



Szkoła Główna Gospodarstwa Wiejskiego

w Warszawie

Instytut Nauk Leśnych

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**Zmienność wybranych cech
jakości technicznej drewna daglezi zielonej
(*Pseudotsuga menziesii* (Mirb.) Franco)
rosnącej na siedliskach LMśw i Lśw w Polsce**

Variability of selected technical quality features
of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) wood
growing in the habitats of FMBF and FBF in Poland

Rozprawa doktorska

Doctoral thesis

Rozprawa doktorska wykonana pod kierunkiem

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Streszczenie w języku angielskim (Summary in English)

Current climate change is causing changes in the species composition of Polish forests. Due to the loss of critical forest-forming species, such as spruce and pine, increasing the share of broadleaf species and introducing other coniferous species adapted to new climatic conditions is necessary. One such species is Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco), which was brought to Poland in 1833. Despite almost 200 years of DG cultivation, the technical quality of this species' wood in the country has not been well understood.

The aim of the study was to compare the technical quality of Douglas fir wood, defined by selected anatomical elements and structural, physical and mechanical properties, depending on the geographical location, forest habitat type and diameter class.

The scope of work included measurements and analysis of 38 parameters:

- a) parameters and indices of the tracheids structure (broken down into early and late wood): tracheids length, tracheids width, lumen tracheids, wall thickness, felting index, flexibility index, rigidity index, Runkel rigidity index, Mühlsteph's index, compactness index,
- b) structural properties: average ring width, percentage of latewood,
- c) physical properties: wood density determined on samples 20×20×300 mm, wood density determined on samples 20×20×30 mm, oven-dry wood density determined on samples 20×20×30 mm, conventional wood density determined on samples 20×20×30 mm, wood porosity, proportion of wood substance, total shrinkage of wood in longitudinal direction, total shrinkage of wood in radial direction, total shrinkage of wood in tangential direction, total volume shrinkage of wood, coefficient of total shrinkage of wood in longitudinal direction, coefficient of total shrinkage of wood in radial direction, coefficient of total shrinkage of wood in tangential direction, coefficient of total volume shrinkage of wood, anisotropy index of shrinkage, acoustic wave propagation speed in wood, dynamic modulus of elasticity, sound attenuation, acoustic resistance of wood, acoustic constant,
- d) mechanical properties: compression strength parallel to grain, static bending, modulus of elasticity in static bending, coefficient of compression strength parallel to grain, coefficient of static bending, coefficient of modulus of elasticity in static bending.

Thanks to the analysis of the raw material base of Douglas fir in Poland, 5 forest districts were designated (Milicz – RDotSF Wrocław, Babimost – RDotSF Zielona Góra, Chojna – RDotSF Szczecin, Czaplinek – RDotSF Szczecinek and Lębork – RDotSF Gdańsk). In each of them, 2 research areas were established (one each in the FMBF and

FBF habitats), on which, according to the methodology adopted for over 50 years in the Department of Forest Utilization at the Warsaw University of Life Sciences, for each plot 6 sample trees were designated using the Hartig method. Then, a meter-long log was obtained from each tree from a height of 1.3 m. After proper preparation and seasoning of the raw material, 897 long samples (447 from FMBF and 450 from FBF) with dimensions of 20 mm × 20 mm × 300 mm and 2691 short samples (1341 from FMBF and 1350 from FBF) with dimensions of 20 mm × 20 mm × 30 mm were made from the circumferential part of the trunk in accordance with Polish and international standards. Then, tests of specific properties and parameters were carried out according to Polish and international standards.

The obtained results confirm the hypothesis, i.e. the technical quality of Douglas fir wood growing in Poland depends on the geographical location, forest habitat type and diameter class. The highest values in terms of mechanical properties were achieved by samples from Chojna, and in terms of structural properties by samples from Milicz. The lowest results were obtained for samples from Lębork and Babimost (13 parameters each). In 31 cases (out of 48 in total), higher values were obtained for FMBF. In the diameter classes, the highest values were most often obtained in class III (31 parameters), then in class II (11 parameters), and finally in class I (6 parameters). The coefficient of variation in 39 cases was below 25% (of which in 14 cases below 10%), which indicates low variability within and between groups and the stability of wood as a raw material. The density of wood with a moisture content of 12% ranged from 515 kg/m³ to 810 kg/m³ (average 645 kg/m³). Compression strength parallel to grain ranged from 49 MPa to 100 MPa (average 69 MPa), and static bending from 80 MPa to 188 MPa (average 121 MPa). Porosity ranged from 48% to 69% (average 60%). Total shrinkage in the radial direction averaged 5.33%, in the tangential direction 7.44%, and total volume shrinkage of wood 12.64%.

Keywords: structural, physical and mechanical properties of wood, location, forest habitat type, diameter class, Douglas fir