Genetic resources, clonal selection and estimation of productivity of valuable clones of purple willow (*Salix purpurea* L.)

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Four new forms of purple willow (*Salix purpurea*) (*f. rubra, f. lutea, f. viridis* and *f. sphaerica*) were found and described in wild flora of Lithuania. Thirty-two clones were selected from introduced and local taxons of purple willow *f. majak, f. busulukensis* and cv 'Gracilis'. The individual variation of traits in purple willow was indicated after bio-morphological analysis of 16 promising clones. It was established that the rich yield of high quality sprouts was characteristic of the clones *S. purpurea f. rubra* cl. 9618, *S. purpurea* 'Gracilis' cl. 9629 and *S. purpurea f. purpurea* cl. 9639.

Key words: *Salicaceae*, *Salix purpurea*, genetic resources, clonal selection

INTRODUCTION

Growing of willows is unique in the practice of cultivation of woody plants and has much in common with cultivation of crops [1, 2]. At first, interest was attracted to tanning matter of willows, later interest was directed to willow as raw material for trade of wicker and to accumulate energy in wood. It was difficult to satisfy the increasing demand of the developing industry of wicker for thin withes of high quality from natural habitats. The necessity arose to establish a plantation of willows. To this end, investigations aimed at revealing the genetic resources of willow species distributed in wild flora of Lithuania flora were started, with the aim to find the most valuable species, to estimate the genetic recourses and to select the most productive clones suitable for cultivation. Purple willow (*Salix purpurea* L.) is a valuable species due to a high technological quality of sprouts for trade of wicker. The aim of the present work was to summarize the data on the genetic recourses of purple willow, distributed in the country, as well as to evaluate the efficiency of introduced and local clones of this species cultivated in plantation and maintained in field collections.

MATERIALS AND METHODS

The genetic resources of purple willow were studied by the method of scientific itinerary expedition. The intraspecific taxonomic diagnosis was performed as described in [3, 4].

The main criteria of clonal selection were height, the number, straightness, character of thinness and branching of stems and sprouts as well as the quality of wood (coloring, flexibility, thickness of wood and pith in cross-section) and resistance to pests, diseases and frosts.

The stationary investigation of selected clones was performed in the field collection formed in industrial plantations of the joint-stock company "Vilda" (Miroslavas, Alytus district). The collection was established in turfy swampy soil with sandy loam, pH 6.2. The content of minerals in the soil: NO_3 15.9 mg/kg, K_2O 86 mg/kg, P_2O_5 85 mg/kg, Ca 1377 mg/kg.

The distance between the plants in a line was 25 cm and the distance between the lines was 70 cm. The soil was fertilized with mineral phosphorus and potassium in autumn, and mineral nitrogen was introduced in spring (N – 50, K – 80, P – 60 kg/ha).

The characteristics of the morphology and productivity of sprouts were estimated as described in [5]. Statistical analysis of the results was performed according to [6].

RESULTS AND DISCUSSION

Purple willow (*Salix purpurea*) is a common species in Lithuania. Its territory is near the edge of the area of willow distribution. The north and the west borders of distribution range along Latvia [7] and the southeaster edge ranges along Belarus [8]. Va-

riation of populations is characteristic of the regions near the edge of species distribution. This is confirmed by a huge polymorphism of purple willow. The genefund of purple willow in Lithuania consists of local and introduced taxa. Four new forms of purple willow were found in wild flora of Lithuania: 1) *f. rubra* – middle-growing shrub; sprouts and shoots are red; regrows abundantly after cutting; leaves are 10.2 ± 0.2 cm long and 1.0 ± 0.03 cm wide, the length of leafstalk is 0.6 ± 0.001 cm; common; 2) *f. lutea* – middle-growing shrub; the cortex of sprouts and shoots is yellow; leaves are 8.9 ± 0.02 cm long and 0.6 ± 0.01 cm wide, the length of leafstalk is 0.6 ± 0.001 cm; this form is found on the banks of the affluents of the lower reaches of the Nemunas; semi-common; 3) *f. viridis* – high shrub; the green color of cortex and larger sprouts and shoots are characteristic of this form; leaves are 9.1 ± 0.1 cm long and 1.7 ± 0.02 cm wide, the length of leafstalk is 0.7 ± 0.001 cm; common; 4) *f. sphaerica* – shot or middle-growing shrub; the crown is spherical and ornamental; the lancet-shaped leaves are 4.5 ± ± 0.3 cm long and 0.8 ± 0.02 cm wide, the length of leafstalk is 0.4 ± 0.001 cm; rare.

To increase botanical diversity of purple willow in Lithuania, new forms and cultivars were introduced. Cultivar 'Gracilis' was introduced in the collection of the institute of Botany in 1970 from Poland. According to H. Bukievicz and Zwoliński [1], this was cultivar derived from *S. purpurea f. uralensis*. However, it looks like a clone of *S. purpurea f. helix*. It differs from typical *S. purpurea* in short lancet-shaped ovate leaves. The sprouts are thin with the thinner end and flexible. The form *majak* was introduced from the Botanical Garden of Sverdlovsk in 1989. The characteristic indication of this form is a thin wax coating of the cortex. The sprouts are long, very straight, thin and flexible. The coloring of wood under cortex is white-shining. The form *busulukensis* was introduced from the Botanical Garden of Sverdlovsk in 1989. Its leaves are broad, opposite, lancet-shaped sprouts are plenty-leafed, middle-thick and without branching. This form is resistant to pests and diseases and profusely regrows after cutting.

The taxons of *S. purpurea* mentioned above were used for selection of valuable clones. In 1996 32 clones of purple willow were selected. They were investigated at the field collection of the joint-stock company "Vilda". The collection field was set up in 1997. In the first year young plants rooted and gave rise to 1–3 sprouts per brush. After pruning in late autumn, plants grew again in the next year and produced raw material of full value for the trade of wicker.

The main morphological characteristics showing productivity of *S. purpurea* are the intensity of growing during the first year after pruning, the number, length and character of thinness of sprouts and the amount of wood. All these traits of clones are predetermined genetically. The diversity of clones was discovered after the second and third years of cultivation. Most of selected clones in the end of the second and third years formed higher bushes after pruning than did control plants in the population of purple willow (Fig. 1). The highest bushes in third year of cultivation were formed in clones *S. purpurea f. purpurea* cl. 9602 (282 cm), *S. purpurea* f. viridis cl. 9619 (282 cm) and *S. purpurea f. rubra* cl. 9618 (275 cm). Clones 9605 and 9629 derived from cv. 'Gracilis' were lower and reached 172 cm and 232 cm, respectively.

The quantity of withes for wicker depends on the number of sprouts per brush. The largest numbers of sprouts per bush were produced by clones 9603 (42.2) and 9629 (30.5) selected from cv. 'Gracilis'. A lot of sprouts per bush were grown by clones *S. purpurea f. rubra* cl. 9618 (19.6), *S. purpurea f. purpurea* cl. 9639 (18.3), *S. purpurea f. busulukensis* cl. 9621 (16.8). Clones derived from *S. purpurea f. majak* were sensitive to fungal diseases and sprouted poorly.

The length of sprouts was the other significant trait. Longest sprouts in the third year were produced by clones 9639 (188 cm) and 9602 (182 cm)

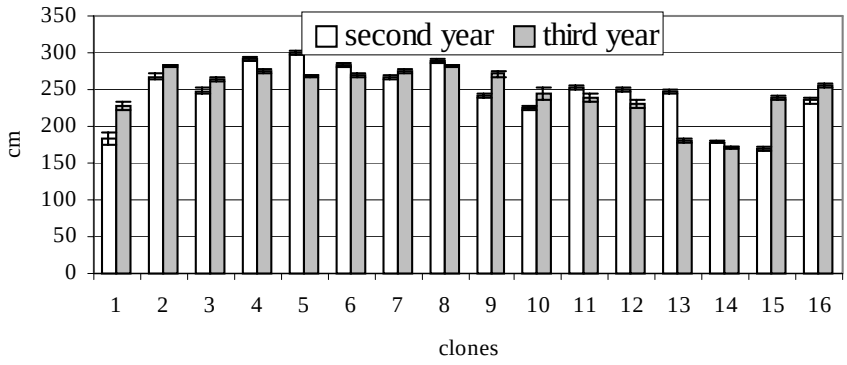

Fig. 1. Height of the second and third year bushes sprouted after pruning: 1 – *S. purpurea* (control), 2 – *S. p. f. purpurea* cl. 9602, 3 – *S. p. f. purpurea* cl. 9603, 4 – *S. p. f. purpurea* cl. 9610, 5 – *S. p. f. purpurea* cl. 9639, 6 – *S. p. f. rubra* cl. 9617, 7 – *S. p. f. rubra* cl. 9618, 8 – *S. p. f. viridis* cl. 9619, 9 – *S. p. f. lutea* cl. 9613, 10 – *S. p. f. lutea* cl. 9615, 11 – *S. p. f. majak* cl. 9604, 12 – *S. p. f. majak* cl. 9620, 13 – *S. p. f. busulukensis* cl. 9621, 14 – *S. p*. cv. 'Gracilis' cl. 9603, 15 – *S. p*. cv. 'Gracilis' cl. 9605, 16 – *S. p*. cv. 'Gracilis' cl. 9629

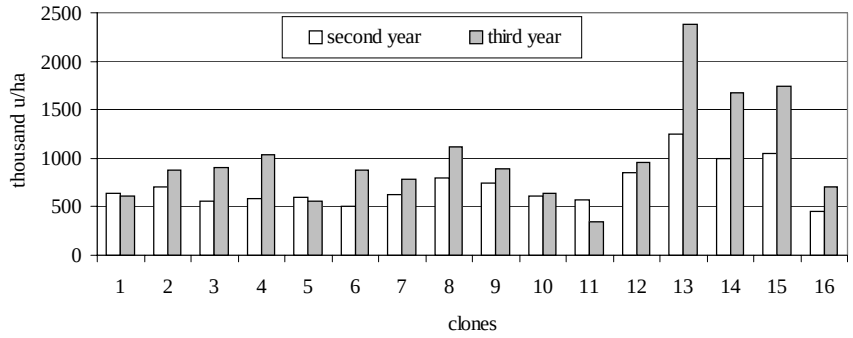

Fig. 2. Number of sprouts per hectare (u/ha) regrown after pruning: 1 – *S. purpurea* (control), 2 – *S. p. f. purpurea* cl. 9602, 3 – *S. p. f. purpurea* cl. 9603, 4 – *S. p. f. purpurea* cl. 9639, 5 – *S. p. f. purpurea* cl. 9609, 6 – *S. p. f. purpurea* cl. 9610, 7 – *S. p. f. rubra* cl. 9617, 8 – *S. p. f. rubra* cl. 9618, 9 – *S. p. f. viridis* cl. 9619, 10 – *S. p. f. lutea* cl. 9613, 11 – *S. p. f. majak* cl. 9604, 12 – *S. p. f. busulukensis* cl. 9621, 13 – *S. p.* 'Gracilis' cl. 9603, 14 – *S. p*. 'Gracilis' cl. 9605, 15 – *S. p*. 'Gracilis' cl. 9629, 16 – *S. p. f. lutea* cl. 9615

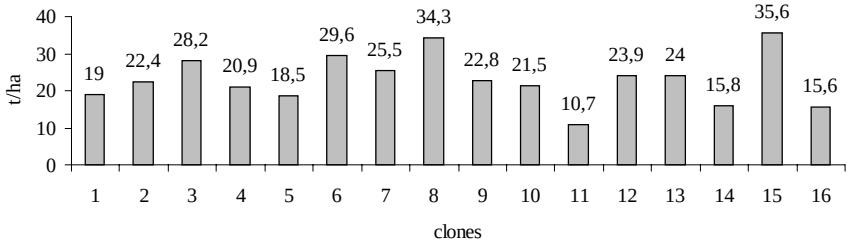

Fig. 3. Mass of leafless sprouts per hectare in the second and third years. For explanation, see Fig. 2

derived from *S. purpurea f. purpurea* and by *S. purpurea f. rubra* cl. 9618 (183 cm). The shortest sprouts were characteristic of clones 9605 (134 cm) and 9629 (163 cm) selected from cv 'Gracilis'.

The yield of the sprouts (units) per hectare is a very important characteristic determining the value of clones. The yield of sprouts obtained from willow *S. purpurea* and *S. purpurea f. lambertiana* grown in Seredžius on the bank of the Nemunas River was 780 thousand u/ha and 564 thousand u/ha respectively [9]. The yield of selected clones was higher (Fig. 2). Rich yields of sprouts were obtained in clones selected from cv. 'Gracilis' as well as in clones *S. purpurea f. rubra* cl. 9618 and *S. purpurea f. purpurea* cl. 9639.

The mass of yield is another characteristic of productivity. It allows to describe the diameter and length of sprouts. The long and thick sprouts weigh more. If clones 9603, 9605 and 9629 derived from cv. 'Gracilis' were superior in the number of sprouts, the mass of yield was higher only in clone 9629 (35.6 t/ha) (Fig. 3). Heavy yield was produced by *S. purpurea f. rubra* cl. 9618 (34.3 t/ha) and *S. purpurea f. purpurea* (29.6 t/ha).

Summarizing the results, it should be noted that clones of purple willow *S. purpurea f. rubra* cl. 9618, *S. purpurea* 'Gracilis' cl. 9629, *S. purpurea f. purpurea* cl. 9639 and 9610 and *S. purpurea f. busulukensis* cl. 9621 are valuable in respect of productivity and quality of sprouts.

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PURPURINIO KARKLO (*SALIX PURPUREA* L.) GENETINIAI IŠTEKLIAI, KLONINĖ ATRANKA IR VERTINGIAUSIŲ KLONŲ PRODUKTYVUMO ĮVERTINIMAS

S a n t r a u k a

Lietuvos natūralioje floroje rastos ir aprašytos keturios naujos *Salix purpurea* formos: *f. rubra, f. lutea, f. viridis* ir *f. sphaerica*. Iš vietinės floros *S. purpurea* taksonų ir introdukuotų (*f. majak, f. busulukensis*, 'Gracilis') kloninės atrankos metodu atrinkti 32 klonai. Apibendrinus 16 klonų biomorfologinių savybių tyrimus nustatyta, kad *S. purpurea* būdingas individualus požymių varijavimas.

Pagal pramoninių vytelių išeigą, jų kokybę bei medienos masės išeigą vertingiausi yra šie *S. purpurea* klonai: *S. purpurea f. rubra* cl. 9618, *S. purpurea* 'Gracilis' cl. 9629 ir *S. purpurea f. purpurea* cl. 9639.