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THE MAIN SOIL CHARACTERISTICS FOR POPLAR GROWING IN ALLUVIAL ZONES OF LOWLAND RIVERS

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ABSTRACT

The typical profiles of the soil systematic units most often used in poplar cultivation on the bottomlands of the rivers Danube, Sava, Tisa and Tamiš were studied. The differences of the soil physical properties and the levels of fertility of various soil systematic units were assessed, as well as of the same systematic units depending on the river, i.e. different site conditions for poplar cultivation.

KEY WORDS:
fluvisol, humofluvisol, soil fertility indicator, black poplar

1. INTRODUCTION

Based on multiannual study of site conditions, the diverse characteristics of the low alluvial lands were evaluated, reflected first of all in the diverse types of hydrologically conditioned forests on different systematic units of soil [1], [2], [3]. In the alluvial plain, the most significant role in soil formation is that of the fluvial process, i.e. the energy of suspended sediment transport. This process results in the formation of a series of evolution-genetically related soils of various degrees of development, which condition the development of different forest types [4], [5], [6], [7], [8], [9], [10].

Parallel with the work on the investgation of the soils properties used in poplar growing, it is necessary to determine the most favourable productivity-ecological units of soil for each newly selected poplar cultivar. For this reason, it is necessary to study the specific site requirements of the selected cultivars, because insufficient knowledge of site requirements may hinder the full realisation of the cultivar genetic potential of wood volume production [11], [12], [13], [14], [15].

2. MATERIALS AND METHOD

The research was carried out in the riparian zone of lowland of Rivers: Danube, Sava, Tisza and Tamish in Voyvodina.

All the most significant soil systematic units for poplar cultivation are represented by typical profiles of the low alluvial lands next to the Rivers: Danube, Sava, Tisza and Tamish. Particle size composition, density and specific gravity, as well as chemical properties were determined by standard laboratory method [16], [17].

3. RESULTS AND DISCUSSION

According to the current classification of soils of Yugoslavia, the soils for poplar cultivation are classified in the order of hydromorphic soils, with the following classes: undeveloped soil, semigley and gley, subdivided into soil types: fluvisol formula A – I – II - ...- nG_r; humofluvisol formula A – C – G and humogley A – G [18]. Within the above classes, the most significant soil types for poplar cultivation are fluvisol and humofluvisol.

Fluvisol is most often formed in the genetic part of bottomland along the banks, characterised by sudden changes of microrelief, which is the consequence of the changes of the intensity of the river transporting power. This causes a great variability of properties, especially of the soil textural class, and consequently soil water and air regimes. Because of the great variability of the fluvisol particle-size composition over small distances, it is impossible to apply the adequate technology for each plant. Therefore, the usual decision in practice is for the best "average" technology of poplar growing [19]. Fluvisol is subdivided into several lower systematic units of soil, based on particle-size composition, which has the highest effect on the success of poplar cultivation.

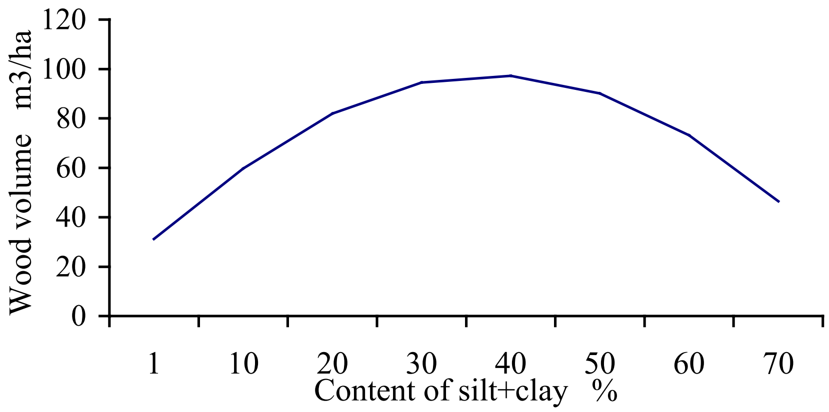
Sandy form of fluvisol is formed on high parts of the alluvial lands in the middle part of the Central Danube Basin, as well as in a very narrow part along the banks in the Basins of the river Sava, Tisza and Tamish. The main characteristic of these profiles is that the fraction of sand prevails along the profile depth, i.e. that the layers of sand prevail in the lower zone of the profile. In the arid period they cause the interruption of capillary action in the profile and the occurrence of Gr horizon below the depth of 3 metres [5]. In addition to the above, this form of fluvisol has a low available water capacity.

Fluvisol with fossil soil occurs in the central zone of the Central Basin of the Danube, in the Basins of Sava, Tisza and Tamish. The depth of the recent alluvial deposit ranges between 40 and 95 cm. Compared to the sandy form of fluvisol, it is distinguished by a significantly higher percentage of total clay [5], [20]. The limiting factor is the position of the fossil horizon, considering the higher clay content, which results in a lower filtration capacity, which can initiate the process of waterlogging.

Loamy forms of fluvisol are formed on gently undulated terrain and on higher plateaux and central parts of the Central Danube Basin. In the Basins of the river Sava, Tisza and Tamish in the zone of poplar growing, compared to the Danube Basin, this systematic unit covers insignificant areas.

Humofluvisols are formed in the conditions of meadow type of soil genesis in the central part of the alluvial land [18]. This soil is usually formed on the flat or gently undulating terrain. Humofluvisol is distinguished by the developed humus horizon 30 to 70 cm deep, most often loamy. The occurrence of the spheroid structure is enabled by the presence of carbonates and humus substances. Below A horizon, C horizon also has the loamy particle-size composition. The deeper parts of the profile represent the G horizon, which is influenced by groundwater (groundwater level varies between one and two metres). Within the gley-G horizon, there is the sub-horizon of the secondary oxidation-G_{so} and the sub-horizon of reduction-G_r. The properties of this type of soil are spatially variable, but to a less extent than in fluvisol. They are conditioned by the calmer course of sedimentation in the central part of the bottomland. Potential productivity of this soil type is very high, depending on the particle size composition, percentage of humus and groundwater level [18].

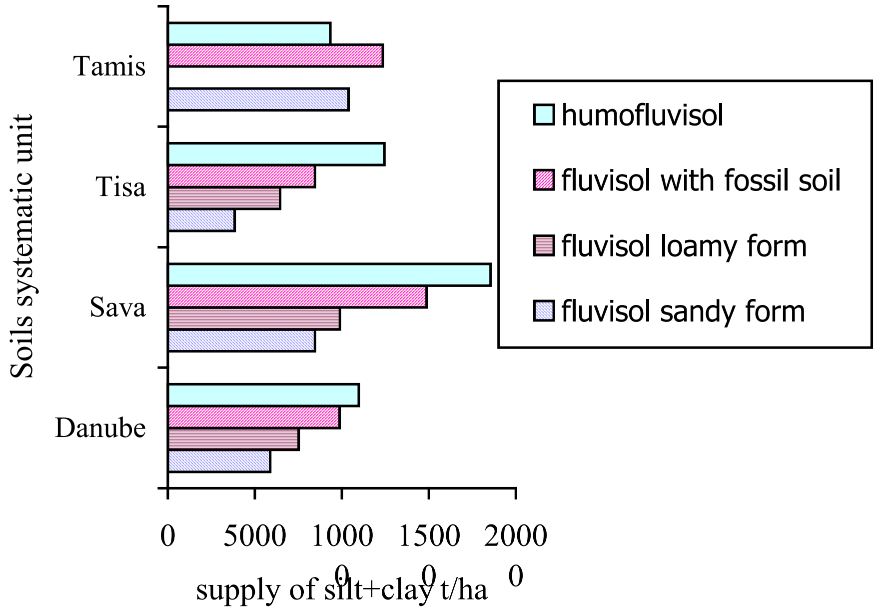
Based on multiannual research, we determined the effect of the average content of silt+clay fraction on tree and plantation growth elements. The volume of *Populus x euramericana* cl. I-214 mean stand tree depending on the content of the fraction silt+clay has a parabola form, with the optimum of 30 do 45 % of this fraction (picture 1).
The volume of the clones *Populus deltoides* mean stand trees, depending on the content of the fraction silt+clay has a linear tendency [23], [24]. This tendency is more expressed for the lower percentage of this fraction in the textural composition. Consequently the selection of the clone depends on particlesize composition of the soil, because this soil property is considerably variable depending on the lowland river bottomlands in Voyvodina.



PICTURE 1. THE DEPENDENCE OF WOOD VOLUME OF I-214 IN SEVENTH YEAR OF VEGATATION ON THE SILT+CLAY CONTENT $Y=27,5394+3,7005*x-0,0490*x^2$

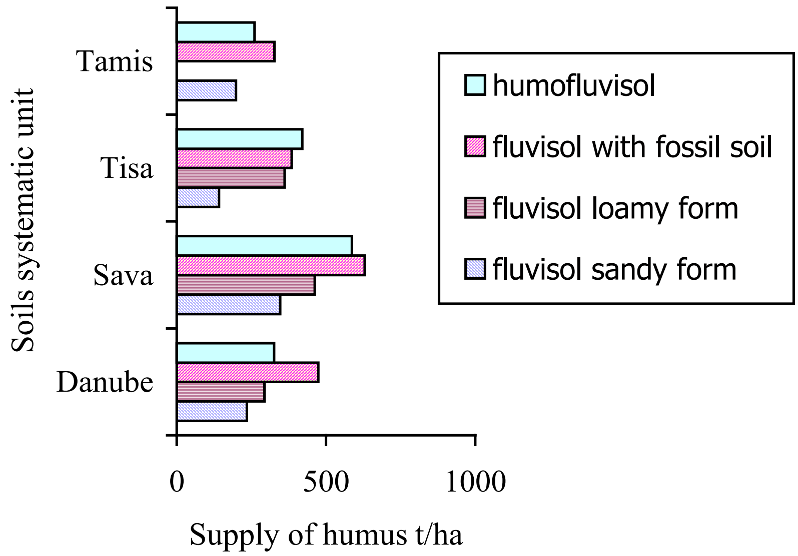
In addition to the above, successful cultivation of poplars is also affected by the level of soil fertility. As it has been stated, the level of fertility in the physiologically active part of the profile is determined by the content of the silt and clay fraction, content of humus, amount of available water and soil aeration per profile depth [5], [21] and [22].

Typical profiles of the Danube, Tisza, Sava and Tamish bottomlands differ by the amount of humus and silt+clay, as well as by the potential amount of available water in the profile (Picture 2, 3 and 4).



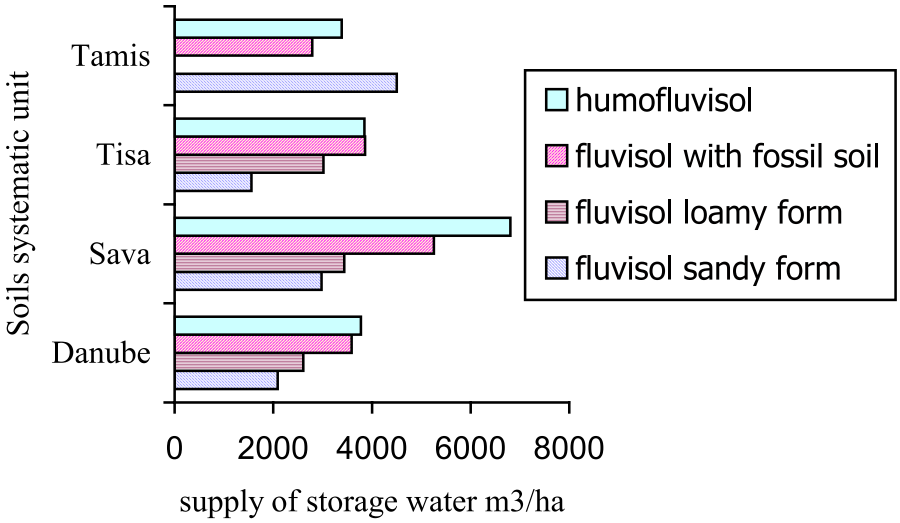
PICTURE 2.: SUPPLY OF SILT +CLAY

The contents of silt+clay are the lowest in the sandy forms of fluvisol of all study bottomlands. In the bottomlands of the Danube and Sava, humofluvisol is best supplied with this element of fertility, while in the bottomland of the Tamish, fluvisol with fossil soil has the highest amount of this element of fertility.



PICTURE 3.: SUPPLY OF HUMUS

The contents of humus and available water are the lowest in the sandy forms of fluvisol of the Danube and Sava bottomlands. In the Danube and Sava bottomlands fluvisol with fossil soil has the highest supply of humus, humofluvisol has the best supply of available water. In the Tamish alluvial land, the deviation is considerably lower compared to the bottomlands of the Danube and Sava (Picture 3 and 4).



PICTURE 4.: SUPPLY OF WATER STORAGE

As it has been stated, the level of fertility depends on the study elements which indicate soil fertility, because the main part of nutrients is concentrated in the loamy fraction. The higher content of humus substances in the calcareous soils considerably increases the availability of readily available nutrients [5]. *Inter alia* the elevated amount of humus and silt+clay are functionally related to the potential of available water storage.

4. CONCLUSIONS

Fluvisol and humofluvisol differ at the level of the type, form and river bottomland by textural class, chemical properties and capacity of available water storage.

The contents of silt+clay are the lowest in the sandy forms of fluvisol in the study bottomlands. In the Danube, Tisza and Sava bottomlands, humofluvisol has the highest content of this element of fertility. In the Tamish alluvial plain, fluvisol with fossil soil has the highest amount of this element of fertility. The contents of humus and available water are the lowest in the sandy forms of fluvisol in the Danube and Sava bottomlands. In the Danube and Sava plains, fluvisol with fossil soil has the highest content of humus, and humofluvisol has the highest quantity of available water. There is a considerable deviation of the Tamish alluvial plain compared to the Danube and Sava bottomlands.

The above conclusions point to the differences of the most significant properties and levels of soil fertility along the major lowland rivers in Voyvodina. As the conditions of poplar growing are different, the optimal use of site conditions requires a detailed knowledge of soil properties.

REFERENCES

[1.] ERDEŠI J.: Fitocenoze šuma jugozapadnog Srema, doktorska disretacija, Šumarski fakultet, Beograd, 1971
[2.] GALIĆ Z.: Istraživanje uticaja značajnijih faktora staništa na gajenje nekih sorti crne topole u Srednjem Podunavlju, Magistarski rad, Beograd, 2001
[3.] GALIĆ Z.: Application of multivariate analizis in the assessment of soil productivity-ecological categories for the cultivation of black poplars, Zemljište i biljka,49/3, 2000
[4.] Grupa autora: Hemijske metode ispitivanja zemlji{ta, Priru~nik za ispitivanje zemlji{ta, Knjiga I, JGPZ, Beograd, 1971
[5.] Grupa autora: Metode istra`ivanja i odre|ivanja fizi~kih svojstava zemlji{ta, Priru~nik za ispitivanje zemlji{ta, JDPZ, Novi Sad, 1997
[6.] HERPKA I.: Postanak i razvoj prirodnih vrba u Podunavlju i donjoj Posavini, Topola 61-64, JNKT, Beograd, 1963
[7.] HERPKA I.: Ekolo{ke i biolo{ke osobine autohtonih topola i vrba u ritskim {umama Podunavlja, Radovi knjiga br.7, Institut za topolarstvo, Novi Sad, 1979
[8.] JOVIĆ N., KNEŽEVIĆ M.: Zemljišta u šumama Ravnog Srema, Zemljište i biljka № 1, Beograd, 1986
[9.] IVANIŠEVIĆ P.: Fizičke i vodnovazdušne osobine zemljišta u šumama topola i vrba u inundaciji Tamiša, Radovi knjiga 24, Instutut za topolarstvo, 1991
[10.] IVANIŠEVIĆ P.: Efekti |ubrenja u proizvodnji sadnica topola na aluvijalnim zemljištima Srednjeg Podunavlja, Magistraski rad, Šumarski fakultet, Beograd, 1991
[11.] IVANIŠEVIĆ P.: Značaj svojstava zemljišta u proizvodnji drveta topola za celulozu i papir, Radovi knjiga 26, Instutut za topolarstvo, 1995
[12.] IVANIŠEVIĆ, P. MILANOVSKIJ, E.: Mogućnost klasifikacije zemljišta Srednjeg Podunavlja na bazi rezervi i sastava humusa, Radovi Instituta za topolarstvo, 1991
[13.] IVANIŠEVIĆ P., ORLOVIĆ, S., RONČEVIĆ, S.: Šume i šumska zemljišta pored reke Tamiš, Monografija Naš Tamiš, Novi Sad, 1998
[14.] IVANIŠEVIĆ P., GRBIĆ, P.: Rezultati proučavanja zemljišta u šumama Ravnog Srema, Institut za topolarstvo, Novi Sad, 1992
[15.] IVANIŠEVIĆ P., GALIĆ Z., RONČEVIĆ S.: Black poplar productivity on soils in the middle Danube Basin, Zemljište i biljka, Vol. 49, № 3, 2000
[16.] IVANIŠEVIĆ P., PANTIĆ D., GALIĆ Z.: Pedološka i proizvodna istraživanja staništa topola u poloju reke Save na području Ravnog Srema, Glasnik Šumarskog fakulteta, broj 84, 2001
[17.] ORLOVIĆ S.: Prou~avanje varijabiliteta svojstava crnih topola zna~ajnih za unapre|enje selekcije na bujnost, Doktorska disertacija, [Beograd, 1996]
[18.] RONNBERG-WASTLJUNG, A.C.: Breeding in *Salix*. Genetics of quantitative characters. 'Dissertation, Swedish University of Agricultural Sciences, 1996
[19.] TOMIĆ Z.: Šumske fitocenoze Srbije, Šumarski fakultet, 1992
[20.] FILIPOVSKI, G. (1985): Klasifikacija zemlji{ta Jugoslavije, Akademija nauke i umjetnosti Bosne i Hercegovine, str. 66, Sarajevo
[21.] ŠUMAKOV V.: Zemljišni uslovi u kulturama topola na rečnom poloju, Dokumentacija 23, Jugoslovenski centar za poljoprivredu i šumarstvo, Beograd, 1960
[22.] ŽIVANOV, N.: Osobine aluvijalnih zemljišta i njihov značaj za taksacione elemente *Populus x euramericana* (Dode) Guinier, cl. I-214, Doktorska disertacija, Institut za topolarstvo, Novi Sad, 1977
[23.] ŽIVANOV N., IVANIŠEVIĆ, P.: Zna~aj prostorne varijabilnosti aluvijalnih zemlji{ta za razvoj topola osnovanih postupkom duboke sadnje, Zbornik radova, Knjiga 16, Institut za topolarstvo, Novi Sad, 1985
[24.] ŽIVANOV N., IVANIŠEVIĆ, P., GRBIĆ P.: Rezultati uzgoja topola na eutričnom kambisolu, Topola 145-146, JNKT, Beograd, 1985