

## **Wood macrostructure of Norway spruce (*Picea abies* [L.] Karst) coming from an experimental site in the Siemianice Forest Experimental Station**

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**Abstract** *Wood macrostructure of Norway spruce (*Picea abies* [L.] Karst) coming from an experimental site in the Siemianice Forest Experimental Station.* The paper presents results of studies concerning the effect of provenance on the share of latewood in annual rings. Analyses were conducted on seven provenances grown on an experimental site located in the Siemianice Forest Experimental Station. It was established which of the investigated provenances have the greatest share of latewood in annual rings. It was also investigated which of the provenances differ significantly in terms of the analysed trait. Measurements were taken on discs collected from breast height of mean sample trees.

*Keywords:* Norway spruce, latewood, provenance.

### INTRODUCTION

Trees growing under different forest site and climatic conditions, coming from different regions of a country, may exhibit diverse technical properties (Szaban et al. 2014). It needs to be stressed that in Poland Norway spruce has two geographical ranges: north-eastern and southern, but it may be found over a greater area of Poland than it would result from the limits of its natural range (Boratyński 1998). Such a situation may have a significant effect on wood properties (Puchniarski 2008, Barzdajn et al. 2003). The wood industry has increasingly higher requirements concerning supplied timber. For this reason identification of technical properties – biological traits of individual provenances of Norway spruce found in Poland may prove of great importance for the wood industry, as it will facilitate selection of the provenance which traits are most desirable (Białobok 1977, Jaworski 2011). Principles of Silviculture (ZHL 2012) in commercial stands do not permit transfer of local provenances outside their range. However, such restrictions do not apply to plantations, which may in the future produce high quality timber. Spruce could be a very attractive species in such a production cycle due to its high growth increment potential.

The aim of this study was to compare the share of latewood in annual rings of spruce wood coming from trees representing 7 different provenances. It was assumed in this study that provenance of Norway spruce affects the proportion of latewood in annual rings.

### METHODS

The experimental site was established in 1975 at the Laski Forest Division, compartment 89. It is a rectangular area of 378 x 96 m, divided into 5 complete blocks of 20 randomly distributed populations each. Within this site 20 spruce populations were planted, coming from the following forest divisions: Zwierzyniec Białowieski 281 B, Zwierzyniec Białowieski 449 C, Wigry, Przerwanki, Borcki, Nowe Ramuki, Międzygórze, Stronie Śląskie, Wisła, Istebna Bukowiec, Istebna Zapowiedz, Rycerka Zwardoń, Rycerka Praszywka 700, Rycerka Praszywka 950, Orawa, Witów, Tarnawa, Zwierzyniec Lubelski, Bliżyn and Kartuzy (Barzdajn 1994, 2003).

In 2012 material was collected from 7 provenances - Zwierzyniec Białowieski 281 B (1), Nowe Ramuki (6), Międzygórze (8), Istebna Bukowiec (11), Orawa (16), Zwierzyniec Lubelski (19) and Kartuzy (21).

Based on diameter at breast height and tree height measurements 84 mean sample trees, a total of 12 for each of the 7 provenances, were identified using the Urich II dendrometric method (Grochowski 1973). Upon felling a disc of approx. 5 cm in thickness was cut from each tree at breast height. After sanding the principal geographical directions were marked on the discs. Samples were sorted into each provenance and next measured in the individual north-south and west-east directions using a BIOtronik increment meter. The measured share of latewood was expressed in percent (Kokociński 2004). Measurements were transferred to the MS Office – Excel package and next analysed statistically in the Statistica 10 programme.

## RESULTS AND DISCUSSION

All the recorded results were used to determine variation in the share of latewood in annual rings of individual provenances. We may distinguish provenances with the share of latewood over the average: Zwierzyniec Lubelski, Zwierzyniec 281B, Istebna Bukowiec and Kartuzy. Provenances from Międzygórze, Nowe Ramuki and Istebna were below average. The highest share of latewood was found for the provenance from Zwierzyniec Lubelski at approx. 24.75%, while the lowest of approx. 18.25% was found for the Międzygórze provenance (Fig. 1).

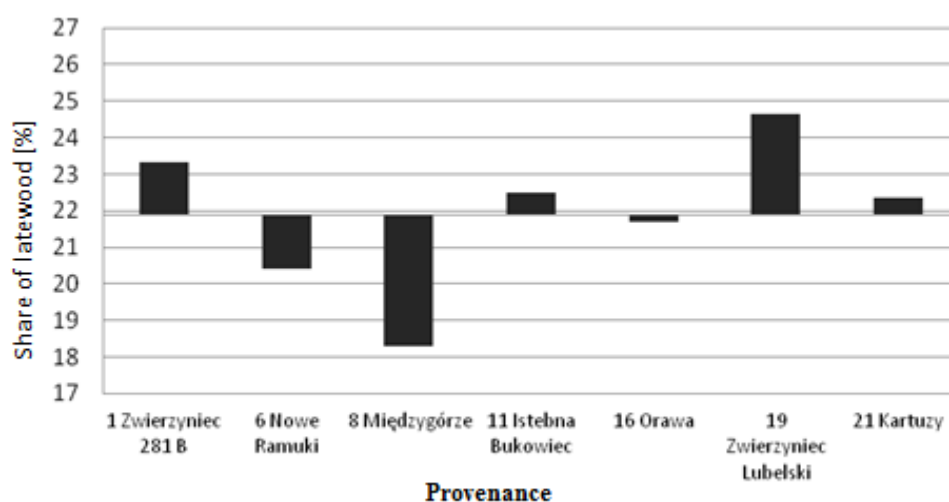


Fig. 1 Mean shares of latewood in annual rings for all provenances in relation to the arithmetic mean of all samples

When analysing the distribution of mean shares of latewood in the tested provenances it may be stated that the provenance from Zwierzyniec Lubelski, which has the greatest share of latewood, is characterised by medium consistency of results. The Międzygórze provenance, for which it was established that it yields the most consistent results, has the lowest mean share of latewood (Fig. 2).

It results from the conducted analyses that the provenance from Międzygórze is characterised by the most statistically significant differences among all the investigated provenances. The second provenance distinguished by significant differences is that from Zwierzyniec Lubelski. The other provenances exhibit slight variability (table 1).

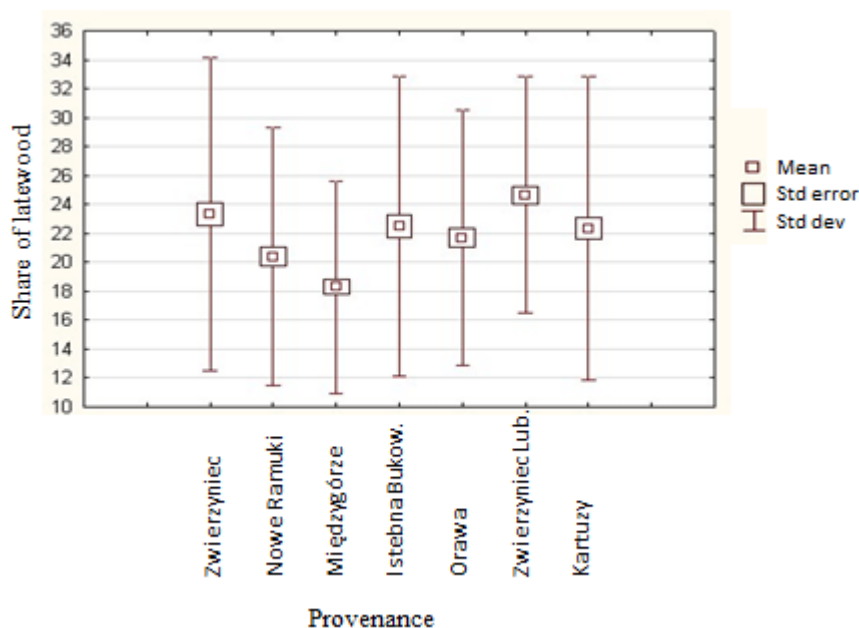


Fig. 2 Distribution of mean shares of latewood in individual provenances.

The Duncan test in the presented form (tab. 2) makes it possible to create homogeneous groups, between which there are no statistically significant differences.

Tab. 1 The Duncan test. Table of multiple comparisons. \* - denotes a statistically significant difference

Provenance	Zwierzyniec 281 B	Nowe Ramuki	Międzygórze	Istebna Bukowiec	Orawa	Zwierzyniec Lubelski	Kartuzy
Zwierzyniec 281 B		0,077491	0,002062 *	0,571654	0,324553	0,353102	0,54476
Nowe Ramuki	0,077491		0,141398	0,197694	0,36988	0,009904 *	0,207781
Międzygórze	0,002062 *	0,141398		0,009186 *	0,025444 *	0,00012 *	0,009853 *
Istebna Bukowiec	0,571654	0,197694	0,009186 *		0,621858	0,160599	0,934766
Orawa	0,324553	0,36988	0,025444 *	0,621858		0,072709	0,655797
Zwierzyniec Lubelski	0,353102	0,009904 *	0,00012 *	0,160599	0,072709		0,153419
Kartuzy	0,54476	0,207781	0,009853 *	0,934766	0,655797	0,153419	

The first group, characterised by mean shares of latewood ranging from 20.29 to 23.32%, consists of provenances from Nowe Ramuki, Orawa, Kartuzy, Istebna Bukowiec and Zwierzyniec 281B. The second group, comprising results ranging from 21.68 to 24.75%, is represented by provenances from Orawa, Kartuzy, Istebna Bukowiec, Zwierzyniec 281B and Zwierzyniec Lubelski. The third group includes provenances from Międzygórze and Nowe Ramuki with the results of 18.25 and 20.39%. The second group comprises provenances characterised by the greatest mean shares of latewood. In this group the Zwierzyniec Lubelski provenance with the greatest share of latewood is definitely distinguished. The third group consists of provenances distinguished with the lowest mean shares of latewood.

It results from the conducted analyses that there are statistically significant differences between provenances. This thesis was earlier confirmed also by other researchers (Siek 1970, Giertych 1977). This test clearly showed the provenances from Zwierzyniec Lubelski, Międzygórze and Nowe Ramuki as significantly distinguished from the others.

Tab. 2 The Duncan test. Distribution in groups.

Provenance	Mean shares of latewood (%)	1	2	3
Międzygórze	18,25			****
Nowe Ramuki	20,39	****		****
Orawa	21,68	****	****	
Kartuzy	22,35	****	****	
Istebna Bukowiec	22,49	****	****	
Zwierzyniec 281 B	23,32	****	****	
Zwierzyniec Lubelski	24,75		****	

When investigating mean shares of latewood it may be stated that the Zwierzyniec Lubelski provenance is particularly distinguished. Analyses were conducted on 40-year old trees, in which the juvenile wood zone covered a considerable part of the cross-section, thus similar studies need also to be conducted on mature trees.

## CONCLUSIONS

1. Shares of latewood in Norway spruce (*Picea abies* [L.] Karst.) differ between provenances growing under similar site conditions.
2. The greatest mean share of latewood was found for the provenance from Zwierzyniec Lubelski. These values differed significantly from the others.
3. The lowest mean shares of latewood were recorded for the provenance from Międzygórze. These values differed significantly from the others.
4. In view of the unique character of the experimental site, from which the material for analyses was collected, it needs to be stated that studies concerning differences in wood structure in different provenances should be continued in the future.

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**Streszczenie:** *Makrostruktura drewna świerka pospolitego (Picea abies [L.] Karst) pochodzącego z powierzchni doświadczalnej zlokalizowanej na terenie LZD Siemianice.* Celem pracy było zbadanie udziału drewna późnego w przyrostach rocznych wybranych proveniencji świerka pospolitego wyrosłego na powierzchni doświadczalnej znajdującej się na terenie Leśnego Zakładu Doświadczalnego w Siemianicach. Powierzchnia doświadczalna została założona w 1975 r. Posadzono na niej najlepsze polskie pochodzenia świerka. W 2012 roku pobrano z wyznaczonych wcześniej drzew modelowych materiał w postaci krążków z wysokości pierśnicy. Szerokość strefy drewna późnego mierzono przy użyciu przyrostomierza Biotronik. Ze względu na unikatowy charakter powierzchni doświadczalnej do analiz przyjęto siedem pochodzeń (Zwierzyniec Białowieski, Międzygórze, Istebna Bukowiec, Orawa, Zwierzyniec Lubelski, Kartuzy i Nowe Ramuki) pobierając po 12 drzew z każdego pochodzenia.

Wyniki badań w formie analiz statystycznych wykazały, że pochodzenie świerka pospolitego wpływa na udział drewna późnego w przyrostach rocznych. Największym udziałem drewna późnego charakteryzowało się pochodzenie Zwierzyniec, a najmniejszym Międzygórze. Analizy statystyczne wykazały również, że pochodzenie Zwierzyniec Lubelski wykazuje najbardziej istotne zróżnicowanie badanej cechy względem pozostałych proveniencji.

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