

RESULTS OF POPLAR CLONE TESTING IN FIELD EXPERIMENTS

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Growth vigor of 7 poplar clones was researched, i.e. 5 candidate clones for registration (B-81, B-229, PE 19/66, 182/81 and 129/8) and 2 clonal cultivars (I-214 and “Pannonia”) which had been registered earlier. The taxonomy of the study poplar clones was as follows: B-81 (*Populus deltoides*), B-229 (*Populus deltoides*), PE 19/66 (*Populus deltoides*), 182/81 (*Populus deltoides*), 129/81 (*Populus x euramericana*), I-214 (*Populus x euramericana*) and “Pannonia” (*Populus x euramericana*). The research was performed in three field experiments established in 2002 on the area of the Forest Estate Sremska Mitrovica. Although the experiments were established with several planting spaces, the first information indicate that the candidate clone PE 19/66 had the greatest vigour on the optimal soil types (humofluvisol and fluvisol loamy form), while the candidate clone B-81 had the advantage on the less favoured soil type (meadow black soil on loess alluvium). Based on the attained diameters and heights, it can be concluded that these are the successfully established plantations and that the candidate clones showed significant

genetic potentials, which points to the fact that in future the production of poplar wood volume can be significantly increased.

Key words: Poplars, selection, growth vigour

INTRODUCTION

The genus *Populus* is widely distributed throughout Europe, North America and Asia. Its wide range, ability of spontaneous and controlled intra- and inter- species hybridization, have enabled the creation of numerous sub-species, and a whole series of transition forms, i.e. simple and complex hybrids. The result is its great natural variability which makes it possible for poplar to inhabit different sites, both along the rivers and in the belt of submontane forests. In addition to all the above advantages which are significant for breeding, poplars are characterised by fast growth and by simple vegetative reproduction (CAIN and ORMORD, 1984). In the economic sense, especially significant are the poplars in the section *Aigeiros* which occupy small areas in Serbia and Montenegro, but they have a large share in the allowable cut and financial effects. A great impetus to the development of poplar research through the creation of new cultivars and the advancement of nursery production methods and plantation establishment was given by the program Short Rotation Intensive Culture (SRIC). This program is actually a widely distributed concept of biomass production for energy and chemical and mechanical processing (ANDERSON *et al.*, 1983; FEGE, 1987; STETTLER *et al.*, 1988).

If it is taken into account that it is predicted that cheap wood volume for mechanical and chemical processing, as well as for the generation of energy, is going to be increasingly deficient, it is not unexpected that the interest for the cultivation of fast-growing tree species has suddenly increased. For this reason, the greatest number of poplar breeding programmes is directed to the highest possible utilisation of their genetic potential and adaptation values. In this sense, it is aimed to form the cultivars (clones) characterised by great growth vigour and resistance to pests and diseases of leaf, stem and bark. The basic problem for any breeder is the issue of the earliest possible identification of genotypes with desired characters. The shortening of the selection period, in addition to time-saving, also reduces the costs of research (CEULEMANS *et al.*, 1987, ORLOVIĆ *et al.*, 1986). The creation of new poplar cultivars is particularly complex because growth vigour is determined based on growth elements (tree diameter and height) and produced biomass, which are, just as the greatest number of other quantitative characters, controlled by several genes. For this reason, numerous anatomic traits, as well as the physiological and biochemical processes related to growth, are researched in order to be able to assess the genotype potential as soon as possible.

The Institute of Lowland Forestry and Environment Novi Sad has created by hybridization and multiple selection, numerous poplar cultivars (clones) characterised by high growth vigour and a series of desirable characters of which the most significant is the resistance to leaf, stem and bark diseases. Aiming at the basic preconditions for the acceleration of the procedure of creating fast-growing

cultivars, i.e. the earliest possible selection, as well as to create the ideotype, the Institute has created a program of long-term research which, through the research of anatomic characters and physiological processes, i.e. structural functional relations, enables the earliest possible detection of the growth vigour potential. The ideotype construction, after DICKMANN *et al.* (1994) is actually a method of uniting the all-inclusive plant physiology. According to STETTLER *et al.* (1992), its use is one of the possibilities for the creation of cultivars for Short Rotation Intensive Culture.

Numerous results of genotype – poplar clone testing have been published in scientific papers: HERPKA, 1986; 1989; MARKOVIĆ *et al.*, 1986; GUZINA *et al.*, 1991. All the results indicate clearly that, by creation and introduction in production of the new high-yield poplar cultivars, it is possible to increase significantly wood volume production and to make new cultivars with significantly higher genetic potential. Also, the research of susceptibility to diseases points to the permanent care and the introduction of new poplar cultivars to prevent the adverse effects which can be caused by monoclonal plantations cultivated over vast areas.

As the procedure of genotypes – candidates for registration testing lasts for several years, it is attempted to accelerate the registration and to start the production as soon as possible. The results of the study of juvenile - adult relations (HERPKA 1979; 1987; 1988) indicate that it is possible with high probability to register the poplar clones and in younger stages.

Poplar plantations are located at the sites along the rivers on different soil types. The soil formation in the alluvial plain is conditioned by the river competency, deposition of river sediment (fluvial sedimentation) and by the dynamics of surface and underground waters. The process of fluvial sedimentation is a dynamic and non-uniform process in space and time, which results in a sudden change of the particle size distribution on the vertical section of the profile (ŠUMAKOV, 1960; ŽIVKOVIĆ *et al.*, 1972) at small distances and a pronounced micro-relief (ŽIVANOV, 1970, 1977, 1979, 1982; ŽIVANOV and IVANIŠEVIĆ, 1985; IVANIŠEVIĆ, 1991). Different conditions of soil formation condition significant differences between the types, but also between the lower systematic units (variety and form).

As poplar plantations are established on different soil types, it is very significant to establish multiannual field experiments on as many as possible different soil types, so as to examine the adaptation of cultivars, i.e. to find out on which soil type the cultivar yields the highest results in wood volume production, i.e. on which soil types it can grow and produce the satisfactory yield. It is expected that in this way it will be possible to zonate the poplar cultivars, so that all the regions of poplar growing will have more, which will ensure a higher biological stability of the plantations, as well as the longer duration of the cultivars. In this aim, in cooperation with SE “Vojvodinašume” the Institute established the experiment in which the same poplar cultivars are tested on different soil types. In

this way, a network of 10 experiments was created, which will enable the zonation of poplar cultivars and the higher yield.

This paper presents the results of the research of growth vigour presented by diameters at breast height and heights of new cultivars parallel with standard registered cultivars, in order to get the approximate parameters of the advantages of the newly created poplar cultivars.

MATERIALS AND METHODS

Growth vigour of 5 poplar clones was researched of which: B-81, B-229, PE 19/66, 182/81 and 129/81, are the clones – candidates for registration by the cultivar registration commission and clonal cultivars I-214 and “Pannonia” which had been registered earlier. The taxonomy of the study poplar clones is as follows:

1. B-81 (*Populus deltoides*)
2. B-229 (*Populus deltoides*)
3. PE 19/66 (*Populus deltoides*)
4. 182/81 (*Populus deltoides*)
5. “Pannonia” (*Populus x euramericana*)

The research was performed in three field experiments at the following localities:

I) Forest Estate Sremska Mitrovica Sremska Mitrovica, Forest Administration Kupinovo, Management Unit Kupinske Grede 43 d
Soil type: Fluvisol loamy form
Established in 2001
Planting space: 4.25 x 4.25 m

III) Forest Estate Sremska Mitrovica Sremska Mitrovica, Forest Administration Kupinovo, Management Unit Kupinske Grede 43 d
Soil type: meadow black soil on loess alluvium
Established in 2001
Planting space: 4.25 x 4.25 m

III) Forest Estate Sremska Mitrovica, Forest Administration Višnjićevo, Management Unit 2712 Banov Brod 18a
Soil type: Humofluvisol
Established in 2000
Planting space: 4.25 x 4.25 m

The experiments are established in 4 repetitions, with 100 plants each. During the experiments each year, diameters and heights were measured as the indicators of growth vigour. The Tables present the average diameters and heights in the fifth year of plantation age.

RESULTS

The study poplar clones showed statistically significant differences in the attained diameters. The maximal diameters in the experiments 1 and 3 were attained by the clone PE 19/66 (*P. deltoides*), and in experiment 2, the clone B-81. The minimal diameters in all three experiments were reached by the clone “Pannonia“. The statistical processing of diameter measurement data shows the effect of different site types, as well as the interactions G x E on the plant dimensions. The differences between the genotypes were the most evident in experiment 1, while in experiment 3 the diameter of the clone “Pannonia” differed significantly from the other clones (Table 1).

Table 1. Tree diameters of the tested poplar clones

Clone	d (LSD _{gxe} =1.11)								
	Experiment 1			Experiment 2			Experiment 3		
	d _s (cm)	C _v	Duncan	d _s (cm)	C _v	Duncan	d _s (cm)	C _v	Duncan
B 81	16.13	2.05	bcd	13.43	2.46	ef	16.93	1.95	abc
Pannonia	13.63	2.42	e	11.50	2.87	h	15.37	2.15	d
182/81	13.90	2.38	e	11.80	2.80	gh	16.47	2.01	abcd
B 229	15.93	2.07	cd	12.40	2.66	fgh	16.87	1.96	abc
PE 19/66	17.57	1.88	a	12.80	2.58	efg	17.20	1.92	ab
average									
LSD=1.24	15.43	1.33	a	12.39	1.66	b	16.57	1.24	a

Tree heights in the experiment 2 (12.67 m) were significantly lower compared to the other two experiments (14.57 and 14.78 m). The most significant differences between genotypes are determined between the clones “Pannonia” (*Populus x euramericana*) and B-81 (*Populus deltoides*) in the experiments 3 and 2 at the localities Banov Brod and Kupinske Grede 43/2. In these experiments, the clone “Pannonia“ attained the maximal tree heights. The results of Duncan test of the study clone diameter and height regardless of the site also indicate that the maximal heights were attained by the clones “Pannonia” (*Populus x euramericana*) and PE 19/66 (*Populus deltoides*), while the maximal diameters were attained by the clones PE 19/66 and B-81 (*Populus deltoides*) (Table 2).

Table 2. Tree heights of the tested poplar clones

Clone	h (LSD _{gxc} =0.91)								
	Kupinske Grede 43/1			Kupinske Grede 43/2			Banov Brod		
	h _s (m)	C _v	Duncan	h _s (m)	C _v	Duncan	h _s (m)	C _v	Duncan
B 81	14.40	1.94	b	12.17	2.29	e	14.60	1.91	b
Pannonia	14.77	1.89	ab	13.37	2.09	cd	15.60	1.79	a
182/81	14.10	1.98	bc	12.67	2.20	de	14.23	1.96	bc
B 229	14.73	1.89	ab	12.53	2.23	de	14.57	1.91	bc
PE 19/66	14.87	1.88	ab	12.50	2.23	de	14.90	1.87	ab
Average									
LSD=1.24	14.57	1.40	a	12.65	1.61	b	14.78	1.38	a

DISCUSSION

Although the experiments were established with several planting spaces, the first information indicate that the candidate clone PE 19/66 had the greatest vigour on the optimal soil types (humofluvisol and fluvisol loamy form), while the candidate clone B-81 had the advantage on the less favoured soil type (meadow black soil on loess alluvium).

Based on the attained diameters and heights, it can be concluded that these are the successfully established plantations and that the candidate clones showed significant genetic potentials, which points to the fact that in future the production of poplar wood volume can be significantly increased. It is particularly significant that the experiments were established on different soil types, so that this provided the first information on the clone adaptability.

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REFERENCES

- ANDERSON H.W., C.S. PAPDOPOL and L ZSUFFA (1983): Wood energy plantations in temperature climates. *Forest Ecology and Management* 6: 281-306
- CAIN N.P. and D. P. ORMORD (1984): Hybrid vigor as indicated by early growth characteristics of *Populus deltoides*, *P. nigra*, and *P. x euramericana*. *Canadian Journal of Botany* 62: 1-8.
- CEULEMANS R., I IMPENS and V.STEENACKERS (1987): Variations in photosynthetic, anatomical and enzymatic leaf traits and correlations with growth in recently selected *Populus* hybrids. *Canadian Journal of Forest Research* 17: 273-283
- DICKMANN D.I., M.A. GOLD and J.A. FLORE (1994): The ideotype concept and the genetic improvement of tree crops. *Plant Breeding Reviews* 12:163-193

- FEGE A.S. (1987): Evaluation of researcher 's decision in short rotation forestry. *Forest Science* 33: 30-42
- GUZINA V., Z.TOMOVIĆ and S.ORLOVIĆ (1991): Pregled rezultata testiranja klonova crnih topola (sekcija *Aigeiros*) na području Vojvodine. *Radovi Instituta za topolarstvo* 24: 5-18
- HERPKA I. (1986): Rezultati testiranja klonova topola i vrba u oglednim zasadima. *Radovi Instituta za topolarstvo* 16: 7-24
- HERPKA I. (1988): Selection of high productive poplar clone for biomass production in short – rotation. 5th European Conference Biomass for Energy and Industries, Lisbon.
- IVANIŠEVIĆ P. (1991): Fizičke i vodno-vazdušne osobine zemljišta u šumama topola i vrba u inundaciji Tamiša, Zbornik radova, Knjiga 24, str.39-58, Institut za topolarstvo, Novi Sad
- MARKOVIĆ J., I.HERPKA and V. GUZINA (1986): Izbor sorte (klona). U “Topole i vrbe u Jugoslaviji”, Institut za topolarstvo Novi Sad
- ORLOVIĆ S., V. GUZINA, B. KRSTIĆ and Lj.MERKULOV (1986): Genetic variability in anatomical, physiological and growth characteristics of hybrid poplar (*Populus x euramericana* Dode (Guinier)) and eastern cottonwood (*Populus deltoides* Bartr.) clones. *Silvae Genetica* 47 (4): 183-190
- STETTLER R.F., R.C FENN, P.E. HEILMAN and B.J. STANTON (1988): *Populus trichocarpa x Populus deltoides* hybrids for short rotation culture: Variation patterns and 4-year field performance. *Canadian Journal of Forest Research* 18: 745
- STETTLER R.F., H.D. JR BRADSHAW and L ZSUFFA (1992): The role of genetic improvement in short rotation forestry. In *Ecophysiology of short rotation forest crops*. Editors: Mitchell, J.B., Ford-Robertson, J.B., Hinckley, T., Sennerby-Forsse, L. Elsevier Applied Sciences, London and New York. p.
- ŠUMAKOV S.V. (1960): Zemljišni uslovi u kulturama topola na rečnom poloju (Sava-Sr. Mitrovica i Drava-Varaždin), Jugoslov. savetodavni centar za polj. i šumarstvo, br. 23, Beograd
- ŽIVANOV N. (1970): Prilog izučavanju prirasta klona I-214 na zemljištima različitih vodno-fizičkih svojstava, Magistarski rad, Institut za topolarstvo, Novi Sad
- ŽIVANOV N. (1977): Osobine aluvijalnih zemljišta i njihov značaj za taksacione elemente *Populus x euramericana* (Dode) Guinier, cl. I-214, Doktorska disertacija, Institut za topolarstvo, Novi Sad
- ŽIVANOV N. (1979): Zemljišta za gajenje topola i vrba, “Topola”, Bilten JNK T br. 123-124, 43-52, Beograd
- ŽIVANOV N. (1982): Varijabilnost svojstava aluvijalnih zemljišta i njihov značaj za proizvodnju topola, “Topola”, Bilten JNK T br. 133-134, str. 41-48, Beograd
- ŽIVANOV, N. and P. IVANIŠEVIĆ (1985): Značaj prostorne varijabilnosti aluvijalnih zemljišta za razvoj topola osnovanih postupkom duboke sadnje, Zbornik radova, Knjiga 16, str 51-66, Institut za topolarstvo, Novi Sad
- ŽIVKOVIĆ B., V. NEJGEBAUER, Đ.TANASIJEVIĆ, N MILJKOVIĆ., L.STOJKOVIĆ and P.DREZGIĆ (1972): Zemljišta Vojvodine, str. 684, Institut za poljoprivredna istraživanja, Novi Sad

REZULTATI TESTIRANJA KLONOVA TOPOLA U POLJSKIM OGLEDIMA

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I z v o d

Istraživana je bujnost rasta 7 klonova topola i to 5 klonova kandidata za priznavanje (B-81, B-229, PE 19/66, 182/81 i 129/8) i 2 klonske sorte (I-214 i "Pannonia") koje su priznate ranije. Istraživani klonovi topola su bili sledeće taksonomske pripadnosti: B-81 (*Populus deltoides*), B-229 (*Populus deltoides*), PE 19/66 (*Populus deltoides*), 182/81 (*Populus deltoides*), 129/81 (*Populus x euramericana*), I-214 (*Populus x euramericana*) and "Pannonia" (*Populus x euramericana*). Istraživanja su obavljena u tri poljska ogleda koji su osnovani 2002. godine na području Šumskog gazdinstva Sremska Mitrovica. Iako su ogledi osnovani u više razmaka sadnje prve informacije ipak upućuju na to da se na optimalnim tipovima zemljišta (humofluvisol i fluvisol forma ilovasta) najbolje pokazao klon kandidat PE 19/66 dok je na manje odgovarajućem tipu zemljišta (livadska crnica na lesoaluvijumu) u prednosti bio klon kandidat B-81. Prema postignutim prečnicima i visinama može se konstatovati da se radi o zasadima koji su uspešno osnovani i da su klonovi kandidati ispoljili značajne genetske potencijale što upućuje na to da će se u budućnosti moći značajnije povećati proizvodnja drvne mase topola.

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