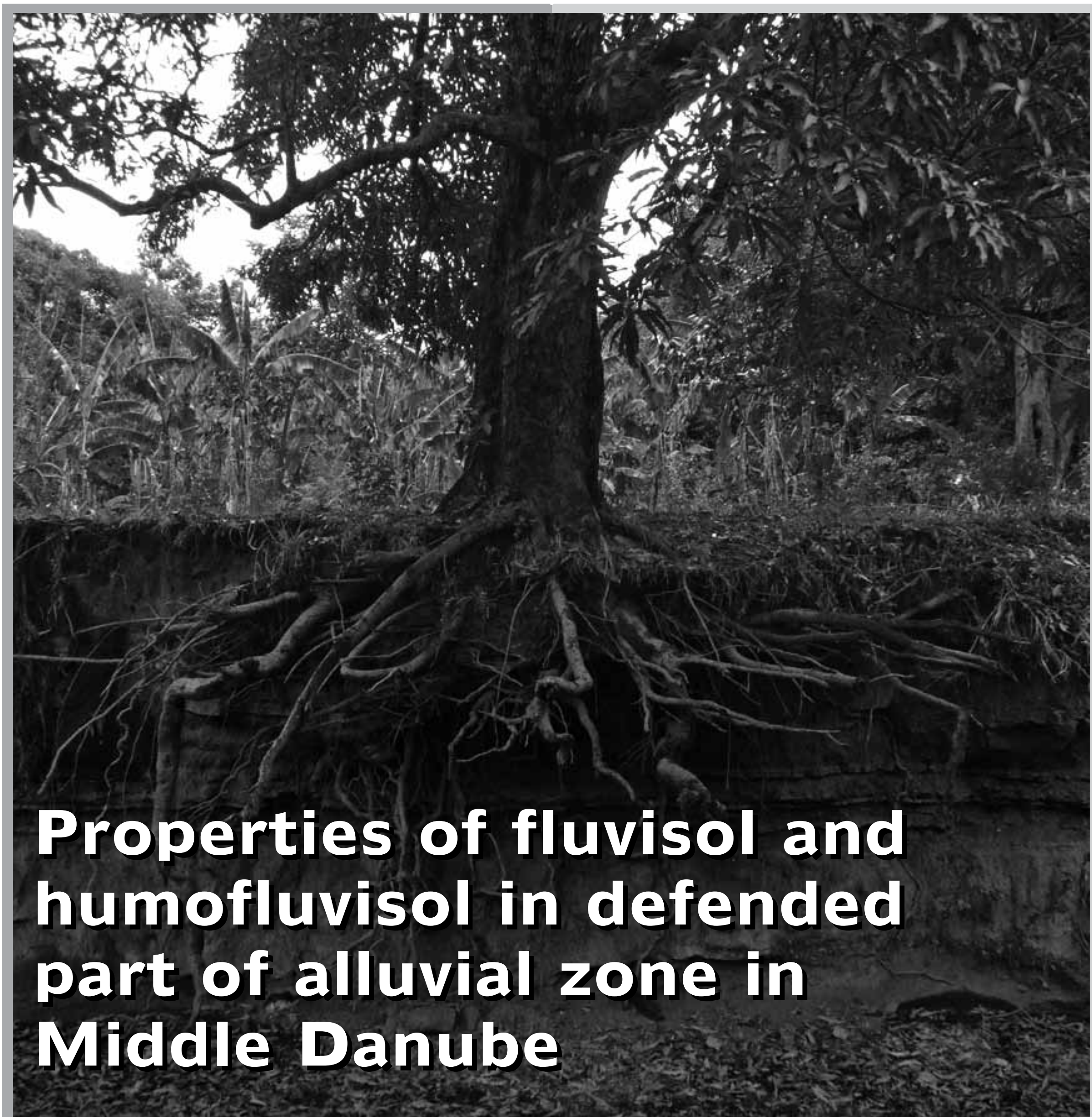

Properties of fluvisol and humofluvisol in defended part of alluvial zone in Middle Danube

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Background and purpose:
In paper analyzed the characteristics of the soil in the defend part of the alluvial plains in the Middle Danube region.

Material and methods:
The research was carried out in the protected part of the river Danube riparian zone. Particle size composition, density and specific gravity, as well as chemical properties were determined by standard laboratory methods.

Results and Conclusion:
At the investigated sites determinated two types of soil (humofluvisol and fluvisol). Within fluvisol were separated in two forms, namely: sandy and loamy. Content analysis and distribution of silt + clay fraction, and analysis of the timing and content of humus in the depth profile is determined by the closeness in the genesis of humofluvisol and loamy form of fluvisol. Application of multivariate analysis defined two categories of soil of ecological production.

Key words:
humofluvisol, fluvisol, Danube

INTRODUCTION

Soil formation in the alluvial plains is conditioned by the river transport competency, fluvial sedimentation and by the dynamics of surface and ground waters. The process of fluvial sedimentation is a dynamic and irregular process in space and time, which results in sudden changes of textural compositions in the vertical sections of the profiles (1, 2, 3, 4) at short distances and a prominent micro-relief (5, 6, 7, 8, 9, 10). Different conditions of soil formation conditioned significant differences between soil types, but also between lower systematic units (variety and form).
Previous research shows that the presentation of simple analytical parameters does not reveal clearly enough the differences between soil types, and especially the lower systematic units, so a more reliable criterion is the diagnosis by the derived parameters, such as: supplies of humus, fraction silt + clay and available water (10, 11, 12).
All regions of the world experienced an extreme accelertion of dam-building activity (13). River regulation have impact on the hydrology of the forest sites (14).
Similar observations are reported from Austria (15), and from United States (16). Depending on the severity of the alteration of lowering the water table and reducing annual amplitude, hybrid poplar stands have exhibited reduced productivity. For this reason, special attention should be focused to the defended part of the alluvial plain, because of the absence of flooding. Defended areas in Central Danube Basin were flooded until 1928. After the construction of levees (dams) to protect from the Danube floods, these areas receive additional moisture only by groundwater.
The consequence is the changed direction of the pedogenetic process compared to the part of the alluvial plain affected by flooding, which causes the changes of site conditions.
The differences are seen in the vegetation type compared to the part of the alluvial plain influenced by additional moisture and flood and underground waters.
For this reason, the properties of different soil systematic units were compared based on analytical indicators of their physical and chemical characteristics, distribution of characteristics per profile depth and analysis of fertility elements.

MATERIAL AND METHODS

The research was carried out in the protected part of the river Danube riparian zone.
The study sample plots are situated in defended part of alluvial plain near Novi Sad in three poplar plantation. Particle size composition (%) was determined by the international B-pipette method with the preparation in sodium pyrophosphate; Soil

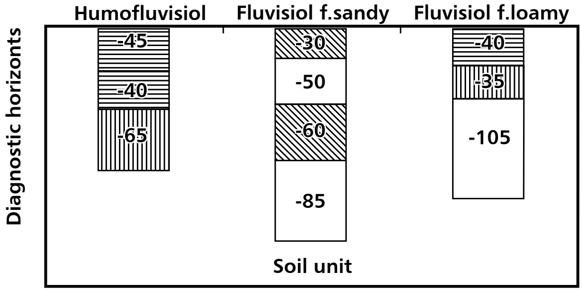

Figure 1
Morphological properties of study soils

particle classification in the particle size composition was based on Atterberg's classification; Specific gravity -Sp - (g/cm^3) was determined after Albert Bogs by using xylole as the inert liquid; Soil density -Sv - (g/cm^3) was determined in Kopecky cylinders volume 100 cm^3 (17).
Chemical characteristics were determined by laboratory research by the following methods: humus (%) after Turin modified by Simakov (18); reaction of soil solution was determined in H_2O and in KCl (19); the content of $CaCO_3$ was determined on Scheibler calcimeter.
Silt+clay and humus supply per hectare was calculated on basis of % and depth of each soil horizon depth and soil density.

RESULTS AND DISCUSSIONS

In WRB (20) fluvisols accommodate genetically young, azonal soils in alluvial deposits.

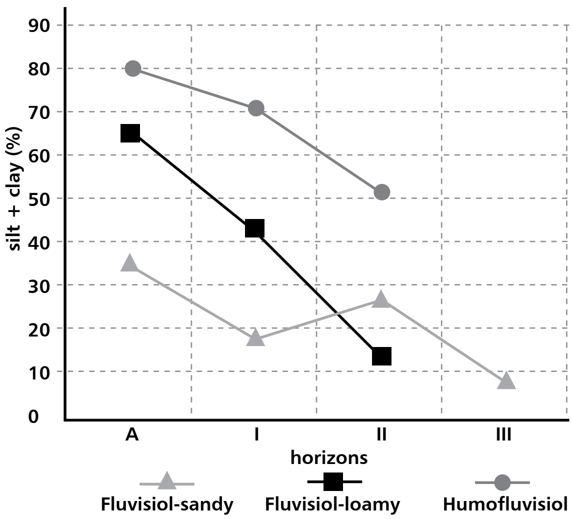

Figure 2
Distribution of the fraction silt + clay per profile depth

Fluvisols occupy some 350 million ha worldwide, of which more than half are in the tropics (20).
Poplar cultivation demand a differentation on more soil unit. For this reason we still use a regional soil Classification.
According to Soil Classification (21), two types of soil were recorded in the study field multiclonal poplar plantations, i.e.: fluvisol (morphological structure Ap–I-IIGso–IIIGso-Gr and Ap-IGso-IIGso-Gr) and humofluvisol (morphological structure Ap - C - Gso - Gr). Based on the above Soil Classification, two fluvisol forms were singled out based on the contents of the fraction silt + clay.
Based on the contents of these fractions, a sandy form (21.2 %) and a loamy form (39.8 %) of fluvisol were differentiated. The content of the fraction silt + clay in the sandy form has a discontinuous distribution per profile, which confirms the marked process of fluvial sedimentation in this form of fluvisol in the past. In the loamy form of fluvisol, the content of this fraction decreases regularly with depth, which indicates that the process of fluvial sedimentation was more steady and similar to the sedimentation process in humofluvisol (Figure 2).
Along with the content and distribution of the fraction silt + clay per profile depth, soil differentiation and diagnosis can also be based on the content and distribution of organic matter in the profile (11).
The average content of humus was the highest in humofluvisol, and the lowest in the sandy form of fluvisol. The analysis of humus content in the profile cross section shows that it decreases regularly with depth in the loamy form of fluvisol and in humofluvisol, which indicates a humus accumulation type of distribution of organic matter in the profile and a close genetic relation of these two systematic units of soil (Figure 3). However, in sandy fluvisol, the distribution of organic matter is conditioned by the discontinuity of the fraction silt + clay, as reported by Ivanisević et al (11).

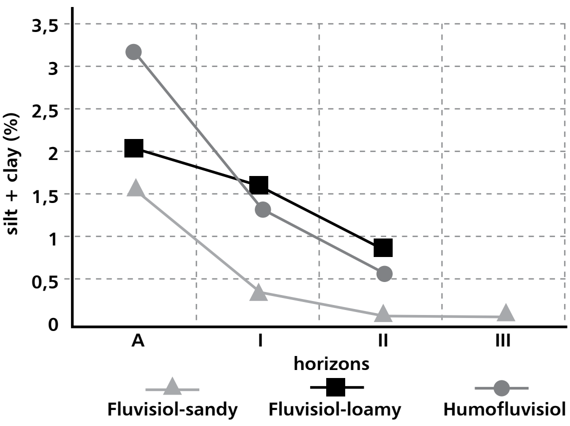

Figure 3
Humus distribution per profile depth

The above statement is also confirmed by the distribution of the supply of the fraction silt + clay and humus in the profile cross section.
The supply of silt + clay in humofluvisol was 13144 t/ha, in loamy fluvisol 7164 t/ha, in sandy fluvisol 5477 t/ha.
The results agree with the previous research by Ivanisevic (22) who reported for humofluvisol the supply of more than 10000 t/ha, loamy fluvisol - between 6500 and 8000 t/ha, and sandy fluvisol - less than 6500 t/ha. The supply of humus in humofluvisol was 335 t/ha, in loamy fluvisol 314 t/ha, and in sandy fluvisol 119 t/ha. These supplies agree with the previous research, as it was assessed that in the soils of the Middle Danube Basin the reserves of humus in humofluvisol were above 350 t/ha, in loamy fluvisol

from 250 to 300 t/ha, and in sandy fluvisol - less than 250 t/ha. The systematic units of the study soil were categorised by cluster analysis (Figure 4) and the groupings of individual layers of the study soil were compared (Figure 5).
Cluster analysis confirmed the grouping of loamy fluvisol and humofluvisol at short distances, which means that these soil systematic units are in a close evolution-genetic relation. In addition, this paper deals with the character of relations of individual layers in study soils.
This indicates the interrelationship (closeness) of individual process of soil formation, which are in a way reflected in the values of physical and chemical properties.Based on the cluster analysis dendrogram of the study soil horizons and layers (Figure 5) it was

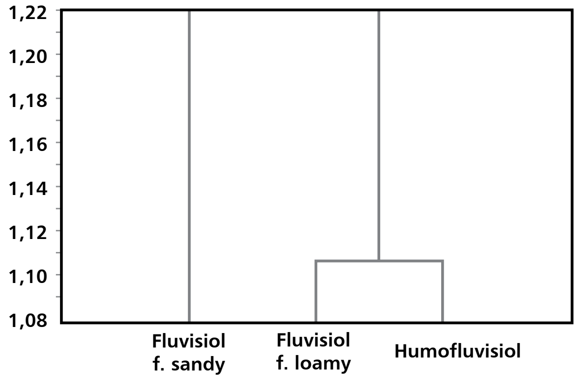

Figure 4
Cluster analysis dendrogram of the study soil systematic units

concluded that the processes of soil formation were close in loamy fluvisol and in humofluvisol.
This conclusion is supported by the grouping of humus accumulation horizons at short distances. The same Figure also shows that the conditions of soil formation of sandy fluvisol differed from the conditions in the two previously mentioned soil systematic units.
The Figure also shows the irregular grouping of layers and horizons below the humus accumulation horizon, which can be explained by the nature of soil formation in the alluvial plain.
The conditions of plant development deteriorated with soil depth which confirms the research by Zivanov (6) who reported that the depth of the profile from 30 to 150 cm is very important for poplar growing.

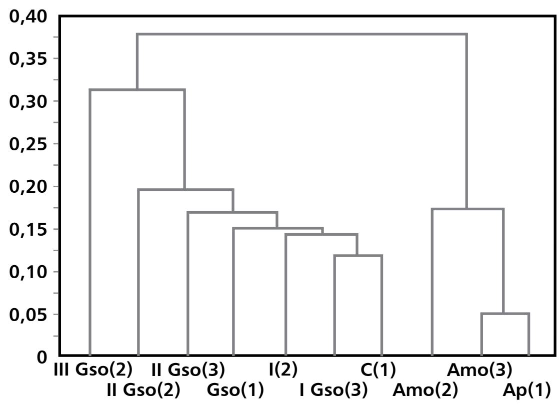

Figure 5
Cluster analysis dendrogram of the study soil horizons and layers (1 humofluvisol 2* sandy fluvisol 3* loamy fluvisol)*

CONCLUSIONS

The following conclusions can be made based on the above study:

- Two types of soil were in the Middle Danube Basin: humofluvisol and fluvisol. Fluvisol was differentiated into two forms, i.e.: loamy and sandy form of fluvisol;

- The analysis of distribution of the fraction silt + clay and the content of humus showed the closeness in the genesis of humofluvisol and loamy fluvisol as distinguished from sandy fluvisol;

- Depending on the accumulation of organic matter (humus), humofluvisol and loamy fluvisol are classified as humus accumulation types, while sandy fluvisol is a discontinuous type, i.e. it depends on the content of the fraction silt + clay.

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