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SOIL PRODUCTIVITY - ECOLOGICAL CATEGORIES FOR THE CULTIVATION OF BLACK POPLARS IN CENTRAL DANUBE BASIN ALLUVIAL PLAIN

GALIC Zoran, ORLOVIC Sasa, IVANISEVIC Petar,
KLASNJA Bojana, VASIC Verica

FACULTY OF AGRICULTURE, INSTITUTE OF LOWLAND FORESTRY AND ENVIRONMENT, NOVI SAD, SERBIA AND MONTENEGRO

ABSTRACT

Parallel with the work on the development of classification of soils for poplar growing, the aim of the paper was to determine the most favourable productivity-ecological soil units for each newly selected cultivar. A close genetic relation was determined between loamy fluvisol and humofluvisol in the study localities. The cultivars of eastern cottonwood reacted differently than the Euramerican cultivar of black poplar.

KEY WORDS:
humofluvisol, fluvisol, poplar cultivars, multivariate analysis

1. 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]) at short distances and a prominent micro-relief ([3], [4], [5], [6], [7], [8]). 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 ([8], [9], [10]). Further objectivization of the classification of natural phenomena for the establishment of a more real model of soil classification requires the introduction of numeric parameters for a multivariate method of simultaneous analysis of a higher number of data [11].

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, in order to assess the most favourable soil systematic units for the cultivation of black poplar cultivars in the Middle Danube Basin.

2. MATERIALS AND METHOD

The research was carried out in two field multiclonal test plantations in the Middle Danube Basin in the protected part of the river Danube riparian zone. At the site "Voyno Dobro", a field multiclonal test plantation was established in 1978, and at the site "Topolik" in 1979. Both test plantations were established by deep planting, planting space 5 x 5 metres, with several selected cultivars of black poplar of which the following cultivars were analysed: I-214 (*Populus x euramericana* (Dode) Guiner), 618 and 450 (*Populus deltoides* Bartr.).

Particle size composition, density and specific gravity, as well as chemical properties were determined by standard laboratory methods.

Growth elements were assessed based on the analysis of the mean stand tree.

3. RESULTS AND DISCUSSION

According to Soil Classification [12], two types of soil were recorded in the study field multiclonal poplar plantations, i.e.: fluvisol (morphological structure A_p–I-IIG_{so}–IIIG_{so}-G_r and A_p-IG_{so}-IIG_{so}-G_r) and humofluvisol (morphological structure A_p - C - G_{so} - G_r). 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.

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 [9].

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 (Diagram 1). However, in sandy fluvisol, the distribution of organic matter is conditioned by the discontinuity of the fraction silt + clay, as reported by [9].

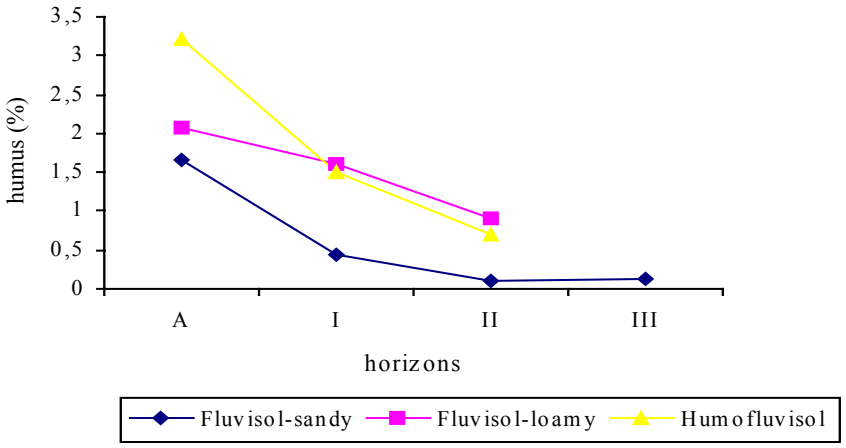


Diagram 1: Humus distribution per profile depth

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 [13] 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 (Diagram 2).

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.

Depending on the above soil parameters, two productivity-ecological categories of soil were singled out: humofluvisol and loamy fluvisol are classified in one category, and sandy fluvisol is another productivity-ecological category. As this paper deals with three cultivars of black poplar from different geographical regions, the most favourable productivity-ecological categories were determined for each study cultivar (Diagram 3).

Multivariate analysis showed three groups of growth elements: cultivar 618 on humofluvisol and loamy fluvisol were in the first group, cultivar 450 on humofluvisol and loamy fluvisol, as well as cultivar I-214 were in the second group, and cultivars 618 and 450 on sandy fluvisol were in the third group.

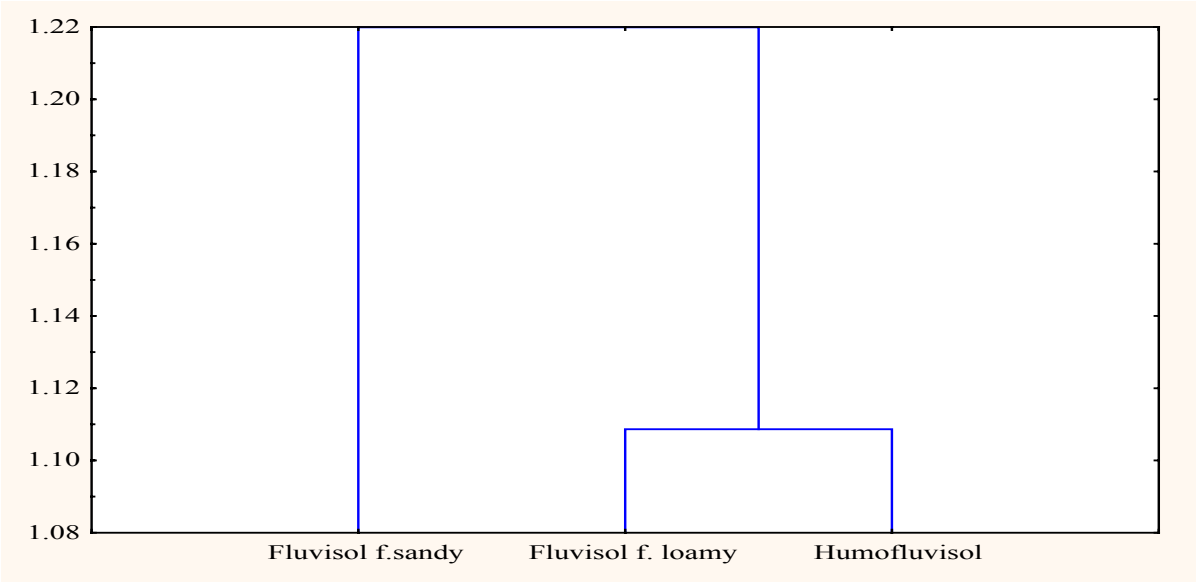
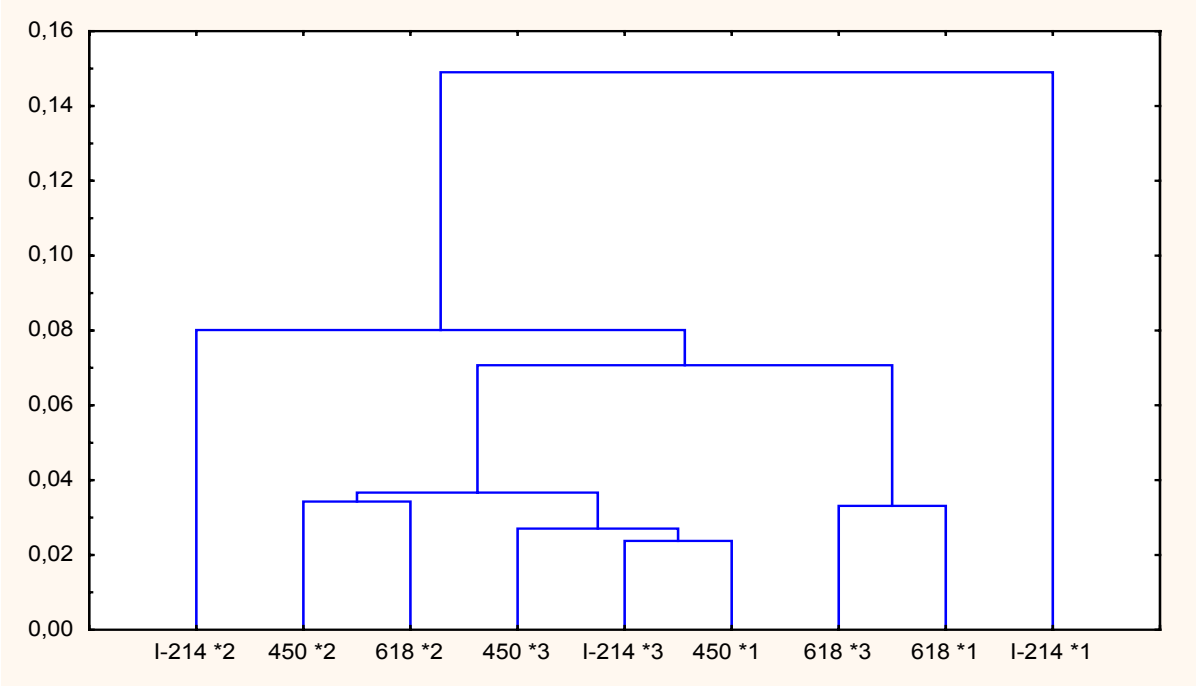


DIAGRAM 2: CLUSTER ANALYSIS DENDROGRAM OF THE STUDY SOIL SYSTEMATIC UNITS



1* humofluvisol 2* sandy fluvisol 3* loamy fluvisol

Diagram 3: Cluster analysis dendrogram of growth elements of mean stand trees

This statistical analysis confirmed the statement that cultivars 618 and 450 (cultivars of eastern cottonwood) in the same site conditions reacted rather differently than the cultivar I-214 (cultivar of Euramerican poplar). On the study soil systematic units, the cultivar 618 showed the best results. The cultivar 450 showed the highest ecological adaptability, i.e. the lowest variation regarding growth elements. These conclusions confirm the need of further research of the reaction of selected black

poplar clones from different geographical regions to different soil systematic units in the Danube alluvial plain.

4. CONCLUSIONS

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

- Two types of soil were determined in the test plantation of black poplars 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;
- The assessment of productivity-ecological categories was carried out by statistic methods: two productivity-ecological categories were singled out;
- The study cultivars reacted differently to soil productivity-ecological categories;
- On the study soil systematic units, the most plastic cultivar was cultivar 450, and the best cultivar was 618;
- The above conclusions point out the need of further study of soil productivity-ecological categories and the reactions of black poplar cultivars from different geographical regions.

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