

## Variation in selected morphological traits of *Cfr. Salix viminalis* from different experimental plots

BOGUSŁAWA WALISZEWSKA, KINGA SZENTNER, WŁODZIMIERZ PRĄDZYŃSKI, HANNA DUKIEWICZ, AGNIESZKA SIERADZKA, AGNIESZKA SPEK-DŹWIGAŁA, PAWEŁ RUTKOWSKI

Institute of Chemical Wood Technology, Faculty of Wood Technology, Poznań University of Life Sciences

**Abstract:** *Variation in selected morphological traits of Cfr. Salix viminalis from different experimental plots.* Analyses were conducted on morphological traits (rod length, rod diameter in the butt end) were conducted on willow *Cfr. Salix viminalis* coming from experimental plots in Siemianice and in Zielonka. The percentage shares of the pith and bark were calculated. Rods from Siemianice were characterized by very high variation in length (from 26 cm to 154 cm). Rods from Zielonka had a very low percentage share of pith – below 1%.

**Keywords:** willow, share of pith, share of bark;

### INTRODUCTION

The abundance of species in the genus *Salix*, their considerable adaptability to growth conditions and presence in almost all climatic zones provide extensive potential applications for willow in different branches of economy.

Apart from its wide applications in wicker industry, willows are also used in a number of other branches of economy, including:

- water protection: degradation of sediments in sewage treatment plants, establishment of protection zones around sewage treatment plants, reinforcement of banks in water reservoirs,
- soil protection: establishment of protection zones around waste dumps, protection against truck and car contamination (Prądyński et al., 1996),
- air protection: establishment of protection zones along roads and motorways, development of noise screens and windbreaks,
- industry: raw material for cellulose production, raw material for production of methanol, production of wood pulp for fiberboards, production of road mats as a base for certain types of dust roads, raw material for wickerwork.

In recent years both in Poland and worldwide we have been observing increased interest in the potential applications of willow for energy purposes and in the production of biofuels (Szcukowski and Tworkowski, 2003; Olejniczak et al. 2011; Ciechanowicz and Szcukowski, 2006). The unprecedented easy hybridization in willows makes it possible to generate new cultivars and clones with desirable properties. Particular interest has been attracted by the potential use of specific properties of certain willow species in the broadly understood environmental protection. Among other things, old, verified methods of fascine strengthening of river and canal banks are re-introduced. In western Europe and increasingly often also in Poland, following ecological recommendations, shrubs of *Salix viminalis* are planted to reinforce lake shores and river banks (protection zones). They are planted on reservoir embankments and landfills. In connection with the very rapid growth in this species

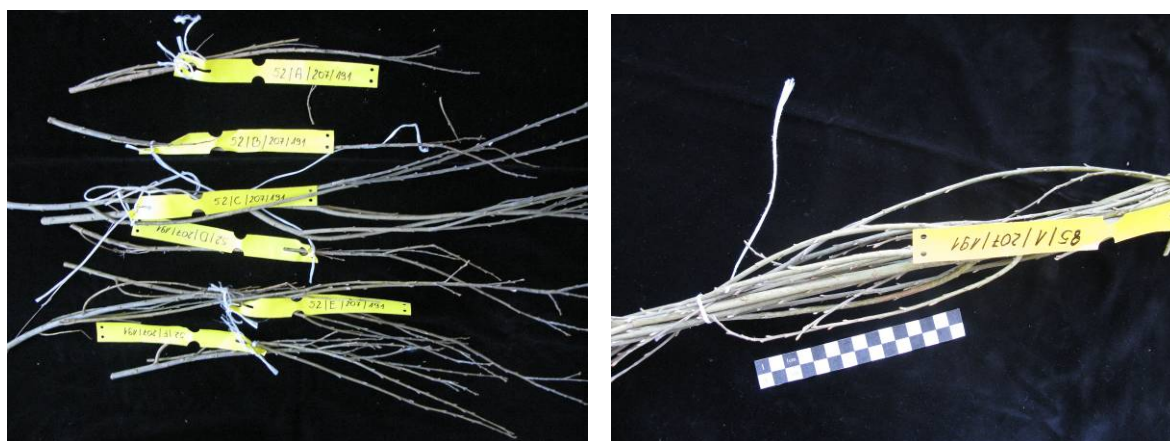
(up to 3 cm a day) and its unique capacity to extract pollutants from soil willow started to be used as a panacea to all ecological problems (Mleczek et al. 2009; 2010).

The aim of this study was to investigate variation in selected morphological traits of 2-year old rods of willow *Cfr. Salix viminalis*, coming from different experimental plots, growing on sandy subsoil in Zielonka and on loamy soil in Siemianice.

## MATERIAL AND METHODS

Among the many willow cultivars and hybrids, found in the collection of the Poznań University of Life Sciences, the clone of *Cfr. Salix viminalis* was selected for analyses. Within the framework of a project financed by the Ministry, in 2011 on experimental plots of the Poznan University of Life Sciences in Siemianice (in forest compartments nos. 85, 43 and 52, with several blocks in each) and in Zielonka (the PULS experimental station, approx. 35 km from Poznań) 150 different willow cultivars and hybrids were planted in each experimental plot. The selected clone, according to previous studies ....., in the first and second year of vegetation accumulated the greatest amounts of heavy metals. The aim of the comprehensive studies is to determine whether this is a varietal trait and what effect it has on rod growth and their other properties.

Material for analyses was collected in early spring 2013. From Siemianice rods were collected from eight blocks, while from Zielonka at the same time material was harvested from four blocks. Next rods were conditioned at the laboratory at room temperature in order to determine constant moisture content. Among morphological traits rod length was measured with a metric measure, their diameter was measured in the butt end section, pith diameter and bark thickness were determined (using the Brinnel magnifying glass accurate to 0.1mm, while the percentage shares of pith and bark in rods were calculated.



**Fig. 1.** Willow rods from different experimental plots in Siemianice

## RESULTS

**Tab. 1.** Selected morphological traits of willow rods from Siemianice (forest compartment no. 43)

Block no.	No. of rod	Rod length [cm]	Diameter <sup>1</sup> [mm]	Share of [%]	
				Pith <sup>1</sup>	Bark <sup>1</sup>
1	1	102	9.53	0.83	31.90
	2	110	9.83	0.61	29.89
	3	82	7.40	0.73	26.75
	4	112	10.00	1.60	27.18
2	1	48	4.17	6.38	30.85
	2	47	4.73	5.08	33.27
3	1	62	6.97	4.04	36.15
	2	56	4.57	4.48	24.55
	3	58	5.70	4.94	30.07
4	1	40	4.00	3.93	33.06
	2	99	8.03	0.69	34.53

<sup>1</sup> – mean from three measurements

Rods of willow *Cfr. Salix viminalis* from forest compartment no. 43 in Siemianice, from the first block, were characterized by a relatively large height – from 82 cm to 112 cm (table 1). Rods from the second and third block were by approx. 50% shorter, while in those from the fourth block length of one rod was 40 cm, while that of another was 99 cm. Rod diameter in the butt end was considerably varied and ranged from 4.00 cm to 10.00 cm. The greatest diameter was found for the longest rods, coming from block 1. The percentage share of pith in those rods was very low and ranged from 0.61% to 1.60%, while that of bark ranged from 26.75% to 31.90%. Rods from the second and third block and one from the fourth block were similar both in length (from 47 to 62 cm) and diameter (from 4.17 to 6.97 mm) as well as percentage shares of pith (from 4.04 to 6.38) and bark (from 24.55% to 36.15%). One rod from the fourth block differed in length (99 cm) and percentage of pith (0.69%).

**Tab. 2.** Selected morphological traits of willow rods from Siemianice (forest compartment no. 52)

Block no.	No. of rod	Rod length [cm]	Diameter <sup>1</sup> [mm]	Share of [%]	
				Pith <sup>1</sup>	Bark <sup>1</sup>
1	1	26	4.30	5.41	31.20
	2	45	6.13	4.04	28.12
2	1	106	7.27	2.02	30.30
	2	93	9.00	1.68	23.60
3	1	54	5.00	3.74	29.44
	2	55	5.83	2.04	31.35
	3	98	7.77	2.26	28.51
4	1	28	4.07	7.23	38.08
	2	71	7.70	2.30	28.74

<sup>1</sup> – mean from three measurements

Length of 2-year old willow rods from the first block from compartment no. 52 in Siemianice was very low and amounted to as little as 26 and 45 cm (table 2). The diameter of these rods in the butt end section was slight – 4.30 mm and 6.13 mm. In turn, the share of pith was relatively high (5.41% and 4.04%) and that of bark was as high as 31.20% and 28.12%. Rods from the second block from the same compartment were the tallest – their length was 106 cm and 93 cm and they were characterized by the lowest percentage share of pith –

1.68% and 2.02%. Length of rods from the third block was least varied (54, 55 and 98 cm). Their diameter in the butt end ranged from 5.00 cm to 7.77 cm. The share of pith was also relatively low, amounting to 2.04% - 3.74%, while the share of bark ranged from 28.51% to 31.35%. Rods from the fourth block, similarly as those from the first block, were very low (28 and 71 cm), had small diameters (4.07 and 7.70 mm) and a high percentage share of bark amounting to 28.74% and 38.08%.

**Tab. 3.** Selected morphological traits of willow rods coming from Siemianice (forest compartment no. 85)

Block no.	Rod no.	Rod length [cm]	Diameter <sup>1</sup> [mm]	Share of [%]	
				Pith <sup>1</sup>	Bark <sup>1</sup>
1	1	85	7.47	2.04	23.43
	2	97	8.97	0.86	23.66
	3	65	3.34	25.96	18.98
	4	48	2.87	18.42	17.70
2	1	75	5.43	1.66	25.20
	2	68	3.39	3.48	11.44
	3	34	1.52	4.79	45.62
	4	42	1.81	11.03	44.99
3	1	77	5.27	2.91	30.17
	2	95	7.94	1.59	30.78
	3	58	2.87	4.88	25.96
4	1	123	10.17	0.21	22.21
	2	154	15.41	1.26	18.13
	3	66	3.81	17.67	19.91
	4	54	3.70	17.20	23.65
5	1	115	9.77	1.43	24.26
	2	69	3.05	10.05	35.47
	3	89	8.94	3.91	22.44
	4	60	3.47	7.76	21.73
6	1	93	8.01	1.46	24.85
	2	62	3.42	13.72	22.02
	3	133	12.16	0.51	22.67
	4	71	3.94	10.89	30.98

<sup>1</sup> – – mean from three measurements

The greatest number of 2-year rods was collected from compartment no. 85 in Siemianice – with 4 rods from each block (except for block 3), but their length was also relatively greatly varied, ranging from 34 cm to 154 cm (table 3, Fig. 1). Differences in rod diameter in the butt end section were as high as 400%, while the percentage share of pith ranged from 0.21% for the long rod from block 4 to 25.96%. Very high variation was observed in the percentage of bark in rods, which ranged from 11.44% to 45.62%. The lowest variation in bark content was found for rods from block 3 (from 1.59% to 4.88%).

**Tab. 4.** Selected morphological traits of willow rods from Zielonka

Block no.	Rod no.	Rod length [cm]	Diameter <sup>1</sup> [mm]	Share of [%]	
				Pith <sup>1</sup>	Bark <sup>1</sup>
1	1	101	11.94	0.70	6.59
	2	149	23.49	0.31	15.79
	3	111	19.88	0.19	12.34
2	1	76	15.75	0.58	25.25
	2	97	14.05	0.18	5.61
3	1	82	7.60	0.28	23.05
	2	80	13.60	0.54	5.80
	3	116	8.43	0.76	9.26
	4	78	6.55	0.84	9.91

<sup>1</sup> – – mean from three measurements

Length of rods coming from experimental plots in Zielonka was less varied than in those from experimental plots in Siemianice. Differences in length amounted to 48 cm for rods from the first block, 21 cm for rods from the second block and 38 cm for rods from the third experimental block. Diameter in the butt end of rods from the first and second blocks ranged from 11.94 mm to 23.49 mm (table 4). All rods from the experimental plots in Zielonka were characterized by a low share of pith, below 1% (from 0.18% to 0.84%). The share of bark was more varied and ranged from 5.61% to 25.25%.

## SUMMARY

Rods of willow *Cfr. Salix viminalis* growing on loamy soil and coming from experimental plots in Siemianice showed much greater variation in the analyzed morphological traits, i.e. rod length, diameter in the butt end and in the calculated percentage share of pith and bark. Moreover, considerable differences were also observed in terms of these traits in rods coming from the same experimental blocks.

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**Streszczenie:** *Zmienność wybranych cech morfologicznych Cfr. Salix viminalis z różnych poletek doświadczalnych.* Przeprowadzono badania długości prętów, średnicy prętów w części odziomkowej oraz obliczono procentowy udział rdzenia i kory w 2-letnich prętach *Cfr. Salix viminalis* pochodzących z poletek doświadczalnych w Siemianicach oraz w Zielonce. Pręty z Siemianic charakteryzowały się znacznie większym zróżnicowaniem zarówno w długości i średnicy prętów, jak i w udziale procentowym rdzenia i kory. Pręty wierzbowe z Zielonki były lepiej wykształcone i charakteryzowały się małym udziałem procentowym rdzenia – poniżej 1%.

Corresponding author:

Bogusława Waliszewska  
Institute of Chemical Wood Technology,  
Faculty of Wood Technology,  
Poznań University of Life Sciences  
Ul. Wojska Polskiego 38/42,  
60-637 Poznań, Poland  
email: bwaliszewska@up.poznan.pl  
phone: +48 61 848 74 65