Origin matters: mechanical variability of Scots pine wood from different provenances

M. Sołoniewicz, A. Skręta, A. Jankowska, P. Kozakiewicz*

*Institute of Wood Sciences and Furniture, Warsaw University of Life Sciences, Nowoursynowska 159, 02-776 Warsaw, Poland, *monika_soloniewicz@sggw.edu.pl*

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Scots pine (*Pinus sylvestris* L.) is one of the most widely distributed tree species across Eurasia and the dominant forest species in Poland, covering 58.8% of the forest area with a standing timber volume of 1,650 million m^3. Due to its ecological and economic importance, understanding the variability of its wood properties is relevant for forest ecology, forest management, and the sustainable use of forest resources. Mechanical characteristics such as density, modulus of elasticity (MOE), and modulus of rupture (MOR) are key indicators of wood quality and structural performance. Previous studies have described the general mechanical properties of Scots pine wood, but many do not consider genetic variability among populations or were conducted under varying environmental conditions, which makes it difficult to separate genetic and environmental effects.

This study examines the bending strength (MOR) and modulus of elasticity (MOE) of Scots pine wood originating from three natural populations in Poland. The analyzed material comes from a long-term provenance experiment established in 1966, where trees from different parental origins have grown under identical site and climatic conditions. Such an experimental design enables the assessment of genetic influences on wood properties while minimizing environmental variability.

The results indicate that the mechanical properties of Scots pine wood grown under the same environmental conditions differ depending on parental origin. This confirms the presence of phenotypic variability among populations and highlights the role of genetic factors in shaping wood quality. Identifying such variability is important for forest genetics and tree breeding, as it may support the selection of seed material capable of forming productive and stable stands that produce timber of desirable technological quality. The findings contribute to a better understanding of intra-species variability in Scots pine and provide useful information for sustainable forest management and the future use of wood as a renewable resource. The findings also have implications for tree resistance to changing environmental conditions, as the selection of suitable Scots pine phenotypes may enhance forest resilience to increasingly severe weather events.

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