

OCCURENCE OF SAPWOOD AND HEARTWOOD IN STEMS OF SCOTS PINES (*Pinus sylvestris* L.) GROWN IN CONDITIONS OF MIXED FRESH CONIFEROUS FOREST

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An attempt was undertaken to state if there exists relation between share of sapwood and heartwood in volume of merchantable stems of Scots pines, and selected biometric features of trees. Analysed was interdependence of both kinds of wood with breast diameter, length of crown, area of crown projection, and number of whorls of living crowns at Scots pines grown in conditions of habitat of mixed fresh coniferous forest.

Key words: Scots pine, biometric features of crowns, breast diameter of tree, sapwood, heartwood, mixed fresh coniferous forest

INTRODUCTION

Accordingly to the forecasts concerning the development of the forest-wood sector in Europe up to 2020 year, it is evaluated that, harvesting of wood from the European forests will be increasing from 390 mln m³ in the year 1990, to ca 480-490 mln m³ in the year 2020 (ECE/FAO 1996). It will be an increase about 24%.

From the said forecasts results, that the extent of harvest executed in the European forests will be only 70% of yearly growth of wood, what in result will contribute to the further increase of forest resources in this part of the world, and also in Poland. But there is to be stressed, that there is expected intensive increase of European wood processing industry. In the interval of years 1990 to 2020 is forecasted increase of production; sawn timber 25-35%, particleboards about 20%, cellulose about 30% and paper ca 50% (Strykowski 1996).

The demand for wood raw material in Poland, will be increasing, what is bound strictly with economic increase (Głaz 1996). The use of wood for one inhabitant at home is exceptionally low, and presently is 0.50 m^3 , while in Europe in on an average it is 0.70 m^3 , and in highly developed countries 1.0 up to 1.5 m^3 (Głaz 1996)

Accordingly to the estimations, present deficit of timber and its products in Poland is yearly 6 mln m^3 , and from 2020 could increase up to 10 mln m^3 (Głaz 1996). Due to this deficit of timber, their producers, that is foresters, have to elaborate methods allowing improvement of situation in range of production and proper uses of wood raw material

An important structural element of pine wood, which is to be taken into account during its evaluation and uses is the occurrence of sapwood and heartwood.

Differentiation of properties of sapwood and heartwood is conditioning often various uses of both kinds of wood (Krzysik 1974, Duda and Pazdrowski 1975, Mućk 1984 a,b, Trendelenburg and Mayer- Wegelin 1955). The basic knowledge of quantitative proportions of sapwood and heartwood in the merchantable stems of Scots pines and interrelations among the selected, and in the same easy to assesment biometric elements of trees grown in condition of forest type - mixed fresh coniferous forest, will have essential meaning in improvement of production process of wood raw material in Polish forests.

The share of area of mixed fresh coniferous forest in Polish forests reaches about 21 % (Praca zbiorowa 1990). It is to be stressed, that this forest habitat type is extremely favourable for production of pine timber with high valours (in the range of knottiness), what was verified by the studies of Pazdrowski (1988).

The scope of this study is an attempt to state if exist, and how are forming the relationships between breast diameter of trees, selected quantitative features of their crowns, and share of sapwood and heartwood in stems of Scots pines (*Pinus sylvestris* L.) grown in conditions of mixed fresh coniferous forest.

EXPERIMENTS

Studies were carried out in eight Scots pine forest stands belonging to the so called „Puszcza Notecka“. They were grown in conditions of mixed fresh coniferous forest. The said forest stands were selected so, that their age was in the range from 27 to 95 years. The experimental areas in the one after other forest stands were situated so, to be representative for them. The detailed description of the methods of studies, that are measurements, selection of sample trees and selection of material for tests were presented by Pazdrowski and Splawa -Neyman (1996).

Collected results characterising magnitude of crowns of pines, that is their -length and area of crown projection, number of whorls of living branches, thickness of trees on the breast diameter (1.30 m above ground), and share in volume of the tree stem of sapwood and heartwood enabled to perform analysis of inter-relations between abo-

ve said features. Care was taken to state in what shape particular biometric features are related to some elements of macrostructure of timber, that is sapwood and heartwood. In this study said relations were characterised by correlation coefficients and linear dependencies.

RESULTS

In this study the magnitude of crown, which reflects social position of trees in forest stand, has been characterised by the length, area of crown projection, and number of whorls of living branches (Table 1).

Table 1

Tabela 1

Statistical characteristics of biometric features of trees of Scots pines grown in conditions of mixed fresh coniferous forest

Charakterystyka statystyczna cech biometrycznych drzew sosny zwyczajnej w warunkach siedliskowego typu lasu boru mieszanego świeżego

Measures Miary	Biometric features of trees Biometryczne cechy drzew			
	Breast diameter of tree Pierśnica drzewa [cm]	Crown length Długość korony [m]	Area of crown projection Pole rzutu korony [m ²]	Number of whorls Liczba okółków [pcs] [szt]
Arithmetic mean Średnia arytmetyczna	20.0	5.89	6.535	39
Standard deviation Odchylenie standardowe	7.13	1.46	5.338	14.96
Variation coefficient [%] Współczynnik zmienności	35.6	24.7	81.7	38.1

The average length of the crown consisting of living branches was 5.89 m., and at the same time variability of this quantitative feature of crown reached 24.7% what is presented by calculated variability coefficient. The area of crown projection and the number of whorls of living branches at pines grown in conditions of mixed fresh coniferous forest were in average 6.535 m² in the first and 39 pieces in the second case.

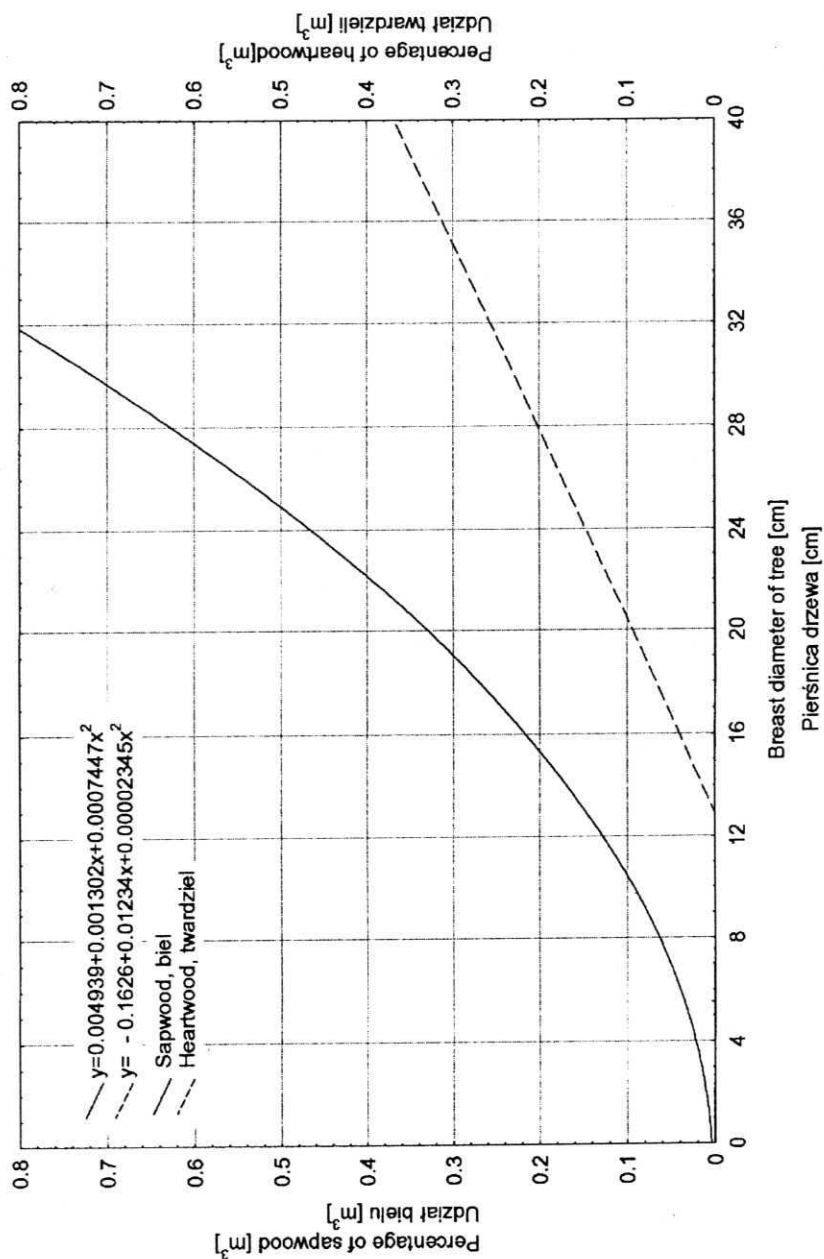


Fig. 1. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of mixed fresh coniferous forest upon breast diameter of tree

Rys. 1. Zależność udziału drewna bielastego i twardzielowego w strzałach sosen zwyczajnych wyrosłych w warunkach boru mieszanego świeżego, od piersnicy drzewa

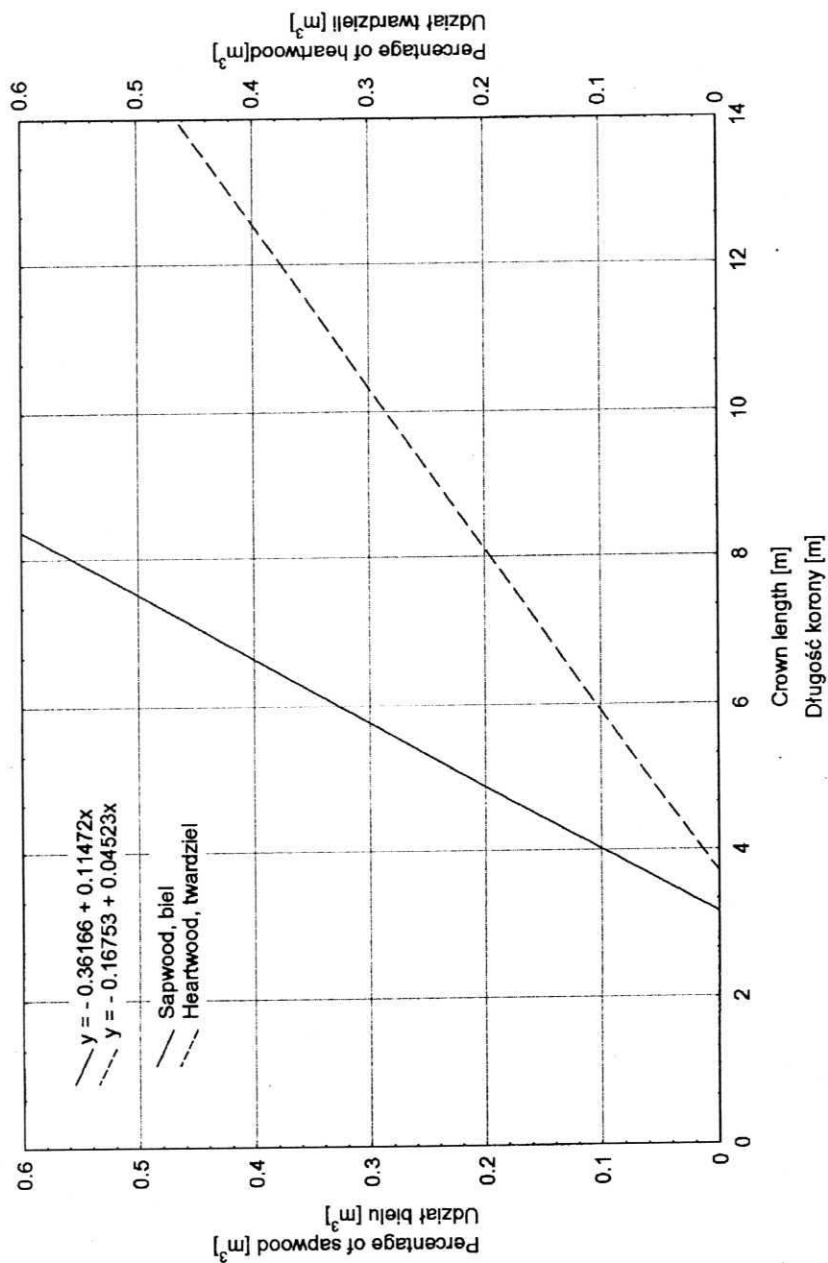


Fig.2. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of mixed fresh coniferous forest upon the length of live crown of tree
 Rys.2. Zależność udziału drewna białego i twardzielowego w strzałach sosen zycząjnych wyrosłych w warunkach boru mieszanego świeżego, od długości żywej korony

Table 2

Tabela 2

Correlation coefficient* concerning the share of sapwood and heartwood in stems of Scots pines grown in the mixed fresh coniferous forest and breast diameter and some crown features

Współczynnik korelacji* między udziałem drewna bielastego i twardzielowego w objętości strzał sosny zwyczajnej wyrosłej w warunkach boru mieszanego świeżego a pierśnicą i pewnymi cechami korony

Kind of wood Rodzaj drewna	Breast diameter Pierśnica [cm]	Crown features Cechy korony		
		Crown length Dług. korony [m]	Area of crown projection Powierzchnia rzutu korony [m ²]	Number of whorls Liczba okółków [pcs/szt]
Sapwood Biel	0.9734	0.7363	0.9089	0.6552
Heartwood Twardziel	0.8672	0.5837	0.8456	0.7288

*significance of dependence at $P=0.99$
istotność zależności przy $P=0.99$

The calculated variation coefficients reached 81.7 % and 38.1 % for this biometric features. In the Table 1 were presented also average breast diameters of the stems (on the height of 1.30 m above the ground), which was in average 20.0 cm, and calculated variation coefficient of this biometric feature was 35.6 %.

Interdependence of share of sapwood and heartwood with breast diameter is very distinct. This accordance is verified by calculated correlation coefficients (Table 2) and regressions equations (Fig. 1). The correlation coefficients are very high and essential equal to + 0.9734 for sapwood, and + 0.8672 for heartwood. It is to be stressed there, that studied dependence is directly proportional, and the heartwood occurs at pines, which have breast diameter above 13.0 cm, that is in conditions described above at the age of 30 years (Czuraj 1990). The correlation of the crown length with the share of sapwood and heartwood in the stem is also distinct and directly proportional. Said dependencies are straight linear (Fig. 2). The correlation coefficients characterising this relation were as follows: + 0.7363 for sapwood, and + 0.5837 for the heartwood. In both cases correlation coefficients were very essential (Table 2).

Interdependence of share of sapwood and heartwood in stems from area of living crown projection of pines is very essential. Values of calculated coefficients were very high and are for sapwood + 0.9089, and for heartwood + 0.8456. This relation is characterised by directly proportional dependence (Fig. 3).

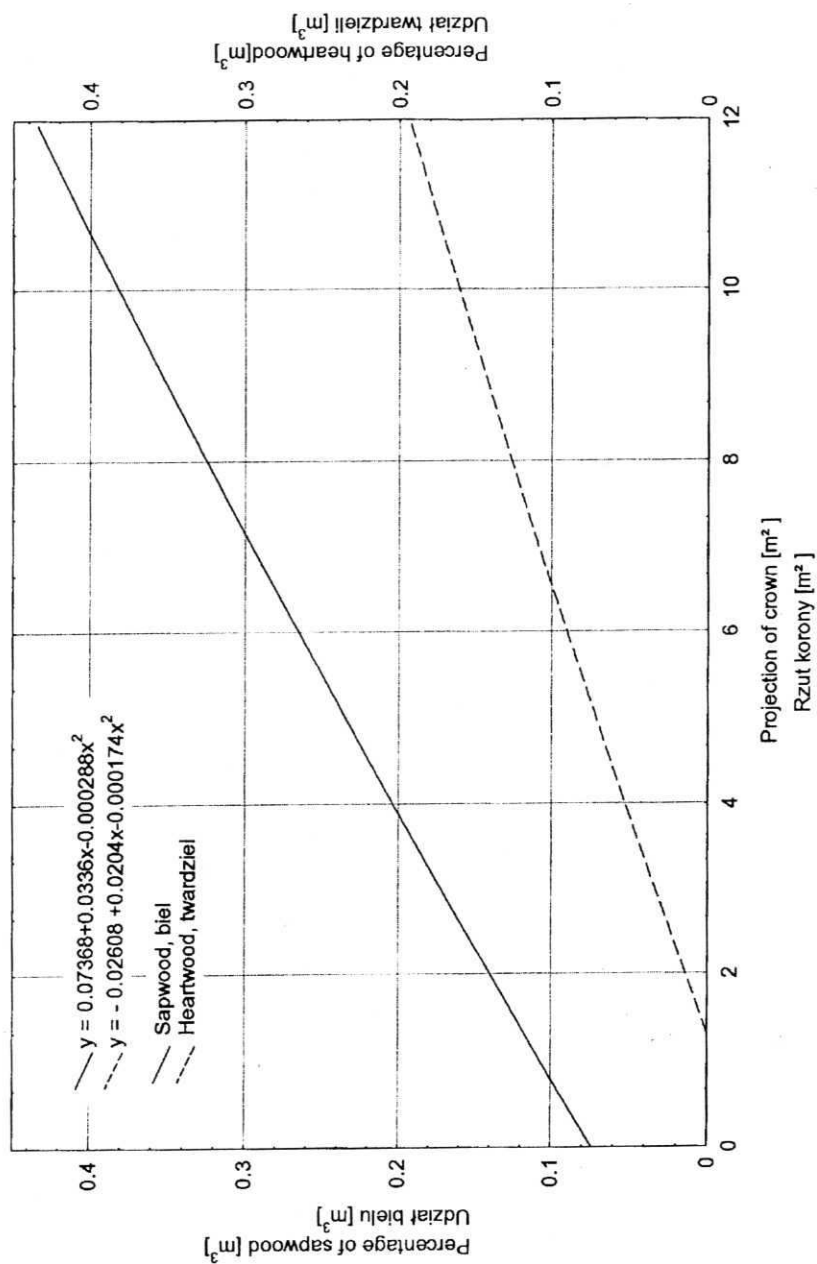


Fig.3. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of mixed fresh coniferous forest upon area of live crown projection of tree

Rys.3. Zależność udziału drewna białego i twardzielowego w strzałach sosen zwyczajnych wyrosłych w warunkach boru mieszanego świeżego, od powierzchni rzutu żywej korony

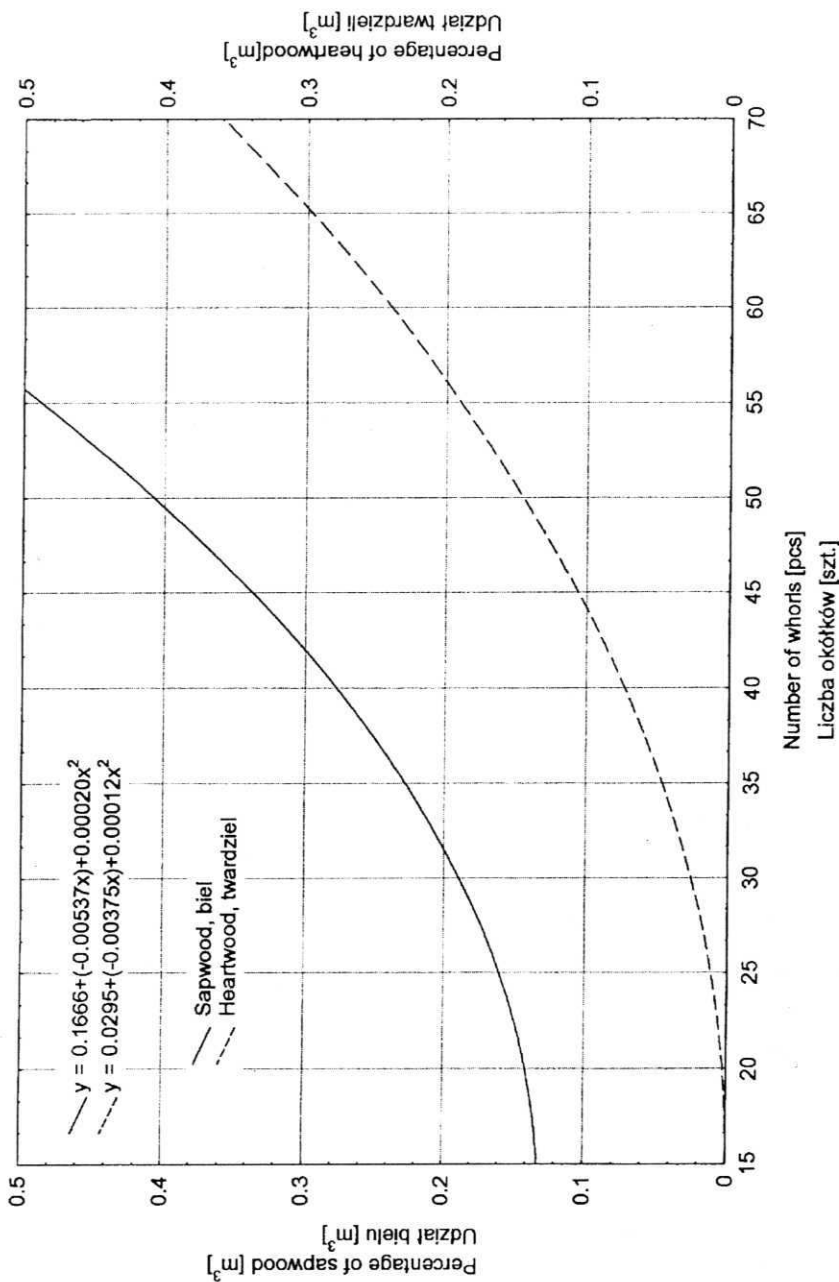


Fig.4. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of mixed fresh coniferous forest the number of whorls of live branches

Rys.4. Zależność udziału drewna bielastego i twardego w strzałach sosen zwyczajnych wyrosłych w warunkach boru mieszanego świeżego, od liczby okółków żywych gałęzi.

The number of whorls of living branches is correlated with share of both kinds of wood in volume of stem of Scots pines grown in conditions of mixed fresh coniferous forest (Fig. 4 and Table 2). Said dependences are directly proportional and have curvilinear character. Calculated correlation coefficients are positive and essential, and their value is +0.6552 in case of sapwood, and + 0.7288 for heartwood.

The close analysis of obtained results of studies shows that breast diameter of tree, and each from studied quantitative features of pines crowns in this studies is correlated very distinctly with the share of sapwood and heartwood in volume of stems of trees. Due to this fact the breast diameter and each of studied quantitative features could be of use in share of both kinds of wood in stems of our most popular forest tree species. Magnitude of correlation coefficients will be tending to use: breast diameter and magnitude of crown, for assesment of trees. However the breast diameter beeing easy to determine is on the first place.

CONCLUSIONS

1. It was stated that there exists occurence of very essential interdependences between analysed quantitative features of crowns of trees, their breast diameters and share of sapwood and heartwood in volume of stems of Scots pines grown in conditions of mixed fresh coniferous forest.
2. Studied relations are characterised by dependence as well curvilinear as straight linear and directly proportional, and calculated correlation coefficients were in the range from + 0.5837 to + 0.9734.
3. Each from analysed biometric features of Scots pines grown in conditions of mixed fresh coniferous forest could be suitable in evaluation of share of sapwood and heartwood in stems of trees, and in the same to contribute to more rational use of wood raw material.

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WYSTĘPOWANIE BIELU I TWARDZIELI W STRZAŁACH SOSEN ZWYCZAJNYCH (*Pinus sylvestris* L.) WYROSŁYCH W WARUNKACH BORU MIESZANEGO ŚWIEŻEGO

Streszczenie

W pracy podjęto próbę określenia kształtowania się zależności między udziałem biału i twardzieli w miąższości strzał sosen zwyczajnych, a niektórymi cechami biometrycznymi drzew. Szczegółowo analizowano współzależność obu rodzajów drewna z pierśnicą drzew, długością korony, powierzchnią rzutu korony i liczbą okółków żywych gałęzi u sosen wyrosłych w warunkach siedliskowego typu lasu boru mieszanego świeżego.

Stwierdzono występowanie bardzo istotnych współzależności między analizowanymi cechami ilościowymi koron drzew, ich pierśnicą, a udziałem drewna białego i twardzielowego w miąższości strzał. Rozpatrywane związki charakteryzowały się zależnościami zarówno krzywoliniową jak również prostoliniową i wprost proporcjonalną. Każda z analizowanych cech biometrycznych sosen wyrosłych w warunkach boru mieszanego świeżego może być przydatna w ocenie udziału biału i twardzieli w miąższości strzał drzew, a tym samym przyczynić się do bardziej racjonalnego wykorzystania surowca drzewnego.

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