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The technical quality of wood of Scots pine (*Pinus sylvestris* L.) of diverse genetic origin

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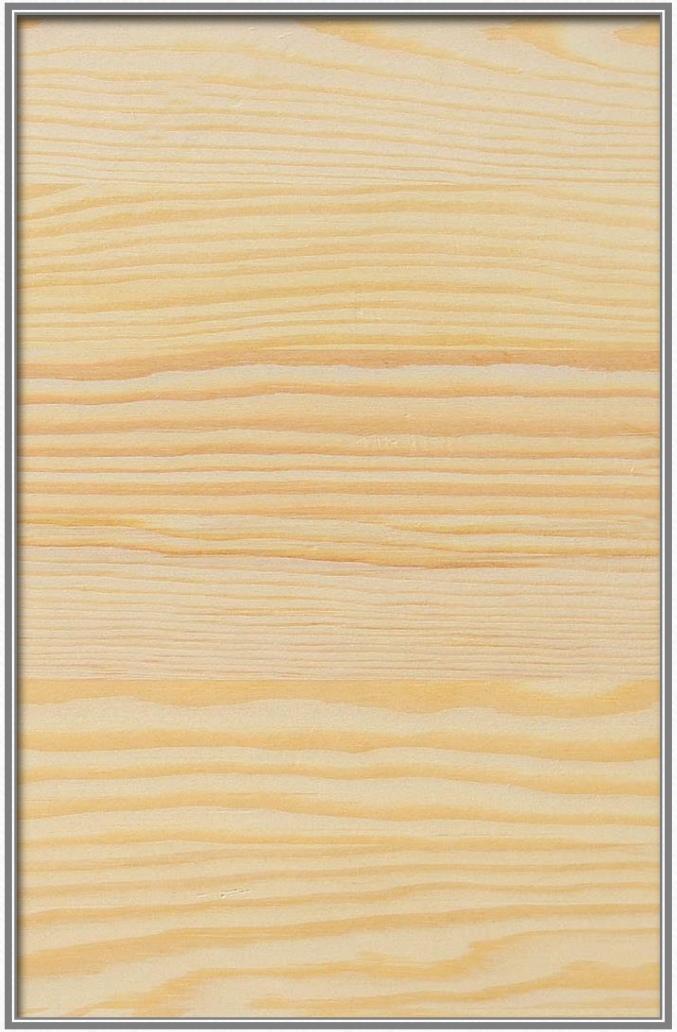
Scots pine (*Pinus sylvestris* L.)

has a range that covers the whole of Scandinavia, north-eastern areas of European Russia, and Siberia, extending eastward as far as the Sea of Okhotsk and the Sea of Japan. In Poland it is a dominant forest species, covering 66.5% of total forest area, according to figures for 1 January 2017 . It is found from sea level to mountain peaks up to around 2700 m above sea level in the Caucasus.

In Poland it occurs mainly in lowland areas, reaching elevations of 700 m in the Carpathians, although individual trees are found up to 1100 m above sea level.

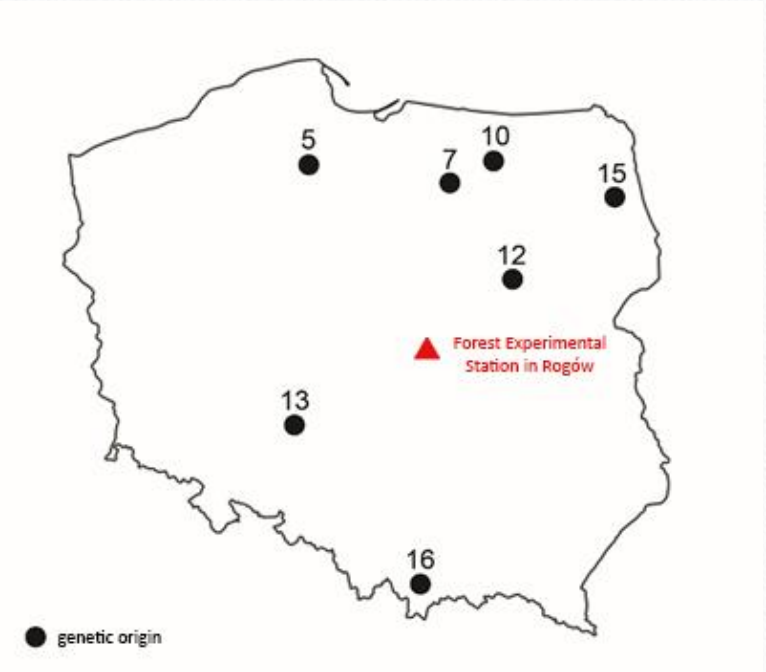
The technical quality of wood is affected by a number of factors:

- geographical location
- habitat type
- tree age
- quality of planting material
- genetics
- environment
- human factors



The aim of this work was to investigate selected physical and mechanical properties of the wood of Scots pine (*Pinus sylvestris* L.) with seven different genetic origins, grown on an experimental plot at the Forest Experimental Station in Rogów in Poland.

The experimental site is located in central Poland, at an elevation of 160 m above sea level. Average annual precipitation is 595 mm, and the average annual air temperature is 7.2 °C. All trees from the seven parent populations grow in a fresh mixed forest habitat, under identical growing conditions.



These are the parent stands numbered:

- 5 (Lipowa, in the Bory Tucholskie region 130 m a.s.l.)
- 7 (Dłużek, Lasy Napiwodzko-Ramuckie 145 m a.s.l.)
- 10 (Ruciane, Puszcza Piska 145 m a.s.l.)
- 12 (Jegiel, Puszcza Biała m 95 a.s.l.)
- 13 (Rychtal, Lasy Namysłowsko-Ostrzeszowskie 190 m a.s.l.)
- 15 (Supraśl, Puszcza Knyszyńska 165 m a.s.l.)
- 16 (Nowy Targ, Bory Nowotarskie 590 m a.s.l.)

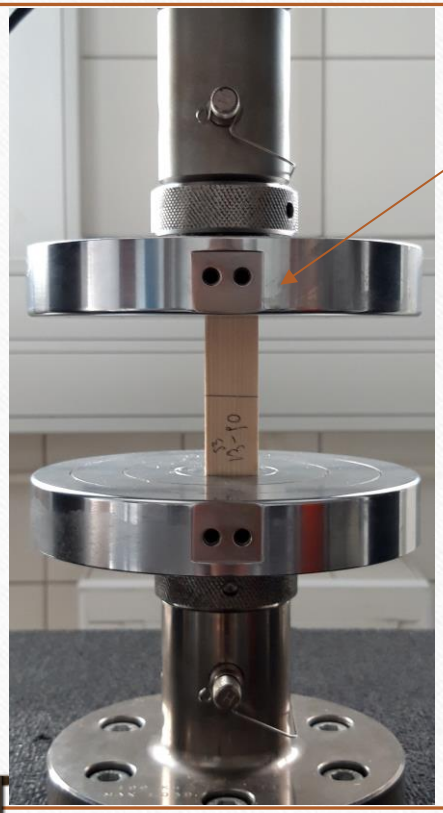
Methods

The tested wood was obtained in 2018 from trees aged 52 years. The research material came from 100 trees in total. After felling, two logs approximately 0.5 m in length were cut from each tree. The height on the tree from which the material was taken ranged from breast height (1.3 m) to approximately 2.5 m. Next, planks were cut from the logs in a north–south direction; these were precisely described, and then left to season. Samples were then produced for particular types of tests in accordance with the relevant provisions of the Polish Standards PN-77/D-04227.

The work included the measurement and statistical analysis of one physical property, wood density [kg/m^3] and of the following mechanical properties: compressive strength along the fibres, Rc_{12} [MPa]; static bending strength, Rg_{12} [MPa]; modulus of elasticity under static bending, Eg_{12} [MPa]; and indices of strength quality of the tested mechanical properties, JRc_{12}, JRg_{12}, JEg_{12} [km] according Polish standards.

The selected properties were measured at an absolute humidity of 12%.

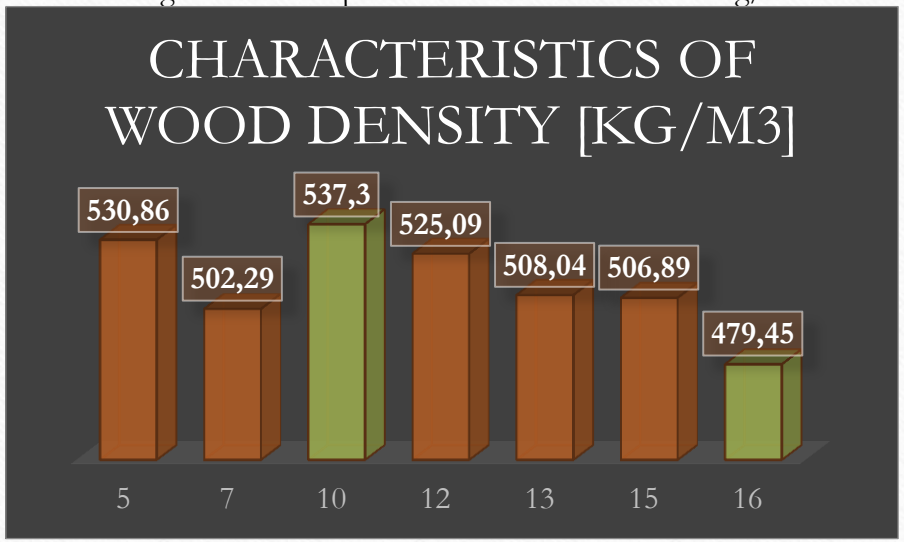
Modulus of elasticity under static bending (Eg_{12}) and static bending strength (Rg_{12}) were measured using an Instron 3369 instrument.

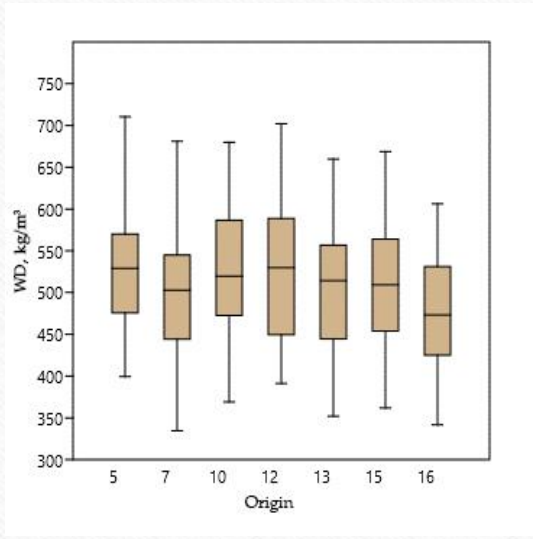


Compressive strength along the fibres (Rc_{12}) was determined using an Instron 3382 machine.

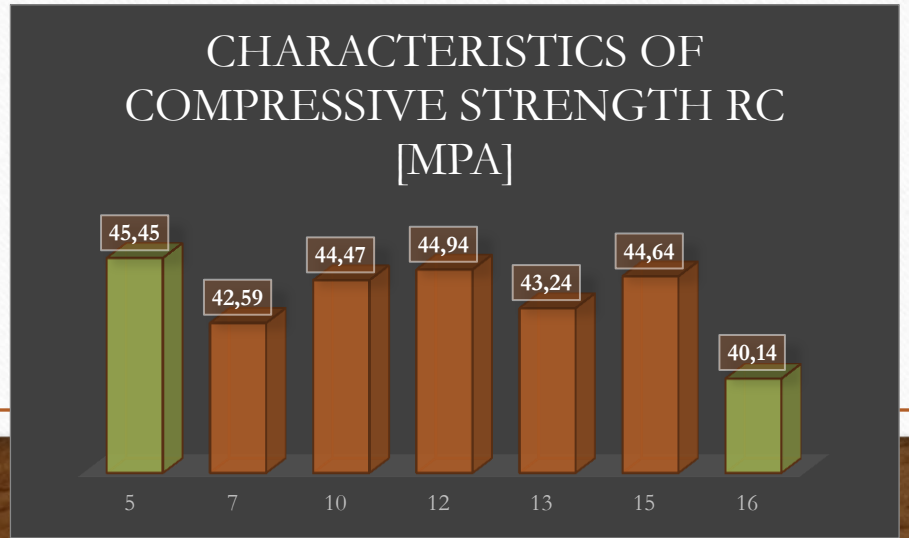
Results

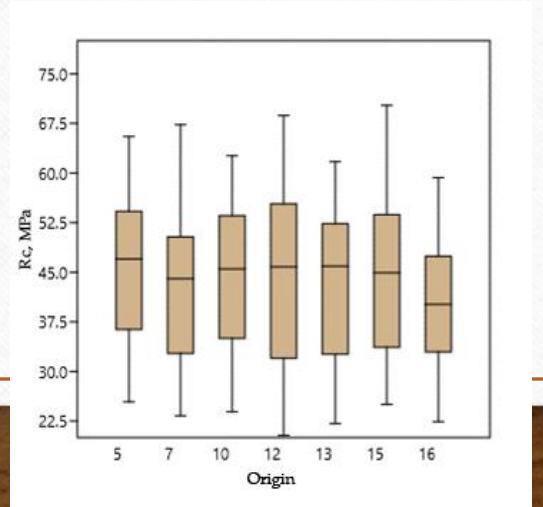
- The highest mean density was obtained for trees from stand 10 (537.30 kg/m^3), and the lowest for stand 16 (479.45 kg/m^3). The average density of Scots pine wood for all of the studied material at Rogów Forest Experimental Station was 513.76 kg/m^3.



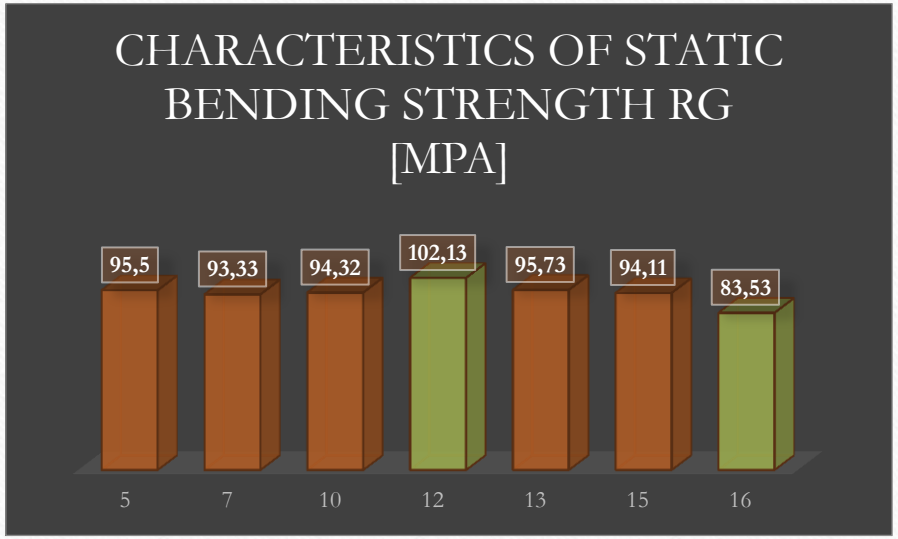


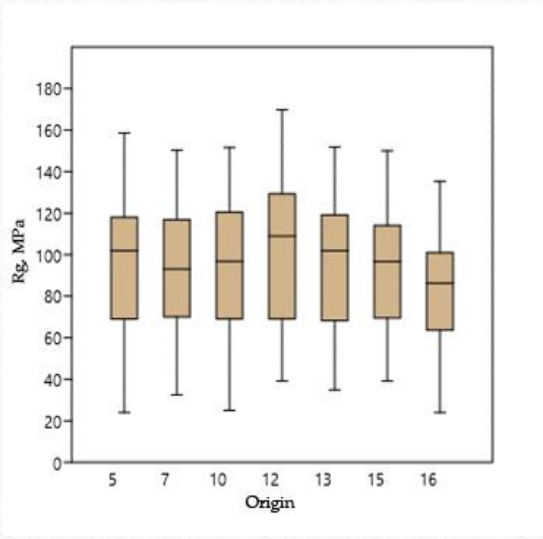
- The highest mean compressive strength (Rc) was obtained for stand 5 (45.45 MPa), and the lowest for stand 16 (40.14 MPa). For the whole of the studied material, the mean compressive strength along the fibres was 43.72 MPa.



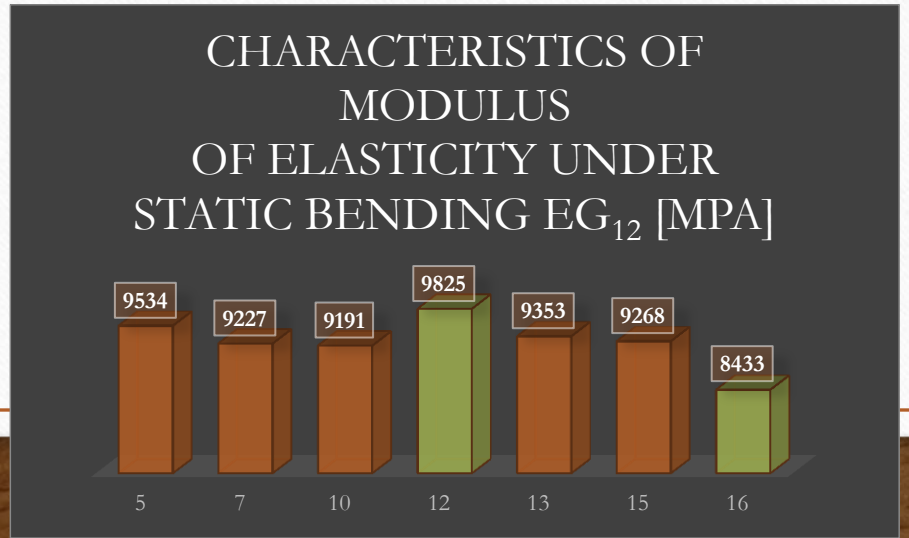


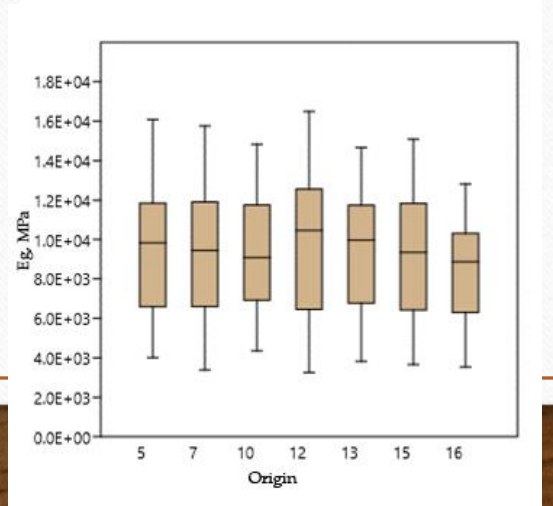
- The highest mean static bending strength (Rg) was found for wood from stand 12 (102.13 MPa), and the lowest for stand 16 (83.53 MPa). The mean for the whole of the studied material was 94.45 MPa.



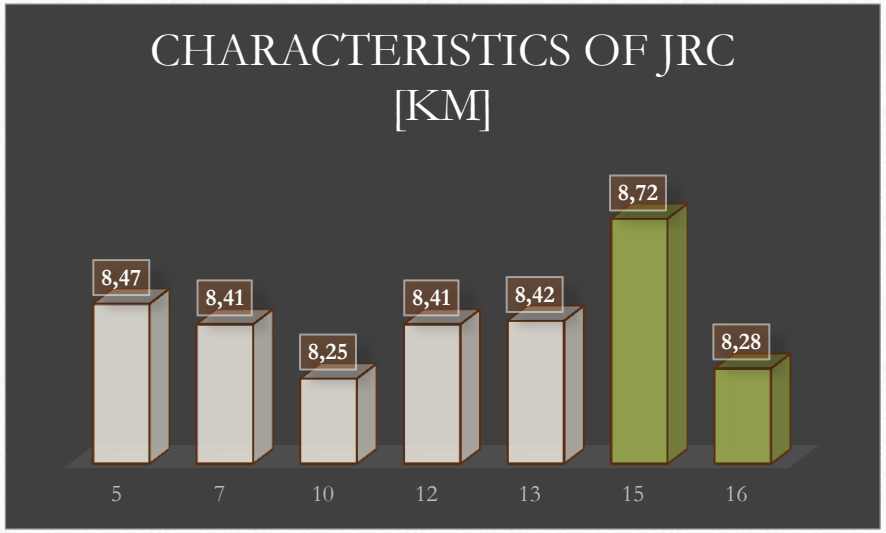


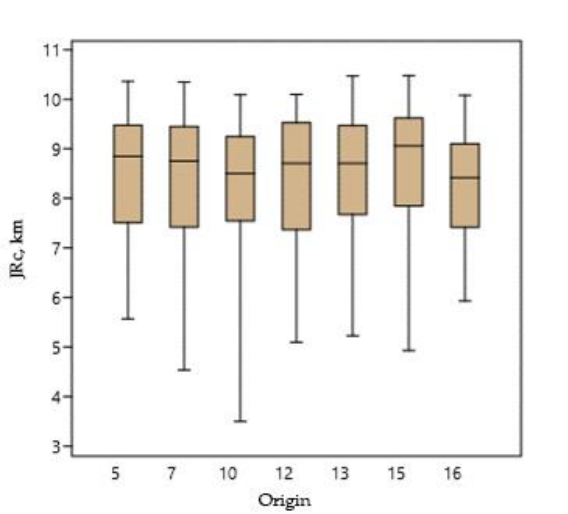
- The highest mean modulus of elasticity under static bending (Eg) was obtained for wood from stand 12 (9825 MPa), and the lowest for stand 16 (8433 MPa). For the whole of the studied material the mean value was 9291 MPa.



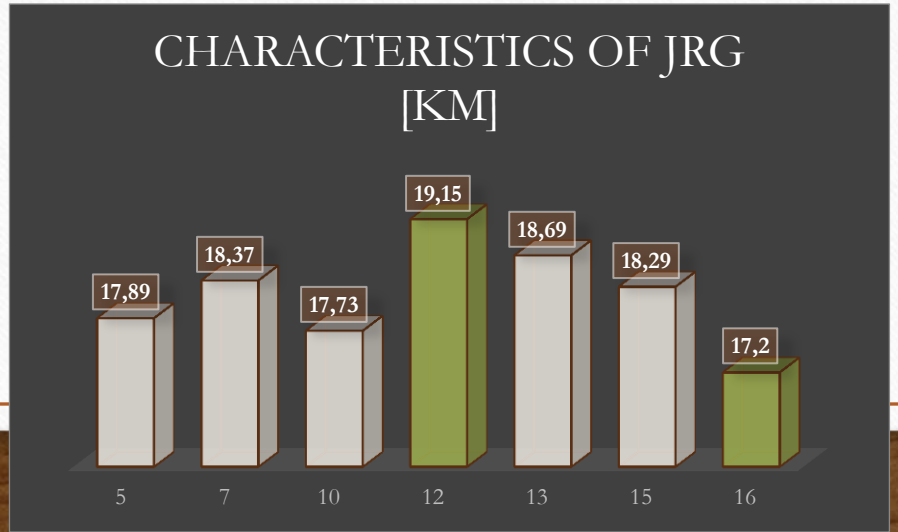


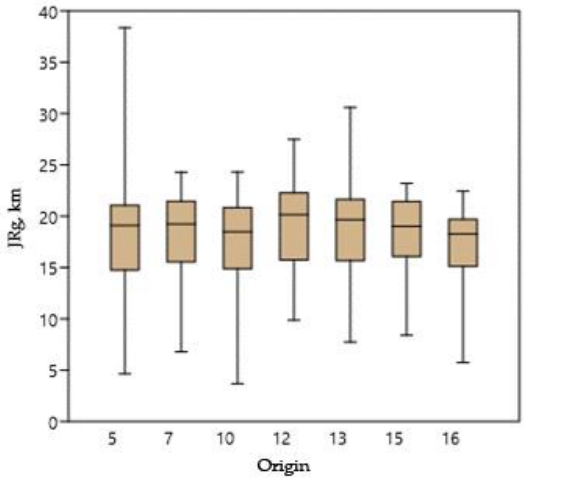
- The highest mean value of the index of strength quality under compression along the fibres (JRc) was determined for pine wood from stand 15 (8.72 km), and the lowest for stand 16 (8.28 km). For the whole of the studied material the mean value of this index was 8.42 km.



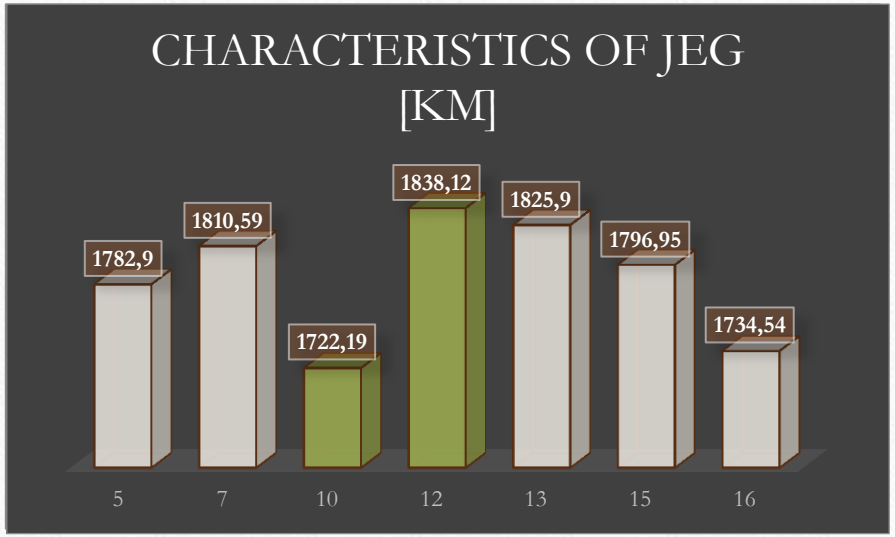


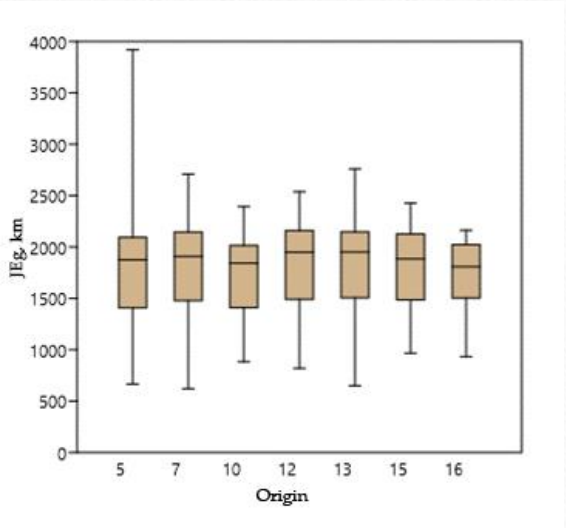
- The highest mean value for the index of strength quality under static bending (JRg) was obtained for wood from stand 12 (19.15 km), and the lowest from stand 16 (17.20 km). The mean value of this index for the whole of the studied material was 18.23 km.





- For the index of strength quality related to the modulus of elasticity under static bending (JEg), the highest mean value was obtained for wood from stand 12 (1838.12 km) and the lowest for stand 10 (1722.19 km). For the whole of the studied material the mean value was 1790.40 km.





Conclusions

- It was shown that the technical quality of the wood of Scots pine (*Pinus sylvestris* L.) growing in the environmental conditions of central Poland, defined on the basis of physical and mechanical properties, exhibits significant differences depending on its genetic origin.
- Origin was shown to have a significant influence on wood density, compressive strength, static bending strength, and modulus of elasticity under static bending.
- The highest mean density was found for trees originating from stand 10 (533 kg/m^3) and stand 5 (531 kg/m^3). The highest values of compressive strength were obtained for trees originating from stands 5 and 12 (45 MPa), and the highest static bending strength and modulus of elasticity under static bending were obtained for trees originating from stand 12 (102 MPa and 9868 MPa respectively).

- The lowest values of the studied properties were obtained for trees originating from stand 16 (Nowy Targ 590 m a.s.l.).
- The results indicate that it ought to be possible to select the origin of planting material so as to obtain the highest quality and productivity of future stands.

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Thank you for your attention.