

Preliminary results of research on main growth characteristics of different poplar clones in ecological conditions of Východoslovenská Lowland

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ABSTRACT: Height and diameter growth and volume production of 22 different clones of poplars were evaluated in Sliepkovce populetum at the age of 12 years. The populetum is situated on medium-heavy and medium humic uninundated alluvia of the Laborec river; typologically, the group of forest types is *Ulmeto-Fraxinetum populeum*. The results of evaluation documented that among the poplars under study the clones Gigant, OP-229 and BL achieved the best growth and maximum volume production while their mean height amounted to 22.9–23.8 m, mean diameter to 31.9–33.2 cm and average annual volume increment was 25.1–28.3 m³ per 1 ha. The growth of *P. Rochester 20/66* poplar was considerably much slower: its mean height amounted to 17.3 m, mean diameter to 18.7 cm and average annual volume increment was 6.3 m³ per 1 ha. It will be necessary to carry out further studies to obtain more detailed values for these clones.

Keywords: poplars; height and diameter growth; volume production; Východoslovenská Lowland

The study and evaluation of growth characteristics of new poplar clones are of great importance in order to ensure high wood production of lowland forests. The results of such evaluation that is carried out in populeta as well as on permanent research plots are applicable to choose the most suitable clones for particular types of localities and different silvicultural methods. The growth characteristics of poplars have been studied in many countries for a long time, especially in countries with advanced poplar management. Well-trying clones of black, white and balsam poplars with high volume production and good health are available on the basis of research results that were obtained in Italy, Netherlands, France, Hungary, Poland, Yugoslavia, Czech Republic and in other countries. In the Netherlands the productivity of poplars *Androscogin* and *Dorschkamp* is high while clones of balsam poplars are productive in France, and particularly *I-214* among the Italian poplars (VAN DER MEIDEN 1961; POURTET 1969; GIORDANO 1970; HEJMANOWSKI 1975; KERESZTESI et al. 1978; SEKAWIN 1979; BONDOR 1978; KNEŽEVIČ 1980; ZSOMBOR 1981; TÓTH, SZEMERÉDY 1982; WEISGERBER 1984; HALUPA, TÓTH 1988; ČÍŽEK et al. 1992, etc.).

The first results of evaluation of growth characteristics in poplars in Slovakia were published by VOJTUŠ (1970, 1978). Ecological and growth characteristics of different poplar clones in populeta were evaluated by KOHÁN (1981, 1988, 1998) and VARGA (1982, 1990). The results of these studies were applied to choose suitable poplar clones for silvicultural systems in the conditions of Slovakia.

It is to assume from hitherto experience that tested clones will contribute to an enlargement of the assortment of regionalized clones and will provide for maximum production of poplar stands in this country. It will also be possible to fulfil other social functions of poplar plantations in Slovakia.

MATERIAL AND METHOD

Growth and volume production of 22 different poplar clones were evaluated at the age of 12 years; of them, 16 clones are classified to the *Aigeiros* group: *Pannonia*, *Guarento*, *Robusta*, *Gigant*, *Sárvár 201/68*, *P. deltooides 63/51* × *P. nigra* (Baka 5), *P. deltooides A-37*, Lux, *P. deltooides* × *D. 37W-1-4*, *P. angulata T.* × *P. nigra* (Vinohr. n/V. 75), *P. deltooides* × *P. nigra* (Vinohr. n/V. 75), BL, *P. 79-45*, *OP-229*, *P. PC 74-203-41* and *P. T-PC-3*. *P. Rochester 20/66* and *P-275* belong to the *Tacamahaca* group and *P. VI-15-7*, *P. 79-54*, *P. 79-50* and *P. 97-55* are inter-American poplars.

Well-developed and healthy one-year poplar plants of average height 1.90 m were set out at a square spacing of 5 × 5 m on a plot with full-area soil preparation: 4 plants of each poplar clone were used at four replications, i.e. 16 plants on the area of 400 m². Total area of the populetum was 8,800 m². Full-area mechanical cultivation of soil was performed on the whole plot every year from its establishment, and young trees were hoed individually in the first three years. Tending measures included systematic treatment of crowns until the 4th year and poplar pruning

in the subsequent years. No thinnings have been necessary until now because the stand is relatively young.

In the course of biometrical measurements heights of all trees were measured to the nearest 0.5 m and diameters to the nearest to 0.5 cm. Data processing provided mean height and mean diameter, standing volume, mean stem volume and average annual increments. The volume of large timber was calculated according to KORSUNĚ's volume tables (1967).

Evaluation of this research object is so important because besides Robusta poplar 19 poplar clones, mostly new bred ones, are evaluated that have not been grown in the Východoslovenská Lowland before now. Therefore the ecological conditions of the area concerned should also be evaluated.

CHARACTERISTICS AND EVALUATION OF ECOLOGICAL CONDITIONS

The Sliepkovce populetum is situated in Michalovce district on uninundated alluvia of the valley course of the Laborec river, in Bodrog watershed. Climatically, the area is warm, moderately dry, with cold winter. Average air temperature registered at Michalovce meteorological

station is 9.1°C, and 16.1°C in the growing season. Growing season lasts 200–220 days. Average number of summer days is 67.2 while the sunshine length is on average 1,916 hours/year, so the conditions are suitable for such clones that require light and warmth. Average annual precipitation sum is 591 mm; of it, 352 mm is rainfall in the growing season: it is often a torrential rain the vegetation cover can utilize very little, therefore cultural practices during poplar growing in intensive systems are very important.

Soil type is deep typical Gleysol: it is medium-heavy loamy, medium humic, with lower content of available nutrients, especially N, P₂O₅, K₂O, soil reaction is weakly alkaline. The groundwater level is at a depth of 2.0–2.5 m, that means it decreased by about 0.5 m against the level before a hydrological measure was taken. Typologically, the group of forest types is *Ulmeto-Fraxineum populeum*, the forest type is elm-ash wood with poplar and nettle.

The description of ecological conditions shows that the research plot represents favorable site, soil, climatic and hydrological conditions suitable for demanding poplar clones in case the principles of an intensive management system are consistently applied. As they account for 18% of forest lands

Table 1. Height and diameter growth of poplar clones at the age of 12 years

Clone	Mean height			Average height increment (m)	Mean diameter			Average diameter increment (cm)
	order	(m)	(%)		order	(cm)	(%)	
Gigant	1	23.8	100.0	1.98	1	33.2	100.0	2.76
OP-229	2	23.4	98.3	1.95	2	32.6	98.2	2.71
BL	3	22.9	96.2	1.90	3	31.9	96.1	2.66
Pannonia	4	22.6	94.9	1.88	6	27.0	81.0	2.25
Guarento	5	22.3	93.7	1.85	4	28.7	86.4	2.39
Robusta	6	22.0	92.4	1.83	14	24.1	72.6	2.01
Sárvár 201/68	7	21.8	91.6	1.82	5	27.8	83.7	2.32
P. PC-74-203-41	8	21.5	90.3	1.79	9	25.8	77.7	2.15
P. 79-54	9	21.3	89.5	1.77	10	25.6	77.1	2.13
P-275	10	21.1	88.6	1.76	7	26.4	79.5	2.20
<i>P. deltoides</i> 63/51 × <i>P. nigra</i> (Baka 5)	11	20.9	87.8	1.74	13	24.3	73.2	2.02
<i>P. deltoides</i> × <i>P. nigra</i> (Vínohr. n/V. 75)	12	20.7	87.0	1.72	8	26.0	78.3	2.16
P. 79-45	13	20.6	86.6	1.72	16	23.5	70.8	1.96
<i>P. angulata</i> T. × <i>P. nigra</i> (Vínohr. n/V. 75)	14	20.5	86.1	1.70	17	23.3	70.2	1.94
<i>P. deltoides</i> A-37	15	20.4	85.7	1.70	15	23.7	71.4	1.97
P. 79-50	16	20.2	84.9	1.68	11	25.3	76.2	2.11
<i>P. deltoides</i> × D 37 W-1-4	17	20.1	84.5	1.67	18	23.0	69.3	1.92
P. 97-55	18	20.0	84.0	1.66	20	22.3	67.7	1.86
P. T-PC-3	19	19.8	83.2	1.65	12	25.0	75.3	2.08
Lux	20	19.5	81.9	1.62	21	21.4	64.4	1.78
P. VI-15-7	21	19.2	80.7	1.60	19	22.6	68.1	1.88
P. Rochester 20/66	22	17.3	72.7	1.44	22	18.7	56.3	1.56

in the Východoslovenská Lowland, the results of our research can be applied in a large part of the territory concerned.

RESULTS AND DISCUSSION

Table 1 shows mean height and mean diameter, average annual height and diameter increment of poplars at the age of 12 years; absolute and percentage values are given. The respective value of a poplar with best height and/or diameter growth is always taken as 100%. The values in the table indicate that height growth was best in Gigant poplar whose mean height was 23.8 m and average annual height increment 1.98 m. It is followed by OP-229, BL, Pannonia and Guarento: the mean height of these poplars exceeds 22.0 m and their average height increment ranges from 1.85 to 1.95 m. The growth of poplar clone P. Rochester 20/66 considerably lags behind: its mean height is 17.3 m only and average height increment 1.44 m. If the mean height value of Gigant poplar is taken as 100%, the mean height values of the poplars OP-229, BL, Pannonia and Guarento are in the range of 93.7 to 98.3% while in P. Rochester 20/66 poplar it is 72.7% only. Percentage values of the other poplars range from 80.7 to 92.4%.

Table 1 also documents the best diameter growth in Gigant, OP-229, BL, whose mean diameter is in the range of 31.9 to 33.2 cm, i.e. it is larger than 30 cm at the age of 12 years; it can be considered as an optimum result in the given ecological conditions. It is to note that the above-mentioned three clones achieved the best mean height at the given age and in the same order. Analogically to the smallest mean height, P. Rochester 20/66 had the worst mean diameter, 18.7 cm only; it is 56.3% if compared with Gigant poplar. The mean diameter of the other poplars, not mentioned in this evaluation yet, ranges from 22.6 cm (P. VI-15-7) to 28.7 cm (Guarento). Average annual diameter increment of poplar clones under study ranges between 1.56 cm (P. Rochester 20/66) and 2.76 cm (Gigant). In comparison with Gigant, whose diameter growth was the best of all (33.2 cm) and which is taken as 100%, the mean diameter value of the other poplars amounts to 56.3% (P. Rochester 20/66) to 98.2% (OP-229). It is remarkable that the percentage difference between Gigant with best diameter growth and the other poplars under study is considerably larger than that in height growth.

Standing volume and average annual volume increment per 1 ha according to large timber volume are documented

Table 2. Volume production of poplar clones at the age of 12 years

Clone	Standing volume			Average volume increment (m ³ /ha)	Mean stem volume			Average mean stem increment (m ³)
	order	(m ³ /ha)	(%)		order	(m ³)	(%)	
Gigant	1	339.6	100.0	28.3	1	0.849	100.0	0.071
OP-229	2	318.0	93.6	26.5	2	0.795	93.6	0.066
BL	3	300.8	88.6	25.1	3	0.752	88.6	0.063
Guarento	4	236.6	69.7	19.7	4	0.591	69.6	0.049
Sárvár 201/68	5	216.4	63.7	18.0	5	0.541	63.7	0.045
Pannonia	6	207.8	61.2	17.3	6	0.519	61.1	0.043
P-275	7	200.4	59.0	16.7	7	0.501	59.0	0.042
P. 79-54	8	194.4	57.2	16.2	8	0.486	57.2	0.041
P. 79-50	9	187.9	55.3	15.7	9	0.470	55.3	0.039
<i>P. deltoides</i> × <i>P. nigra</i> (Vinohr. n/V. 75)	10	187.2	55.1	15.6	10	0.468	55.1	0.039
P. PC-74-203-44	11	185.9	54.7	15.5	11	0.465	54.7	0.038
P. T-PC-3	12	183.6	54.1	15.3	12	0.459	54.1	0.038
Robusta	13	170.8	53.0	14.2	13	0.427	50.3	0.036
<i>P. deltoides</i> 63/51 × <i>P. nigra</i> (Baka 5)	14	157.8	46.4	13.1	14	0.394	46.4	0.033
<i>P. angulata</i> T. × <i>P. nigra</i> (Vinohr. n/V. 75)	15	151.0	44.5	12.6	15	0.377	44.4	0.031
<i>P. deltoides</i> × D-37 W-1-4	16	149.3	43.9	12.4	16	0.373	43.9	0.031
<i>P. deltoides</i> A-37	17	145.5	42.8	12.1	17	0.363	42.8	0.030
P. 79-45	18	141.8	41.7	11.8	18	0.354	41.7	0.029
P. VI-15-7	19	134.6	39.6	11.2	19	0.336	39.6	0.028
P. 97-55	20	133.6	39.3	11.1	20	0.334	39.3	0.028
Lux	21	131.0	38.6	10.9	21	0.327	38.6	0.027
P. Rochester 20/66	22	76.0	22.3	6.3	22	0.190	22.3	0.016

in Table 2. It is evident that among the poplars under study Gigant achieved the highest standing volume (339.6 m³ per 1 ha) and maximum average volume increment (28.3 m³ per 1 ha); it also had maximum mean diameter. It is followed by OP-229 and BL, whose respective standing volumes are 318.0 m³ and 300.8 m³ while their average annual volume increment amounted to 26.5 m³ and 25.1 m³, respectively. Taking into account the volume production of poplars, these values can be considered as optimum in the ecological conditions of Východoslovenská Lowland. On the other hand, the lowest standing volume and average annual volume increment were determined in P. Rochester 20/66: 76.0 m³ and 6.3 m³ per 1 ha. The standing volume of the other poplars that have not been evaluated yet ranges from 131.0 m³ per 1 ha (Lux) to 236.6 m³ (Guarento) per 1 ha, their average annual volume increment is from 10.9 m³ (Lux) to 19.7 m³ (Guarento) per 1 ha. If expressed in percent, it is 38.6–69.7% in relation to 100% of Gigant, which achieved the highest volume production, i.e. highest standing volume, and the highest average annual volume increment.

It is evident from the results of our evaluation that the poplar order with respect to mean stem volume or standing volume does not change. The poplars Gigant, OP-229 and BL, which had maximum standing volume, also had the highest volume of mean stem. The mean stem volume of these poplars ranged from 0.752 m³ (BL) to 0.849 m³ (Gigant). The lowest mean stem volume was recorded in P. Rochester 20/66 – 0.190 m³.

Height and diameter growth of OP-229, BL and Pannonia as well as of standard poplar Robusta was compared with height and diameter growth of poplars that were grown and studied in similar site conditions in Hungary (HALUPA, TÓTH 1988). To compare the results, average annual height and average annual diameter increment of these poplars were used. It can be stated on the basis of the evaluation and comparison that the poplars in Slovakia and in Hungary achieved very similar average annual height increment. On the contrary, the poplars in the Slovak populetum had a slightly higher average annual diameter increment than in Hungary. The difference was 0.25 cm in OP-229, 0.36 cm in BL and 0.16 cm in Pannonia. Standard poplar Robusta also showed a small difference of 0.14 cm.

SUMMARY

Height and diameter growth and volume production of 22 different, mostly new poplar clones were evaluated in Sliepkovce populetum at 12 years of age. The populetum lies on medium-heavy unundated alluvia of the Laborec river. Typologically, the group of forest types on this plot is *Ulmeto-Fraxinetum populeum*, forest type is elm-ash wood with poplar and nettle. One-year plants of average height 1.90 m were used to establish the research object where mechanical cultivation of soil has been carried out on the whole plot every year until now; other measures were crown treatment and tree pruning under an intensive management system.

The results of evaluation show that the poplar clone Gigant achieved the best height and diameter growth as well as maximum volume production: at the age of 12 years its mean height is 23.8 m, mean diameter 33.2 cm and average annual volume increment 28.3 m³ per 1 ha. Good growth and high volume production were determined in OP-229, BL, Guarento, Pannonia and Sárvár 201/68, whose mean height ranged from 21.8 to 23.4 m, mean diameter from 27.8 to 32.6 cm and average annual volume increment from 17.3 to 26.5 m³ per 1 ha. P. Rochester, whose mean height was 17.3 m, mean diameter 18.7 cm and average annual volume increment 6.3 m³ per 1 ha, considerably lagged behind with its growth and production.

As new poplar clones were mostly tested that had not been grown in this region until then and since the age of poplars is relatively low, it will be necessary to continue this research. The results document that the above-mentioned poplars achieve better results than the poplars grown before now. It is realistic to assume that it will be possible to choose the most suitable clones for further use in the 20th year of age, which is preliminarily considered as maturity age, and to enlarge the assortment of promising and/or regionalized poplars for the region of Východoslovenská Lowland.

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Predbežné výsledky výskumu hlavných rastových vlastností rozličných klonov topoľov v ekologických podmienkach Východoslovenskej nížiny

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ABSTRAKT: Hodnotenie výškového a hrúbkového rastu ako aj objemovej produkcie 22 rozličných klonov topoľov sa vykonalo na populeťe Sliepkovec vo veku 12 rokov. Populeťum leží na stredne ťažkých a stredne humózných nezaplavovaných alúviach Laborca a typologicky patrí do skupiny lesných typov *Ulmeto-Fraxinetum populeum*. Výsledky hodnotenia ukázali, že najlepší rast a maximálnu objemovú produkciu zo sledovaných topoľov dosiahli klony Gigant, OP-229 a BL, ktorých stredná výška dosahuje 22,9–23,8 m, stredná hrúbka 31,9–33,2 cm, kým priemerný ročný objemový prírastok 25,1–28,3 m³ na 1 ha. Rastove značne zaostáva najmä topoľ P. Rochester 20/66, ktorý vykazuje strednú výšku 17,3 m, strednú hrúbku 18,7 cm a priemerný ročný objemový prírastok 6,3 m³ na 1 ha. Tieto výsledky bude potrebné ďalším sledovaním doplniť a upresniť.

Kľúčové slová: topole; výškový a hrúbkový rast; objemová produkcia; Východoslovenská nížina

V práci sa hodnotí rast a objemová produkcia 22 rozličných klonov topoľov, a to Pannonia, Guarento, Robusta, Gigant, Sárvár 201/68, *P. deltoides* 32/51 × *P. nigra* (Baka 5), *P. deltoides* A-37, Lux, *P. deltoides* × D 37 W-1-4, *P. angulata* T. × *P. nigra* (Vínohr. n/V. 75), *P. deltoides* × *P. nigra* (Vínohr. n/V. 75), BL, P. 79-45, OP-229, P. PC. 74-230-41, P. T-PC-3, P. Rochester 20/66, P-275, P. VI-15-7, P. 79-54, P. 79-50 a P. 97-55 na populeťe Sliepkovec vo veku 12 rokov. Populeťum leží na stredne ťažkých nezaplavovaných alúviach Laborca v povodí Bodrogu na Východoslovenskej nížine. Typologicky patrí do skupiny lesných typov *Ulmeto-Fraxinetum populeum*.

Z výsledkov hodnotenia vyplýva, že zo sledovaných topoľov najlepší výškový a hrúbkový rast ako aj maximálnu objemovú produkciu dosiahol topoľ Gigant, ktorý v 12. roku vykazuje strednú výšku 23,8 m, strednú hrúbku

33,2 cm, zásobu 339,6 m³ na 1 ha a priemerný ročný objemový prírastok 28,30 m³ na 1 ha ako aj 0,849 m³ objem stredného kmeňa. Dobrý výškový a hrúbkový rast ako aj vysokú objemovú produkciu dosiahli aj topole OP-229, BL, Guarento, Pannonia a Sárvár 201/68, ktorých stredná výška sa pohybuje v medziach od 21,8 m do 23,4 m, stredná hrúbka od 27,8 cm do 32,6 cm, kým ich priemerný ročný objemový prírastok od 17,3 m³ do 26,5 m³ na 1 ha a objem stredného kmeňa od 0,519 m³ do 0,795 m³. Naproti tomu rastovo značne zaostáva najmä topoľ P. Rochester 20/66, ktorý vykazuje strednú výšku 17,3 m, strednú hrúbku 18,7 cm, priemerný ročný objemový prírastok 6,3 m³ na 1 ha a objem stredného kmeňa 0,190 m³.

Hodnotenie nášho výskumu ukázalo, že dosiahnuté výsledky v ekologických podmienkach záujmovej oblasti môžeme pokladať za veľmi priaznivé.

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