

## ON THE OCCURRENCE OF SAPWOOD AND HEARTWOOD IN STEMS OF SCOTS PINES GROWN IN CONDITIONS OF MIXED FRESH BROADLEAVED FOREST

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This paper is an attempt to state to what degree thickness the tree expressed by the breast diameter, and also the length of the living crown, area of its projection, and number of the whorls of living branches, are conditioning the share of sapwood and heartwood in the volume of merchantable bole. Investigated were pines, which were grown in conditions of fresh mixed broadleaved forest.

**Key words:** sapwood, heartwood, whorl of branches, crown projection area

### INTRODUCTION

The area of forested terrain's under management of PGL – State Forests is 80% of forests area in general. Said forests are characterised by considerable area of coniferous species of trees, which jointly are covering 77.9% of forested area, while the rest that 22.1% is under broad-leaved species. Among coniferous species Scots pine (*Pinus sylvestris* L.) covers 69.4% of forested area of Poland (Głaz 1996, Praca zbiorowa 1997). It is forests creating species with small edaphic requirements, and with wide adopting abilities for the various habitats. Accordingly to Przybylski (1993) the amplitude of possibilities is in this area very wide from poor, sandy soils e.g. duries, or stands with trace nutrition mineral substances and analogical in this respect oligotrophical raised mass even to rich habitats of mixed broad-leaved forests – anywhere we can find Scots pine. The share of such forest stand type – fresh mixed broad-leaved forest in State Forest in 1995 year was 13.1% (Praca zbiorowa 1997).

The abundance of pine stands, their dendrometrical parameters and production of timber are closely correlated with fertility of soils and quality of habitat type. From the literature it is known, that to fertile stand in confrontation with needs of pine – that is

very essential factor disturbing proper production of valuable pine timber (Dziewanowski 1965, Jackowski 1972, 1973a, b, Pazdrowski 1988). Very essential structural element of pine timber, which is to be taken into account in course of its evaluation and use, is occurrence of sapwood and heartwood. Differentiation of properties of sapwood and heartwood is conditioning the kind of its use (Duda, and Pazdrowski 1975, Krzysik 1974). The knowledge of quantitative ratios, and correlation's of them with easy to evaluate biometrics parameters is very essential. Such evaluation and knowledge will contribute to processing and uses of pine timber.

The scope of this work is some attempt to state, if there are existing, and how are forming correlation's between selected biometrics parameters of trees, and the share of sapwood and heartwood in merchantable boles of Scots pines grown in conditions of fresh mixed broad-leaved forest.

## MATERIALS AND METHODS

Studies were carried out in pine stands of Experimental Forests Station in Zielonka, Forest District Rakownia.

They have grown in conditions of forest type – fresh mixed broadleaved forest. The examined forests were selected so, that their age was in division from 27-60 years. The experimental areas in next forest stands were localised so that they were representative for them. The detailed description method of examination, selection of trees, their measurements and sampling were presented in publication of Pazdrowski, and Spława-Neyman (1996).

The collected data characterising magnitude of living crowns of pines, that is their length, area of projection, number of living branches, thickness of trees on the height of 1.30 m of stem (breast diameter), and share in volume of merchantable bole of sapwood and heartwood enabled conducting of the analysis of interdependence of said parameters. An attempt was made to state above all to the what degree selected biometrics features of trees are connected with such elements of macrostructure of timber as sapwood and heartwood.

In presented work said relations were characterised by coefficients of correlation and linear relationships.

## RESULTS

Statistical characteristic of selected biometrics features of Scots pines is presented in Table 1. The mean length of live crown was 5.79 m, and the variability of this was on the level 25.2%. The area of crown projection and number of whorls of the living crown of trees grown in conditions of fresh mixed broad-leaved forest were properly 5.66 m<sup>2</sup> and 16 pieces. The calculated coefficients of variation reached 66.3% for the first feature and 28.4% for the second one. The mean breast diameter of trees, that is di-

ameter of stems on the height 1.30 above the ground was 16.2 cm. The variation of this biometrics feature expressed by variation coefficient reached 31.9% (Table 1).

Table 1

Tabela 1

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

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

Measures Miary	Biometric features of trees Biometryczne cechy drzew			
	Breast diameter of tree Pierśnica drzewa [cm]	Live crown length Długość żywej korony [m]	Area of crown projection Pole rzutu korony [m <sup>2</sup> ]	Number of whorls Liczba okółków [pcs] [szt.]
Arithmetic mean Średnia arytmetyczna	16.2	5.79	5.66	16
Standard deviation Odchylenie standardowe	5.17	1.46	3.76	4.67
Variation coefficient [%] Współczynnik zmienności	31.9	25.2	66.3	28.4

The relation between share of sapwood and heartwood in the volume of stems of pines grown in conditions of fresh mixed broadleaved forest, and the breast diameter of trees is very district and highly significant. This is verified by calculated coefficients of correlation (Table 2), and regression equations (Fig. 1). The correlation coefficients characterising above relation are high and are +0.9322 for sapwood, and +0.7699 for heartwood. Discussed relation is directly proportional, while heartwood appeared in pines which breast diameter reached 4 cm. Such breast diameter in conditions of fresh mixed broadleaved forest pines reach in age of about 20 years (Czuraj 1990).

Interrelation of the length of living crown with share of sapwood and heartwood in stems of pines (Fig. 2) is also directly proportional, but significant only in case of sapwood. Coefficient of correlation characterising this relation was +0.6987 (Table 2). The correlation of the area of living crown projection of trees, and the share of sapwood and heartwood in their stems is very significant in case of sapwood and significant for heartwood (Table 2). Values of calculated coefficients of correlation are relatively high, and are for sapwood +0.9119 and for heartwood 0.6790. This relation is characterised by the directly proportional correlation (Fig. 3).

Number of whorls of living branches is correlating with the share sapwood and heartwood in the volume of trees grown in conditions of fresh broadleaved forest (Fig. 4, and Table 2). As well regression curves, as calculated coefficients of correlation are indicating, that said relations are directly proportional, and have curvilinear character. Correlation coefficients characterising discussed relations are positive, and highly significant, and their values are +0.8855 in case of sapwood, and +0.8956 for heartwood.

Table 2

Tabela 2

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

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

Kind of wood Rodzaj drewna	Breast diameter of tree Pierśnica drzewa [cm]	Crown features Cechy korony		
		Live crown length Długość żywej korony [m]	Area of crown projection Pole rzutu korony [m <sup>2</sup> ]	Number of whorls [pcs] Liczba okółków [szt.]
Sapwood Biel	0.9322**	0.6987*	0.9119**	0.8855**
Heartwood Twardziel	0.7699**	0.4482	0.6790*	0.8956**

\*\* significance of dependence at  $P=0.99$   
istotność zależności przy  $P=0,99$

\* significance of dependence at  $P=0.95$   
istotność zależności przy  $P=0,95$

In recapitulation it can be stated, that the breast diameter, and also each of reviewed quantitative features of crowns of the trees, which were grown in conditions of fresh mixed broad-leaved forest is correlating exceptionally distinctly with the share of sapwood and heartwood in the volume of stems of trees.

Exception can be there interdependence among the length of living crown and the share of heartwood in stem, because in this case was not found significant statistical dependence.

The magnitude of correlation coefficients and significance of dependence would be leading in evaluation, area of projection, and number of whorls of living branches.

But due to, that breast diameter of trees is the feature easy to determine and is very significantly bound with the share of both kinds of wood in volume of stems of pines it is tending to occupy first place. In the works of Pazdrowski, and Spława-Neyman (1996, 1997, 1998) were analysed above correlation at pines grown in conditions of dry coniferous forest, fresh coniferous forest and mixed fresh coniferous forest.

There was also found correlation between breast diameter of trees, selected quantitative features of crowns, and the share of sapwood and heartwood in the volume of stems.

In general it is to state, that in the range of analysed forest stand types discussed relations expressed themselves with various intensity.

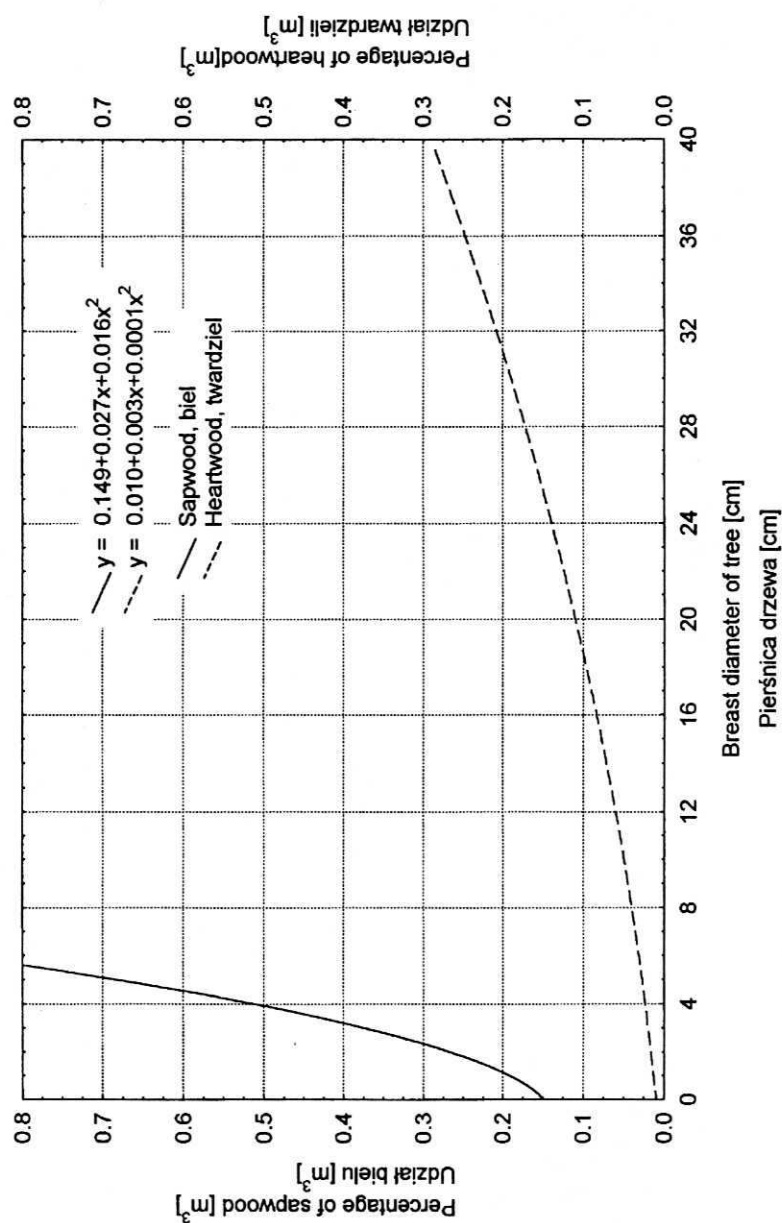


Fig. 1. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of fresh mixed broadleaved forest from breast diameter of tree

Rys. 1. Zależność udziału drewna bielastego i twardzielowego w strzałach sosen zwyczajnych wyrosłych w warunkach lasu mieszanego świeżego od pierśnicy drzewa

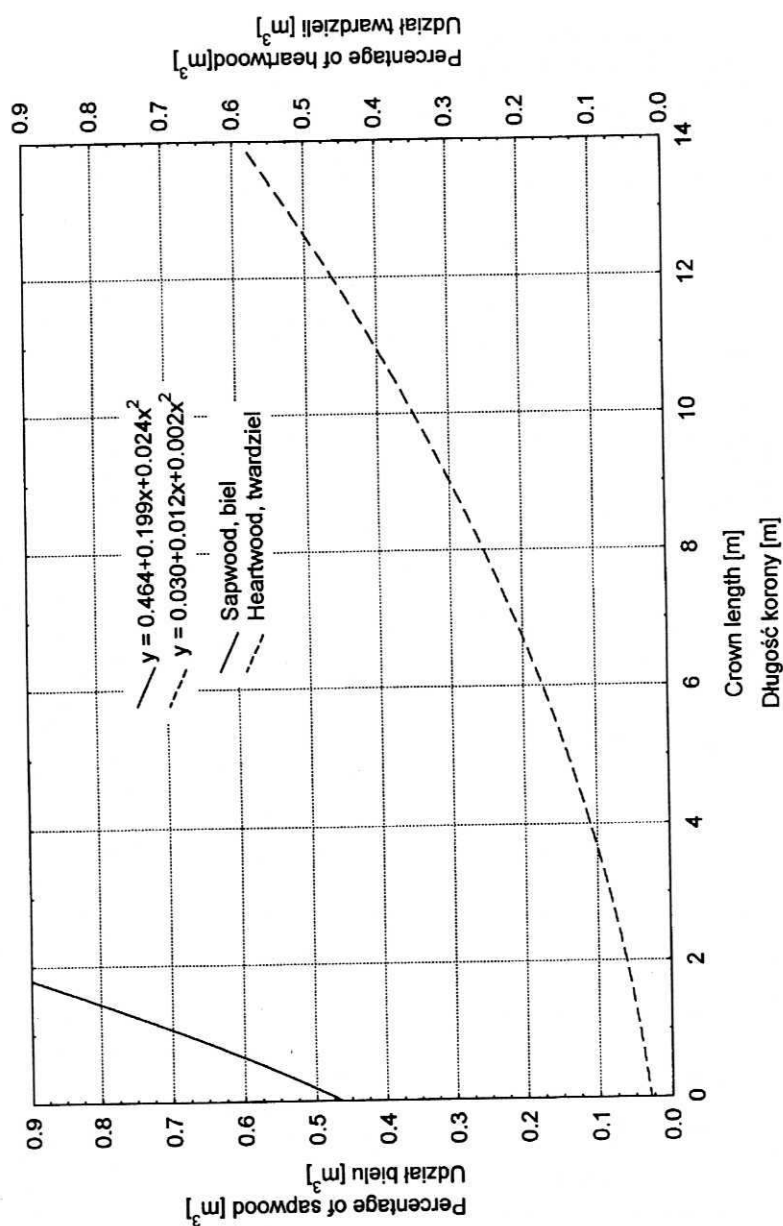


Fig. 2. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of fresh mixed broadleaved forest from the length of live crown

Rys. 2. Zależność udziału drewna bielastego i twarzielowego w strzałach sosen zwyczajnych wyrosłych w warunkach lasu mieszanego świeżego od długości żywej korony

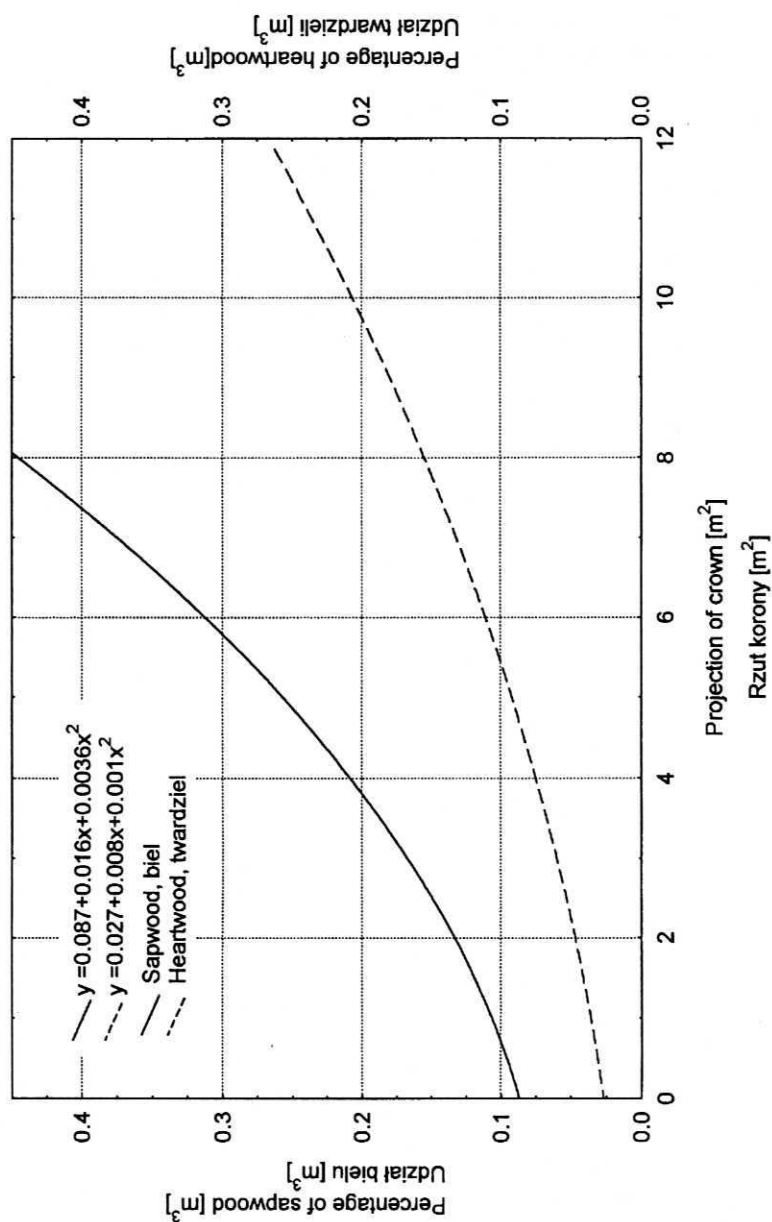


Fig. 3. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of mixed broadleaved forest from area of live crown projection

Rys. 3. Zależność udziału drewna bielastego i twardzielowego w strzałach sosen zwyczajnych od długości żywej korony

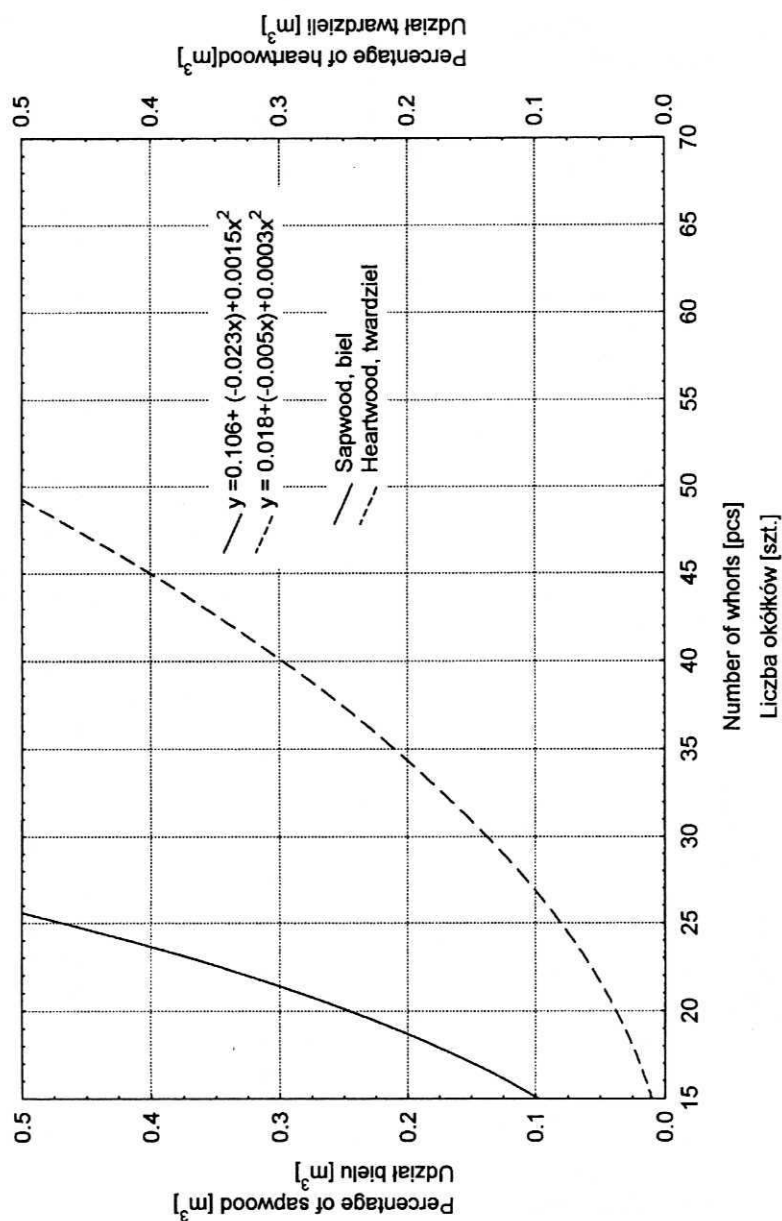


Fig. 4. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of mixed broadleaved forest from the number of whorls of living branches

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



## CONCLUSIONS

1. Studies revealed existence of very significant correlation coefficient among breast diameter of trees and analysed quantitative features of their living crowns and the share of sapwood and heartwood in volume of pines stems, which have grown in conditions of mixed fresh broadleaved forest.
2. The reviewed relations are characterised by curvilinear and directly proportional dependence. Calculated correlation coefficients were rather high and were oscillating from +0.4482 to +0.9322, while the lowest one has not been significant.
3. In principle each of analysed biometric features of pines, which have had grown in connotations of very rich habitat-that is mixed fresh broadleaved forest could be helpful in evaluation of share of the sapwood and heartwood in volume of stems, and thus contribute to rational economy of wood raw material.

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## WYSTĘPOWANIE BIELU I TWARDZIELI W STRZAŁACH SOSEN ZWYCZAJNYCH WYROSŁYCH W WARUNKACH LASU MIESZANEGO ŚWIEŻEGO

### Streszczenie

W pracy podjęto próbę określenia kształtowania się zależności między udziałem biału i twardzieli w miąższości pni sosny zwyczajnej (*Pinus sylvestris* L.) i wybranych cech biometrycznych drzew. Analizowano współzależności obu rodzajów drewna z pierśnicą sosen, długością żywej korony, powierzchnią rzutu korony i liczbą okółków żywych gałęzi u drzew wyrosłych w warunkach lasu mieszanego świeżego.

Stwierdzono występowanie zarówno bardzo istotnych, jak też istotnych współzależności między udziałem biału i twardzieli w strzałach, a analizowanymi cechami biometrycznymi. Analizowane związki charakteryzują się zależnością krzywoliniową i wprost proporcjonalną.

Rozpatrywane cechy biometryczne mogą być przydatne do szacowania udziału obu rodzajów drewna w strzałach sosen, które wyrosły w warunkach lasu mieszanego świeżego.

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