

CULTIVATION OF THE INTRODUCED *SALIX* PLANTS IN PLANTATIONS

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In 2006 in a short rotation coppice plants of 3 *Salix* L. varieties – ‘Gudrun’, ‘Tora’ and ‘Tordis’, were planted in sod-podzolic sandy loam soil and sod-podzolic sandy loam fertilized with sewage sludge compost; cuttings prepared from refrigerated shoots were used. ‘Tordis’ cuttings prepared from freshly cut shoots were also planted. Dendrometric parameters of *Salix* varieties in 2006–2007 were influenced by the time of cuttings’ preparation. The plants grew better in sod-podzolic sandy loam fertilized with sewage sludge compost.

Key words: *Salix*, cuttings, annual shoots, hydrothermal coefficient

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INTRODUCTION

In the production of energy from local and renewable resources, the energy obtained from biomass, i.e. timber and straw, makes the largest portion; its amount could be further increased by cultivating certain energy plants (Liubarskis, 2006). These could be willows (Smaliukas, 1996; Smaliukas et al., 2004), poplars, orchard grass, sunroot, cannabis, rye, etc. The introduced *Salix* varieties ‘Jorr’, ‘Tora’, ‘Torhild’, ‘Sven’, ‘Olof’, ‘Gudrun’, ‘Tordis’, ‘Inger’, ‘Doris’, ‘Karin’ are mostly recommended. Energy plants are cultivated in sites with poor soils, that are not suitable for food and fodder plants. Such infertile soils could be fertilized with sediments from water treatment facilities (Gradeckas, 2001; Stackevičienė, 1997) or with sewage sludge compost.

Objects of the present research – ‘Gudrun’ (*S. dasyclados* ‘Helga’ × *S. viminalis*), ‘Tordis’ (*S.*

schwerinii × *S. viminalis*) × *S. viminalis*), ‘Tora’ (*S. schwerinii* × *S. viminalis*) varieties.

METHODS

A short rotation coppice at the Field Experimental Station of the Institute of Botany was established in 2006. *Salix* varieties ‘Gudrun’, ‘Tora’ and ‘Tordis’ were obtained from the company „Agrobränsle“. Cuttings of these varieties, prepared from refrigerated shoots, were planted in sod-podzolic sandy loam soil (K, I variant) and sod-podzolic sandy loam fertilized with sewage sludge compost (SSC) (II variant). ‘Tordis’ cuttings prepared from freshly cut shoots were planted in sod-podzolic sandy loam soil (III variant) and sod-podzolic sandy loam fertilized with sewage sludge compost (SSC) (IV variant). Sewage sludge compost prepared from Vilnius city sewage was used during the investigation; it was introduced into soil in autumn of 2005;

fertilization rate – 60 t/ha. The willows in the coppice were planted in April. Willow cuttings of 18–20 cm were planted in double rows, distance between them – 75 cm, distance between cuttings – 65 cm. Distance between double rows – 1.5 m.

For investigations of the productivity of annual shoots in 2006 and of new shoots in 2007, the methods of model plant trials were applied (Klein & Klein, 1974). The data were statistically processed (Zaicev, 1984) – average value and deviation error ($\bar{x} \pm S_x$), as well as variation coefficient (V) were calculated. The soil analysis was performed at the Sector of Chemical Analyses of the Institute of Botany. pH was determined by potentiometry method (ISO 10390: 1994), mobile phosphorus – calculated photometrically (GOST 26207-84), total nitrogen concentration – photometrically (GOST 26107-84), mobile potassium – by flame photometry (GOST 26207-84), humus – using the oxidation method (GOST 26213-84). Meteorological conditions are presented according to the data of agrometeorological bulletins of Vilnius Meteorological station (Skeiveliene, 2006, 2007).

RESULTS AND DISCUSSION

Sod-podzolic sandy loam soil of the trial field was characterized by low nitrogen (0.139 %) and potassium (79.7 mg/kg) amounts, but it was

particularly phosphorus-rich (443.2 mg/kg) (Table 1). After fertilization with SSC, the amount of nitrogen increased and reached medium values (0.254 %), and the phosphorus amount increased by three times (1360.3 mg/kg). Although in the fertilized sod-podzolic sandy loam the amount of potassium increased, still the soil remained of medium potassium amount (132.3 mg/kg). The sod-podzolic sandy loam was characterized by medium content of humus (2.13 %), and the soil fertilized with SSC – by very high humus content (3.72 %). SSC produced no evident impact upon the soil pH changes (Table 1).

In April of 2006 the precipitation amount was 30 mm, and during the third decade – only 2 mm. June was also dry (hydrothermal coefficient HTC 0.42); July was somewhat more humid (HTC 0.71). Conditions in August were most favourable for the growth of willows (HTK 2.79). In April of 2007 the precipitation amount was 20 mm; reaching only 43 % of the average many year rate. In May, June and July hydrothermal parameters for willow growth were more favourable than in 2006, while during August and September – less favourable. Despite that, average hydrothermal parameters of individual development phases were similar in both 2006 and 2007 (Fig. 1).

In 2006 in sod-podzolic sandy loam soil (I var.) at the end of vegetation period the average height of shrub of the variety ‘Gudrun’ was 63.7 cm; it consisted of only one shoot on average. In soil fertilized with SSC (II var.) shrubs of this variety were almost twice higher (130.5 cm on average); the average number of annual shoots was 1.5; their average length was 118.9 cm (Table 2). In 2007, in the trial of the I var. ‘Gudrun’ shrubs were almost twice higher than in 2006 (116.7 cm on average); the number of new shoots was also twice higher (1.9 on average); their average length – 96.6 cm. In 2007, in soil fertilized with SSC (II var.) ‘Gudrun’ shrubs were by 1.7 times higher (196.0 cm on average) than in the trial of the I var.; the number of new shoots was by 2.5 times higher; their average length – 158.8 cm (Table 2).

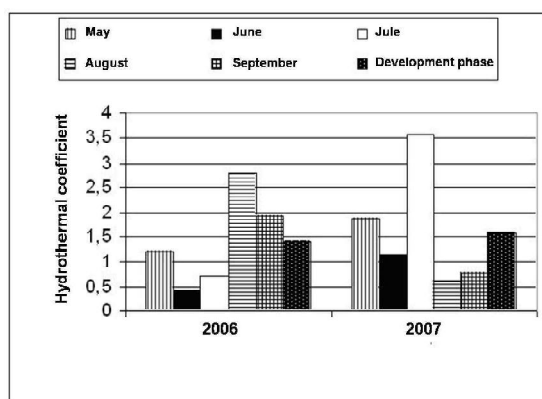


Fig. 1. Hydrothermal coefficients during 2006–2007

Table 1. Amounts of nutritious matter in soil of *Salix* trial field

Soil	N total, %	P ₂ O ₅ mobile, mg/kg	K ₂ O mobile, mg/kg	Humus, %	pH _{KCl}
Sod-podzolic sandy loam	0.139	443.2	79.7	2.13	6.78
Sod-podzolic sandy loam fertilized with sewage sludge compost	0.254	1360.3	132.2	3.72	6.61

In 2006 in sod-podzolic sandy loam soil (I var.) the average height of ‘Tora’ variety shrub reached 62.2 cm, the average number of annual shoots was 1.0 per shrub; its average length – 62.2 cm. Fertilization with SSC considerably influenced the growth of ‘Tora’ shrubs: they were by 2.5 times higher (157.8 cm on average), formed 2.7 annual shoots per shrub, and their average length was by 2.3 times larger (143.5 cm on average) than in the trial of the I var. In 2007 the shrubs in the trial of the I var. were up to 2.3 times higher (157.8 cm on average) than in 2006, but the number of new shoots was only by 1.6 times higher; their average length was 155.7 cm. In the trial of the II var. (fertilized with SSC) the shrubs were high – 274.7 cm on average. Up to 5.0 new shoots formed per shrub; their average length was 204.9 cm (Table 2). Shrubs of this variety were higher than ‘Gudrun’, but dendrometric parameters were worse than of ‘Tordis’ plants.

In 2006 the ‘Tordis’ variety shrubs grown from cuttings prepared from refrigerated shoots and planted in sod-podzolic sandy loam soil (I var.)

were the highest comparing with other varieties – 83.5 cm on average. In this trial variant the plants formed 1.2 annual shoots per shrub on average, and they were longer than of other varieties (80.3 cm on average). In the trial of the II var. (fertilized with SSC), the ‘Tordis’ shrubs were by 2.8 times higher (234.6 cm on average) than in the I var. Although, the average number of shoots was 1.6 per shrub, but they were long (213.8 cm on average). ‘Tordis’ shrubs grown from cuttings prepared from freshly cut shoots and planted in sod-podzolic sandy loam soil (III var.) were by 1.6 times higher than in the trial of the I var. (131.9 cm on average), annual shoots – by 1.4 times longer (110.2 cm on average), their number was by 1.7 times higher. Dendrometric parameters of ‘Tordis’ shrubs in the trial of the IV var. equaled to the ones in the II var., but significantly exceeded the I var. Therefore the impact of the period of cutting preparation and fertilization with SSC during the first years of cultivation is evident.

In 2007 the height of shrubs differed depending upon the trial variant – from 242.3 cm (I var.) to 344.7 (IV var.) cm. In the trial of the I var. the

Table 2. Dendrometric characteristics of the studied *Salix* plants in 2006–2007

Variety	Variant	Year	Shrub height, cm		Annual shoot length, cm		Annual shoot number	
			$\bar{x} \pm S_x$	Vc, %	$\bar{x} \pm S_x$	Vc, %	$\bar{x} \pm S_x$	Vc, %
‘Gudrun’	K (I var.)	2006	63.7±3.3	18.5	63.7±3.3	18.5	1.0±0	
	II var.		130.5±4.4	18.0	118.9±4.0	14.6	1.5±0.1	15.9
	K (I var.)	2007	116.7±4.4	18.3	96.6±3.5	13.2	1.9±0.2	20.8
	II var.		196.0±5.7	18.4	158.8±5.3	16.5	5.0±0.2	14.7
‘Tora’	K (I var.)	2006	62.6±4.1	18.4	62.2±4.1	18.4	1.0±0	
	II var.		157.8±6.9	18.2	143.5±5.2	13.7	2.7±0.1	13.5
	K (I var.)	2007	192.8±7.5	18.3	155.7±8.3	14.3	1.6±0.2	19.4
	II var.		274.7±11.0	18.2	204.9±10.0	17.5	5.0±0.3	19.2
‘Tordis’	K (I var.)	2006	83.5±4.1	18.2	80.3±3.5	16.2	1.2±0.1	18.6
	II var.		234±6.9	18.3	213.8±7.0	12.7	1.6±0.1	19.1
	III var.		131.9±8.8	18.0	110.2±6.6	13.0	2.0±0.1	17.9
	IV var.		243.5±8.9	18.9	226.9±6.2	14.8	2.1±0.1	13.5
	K (I var.)	2007	242.3±8.0	18.3	183.3±8.4	12.7	2.1±0.2	19.4
	II var.		321.0±8.5	18.2	240.5±11.0	17.6	4.6±0.4	20.2
	III var.		308.0±10.5	18.3	212.0±7.8	9.7	3.5±0.4	19.5
	IV var.		344.7±4.5	18.2	261.8±8.1	16.7	5.2±0.2	14.9

shrubs were lowest, new shoots were shortest, and their number per shrub was smallest. 'Tordis' shrubs grown from cuttings prepared from freshly cut shoots and planted in sod-podzolic sandy loam soil (III var.) comparing with trial in the I var. were by 1.3 times higher (308.0 cm on average), formed by 1.7 times more new shoots per shrub (3.5 on average) which were by 1.2 times longer (212.0 cm on average). The most significant impact of the time of cutting preparation and fertilization with sewage sludge compost was observed in the IV var.; there all dendrometric parameters were the best (Table 2). Besides, in the period of 2006–2007 dendrometric parameters of 'Tordis' plants exceeded all other tested varieties.

CONCLUSIONS

Fertilization with sewage sludge compost influenced dendrometric parameters of all tested *Salix* varieties;

Shrubs of the 'Tordis' variety grown from cuttings prepared from freshly cut shoots were characterized by the best dendrometric parameters, but in other trial variants plants of this variety were also the highest;

Plants of the variety 'Gudrun' were the lowest during the investigation period of 2006–2007;

'Tordis' could be considered as the most promising and suitable variety for cultivation in south-eastern part of Lithuania; 'Tora' could also be considered as promising variety.

REFERENCES

- Gradeckas A., 2001. Vandenvalo nuotėkų nuosėdų skleidimo būdų įtaka gluosnių energiniams želdiniams išeksploatuotuose durpynuose. – *Ekologija* (Vilnius), 4: 39–44.
- Klein P. M., Klein D. T., 1974. *Metody issledovanija rastenij*. – Moskva.

- Liubarskis V. 2006. *Biokuras kūrykloms*. Raudondvaris. 44 p.
- Skeiveliene D. 2006. *Meteorologinis biuletenis*. Vilnius.
- Skeiveliene D. 2007. *Meteorologinis biuletenis*. Vilnius.
- Smaliukas D., Noreika R., Karalius D., 2004. *Lygialapio (Salix integra) ir kocho (Salix kochiana) karklų hibridų morfologinės ir biologinės savybės ir produktyvumas*. – *Botanica Lithuanica*, Suppl. 6: 45–54.
- Smaliukas D., 1996. *Lietuvos gluosniai (Salix L.): taksonomija, biologija, fitocenologija, biocheminės savybės ir ištekliai*. – Vilnius.
- Stackevičienė E., 1997. *Biogeninių elementų ir sunkiųjų metalų kiekiai nuotekų dumblo tręštame žemapelkės dirvožemyje ir vandenyje*. – *Vilniaus miesto nuotekų dumblo panaudojimas sunaikintoms žemėms rekultivuoti ir tręšti*. 169–182.
- Zaicev G. N., 1954. *Matematičeskaja statistika v eksperimental'noj botanike*. – Moskva.

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