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INTERDEPENDENCE BETWEEN SOME GROWTH PARAMETERS AND WOOD FEATURES OF SCOTS PINE GROWN IN FRESH FOREST CONDITIONS

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Attempt was undertaken to determine the formation of depedence upon share of sapwood and heartwood in the mass of stems of Scots pine (*Pinus sylvestris* L.) and some biometric parameters of trees.Studies were devoted to analysis of interdependence of two kinds of wood and breast diameter of trees, length of crowns,area of crown projection and number of whorls of living branches in pines grown in conditions of fresh forest .

Key words: Scots pine, biometric parameters, share of sapwood and heartwood, breast diameter, fresh forest

INTRODUCTION

Forests in Poland are characterised by great share of softwood species, which jointly are covering 77.9% of total forested area, and in this Scots pine grows on 69.4% of area, spruce 6.0% and fir 2.5% (Głaz 1996, Praca zbiorowa 1996). From that results conclusion, that at the present and in the nearest future demands for wood and wood materials will be covered by this wood species.

Scots pine belongs to the forest creating species with especially wide ecological amplitude ,what allows for its growth as well on extremly hungry soils, such as dry forests, more fertile (fresh forests and mixed fresh forests), and fertile broadleaved forests (Assmann 1961, Sinadskij1983, Przybylski 1993).

Optimum conditions of development and production this species obtains in conditions of habitatat of fresh forests and mixed fresh forests (Buchholz 1975, Pazdrowski 1988).

Percentage of fresh forests in the area of Polish forests is rather high and is about 32% (Praca zbiorowa, 1990).This habitat type is the most common in Poland.

Important structural element of Scots pine wood (which is to be taken into account) in its evaluation and use, is share of sapwood and heartwood.The differentiation of the properties of both kinds of wood contributes to various uses of wood raw material. In plywood industry it is desirable pine raw material with great share of sapwood,while in saw logs heartwood is more desirable (Duda and Pazdrowski 1975, Krzysik 1974, Mućk 1984a,1984 b, Trendelenburg and Mayer-Wegelin1955).

Mentioned above differences of properties of sapwood and heartwood , and also bound with that its uses are suggesting the more close knowlege about the share of both kinds of wood in stems of this main in our country forest creating species, and some features allowing easily to determine this share. Thorough knowledge of quantitative ratios of sapwood and heartwood in stems of pines, and relations of some biometric parameters of pines grown in most popular in Poland forest habitat, will have essential meaning in controlling of the process of production raw material and its proper uses.

The scope of this work is an attempt to determine if there exist, and how they are related interdependencies among breast diameter of pine trees, selected quantitative features of their crowns, and share of sapwood and heartwood in stems of Scots pines grown in conditions of forest type - coniferous fresh forest.

MATERIALS AND METHODS

Investigations covered eight forest stands from "Puszcza Notecka". They were grown in conditions of fresh forest. The forest stands were selected so, that their age was in the range from 23-95 years. The investigated areas were selected in such a way, that they were representative for them. The detailed descriptin of methods that is: measurements, selection of sample trees, sampling, was presented in article written by Pazdrowski and Spława-Neyman (1996).

Obtained results characterising magnitude of crowns of trees that is length, area of crown projection, number of whorls of living branches, thickness of trees (breast diameter), and share of sapwood and heartwood enabled to analyse relations among mentioned elements. Care was taken to establish to the what degree particular biometric characteristics are interrelated with such elements of wood macrostructure as sapwood and heartwood. In the presented article the said relations were characterized by correlation coefficients and linear relations.

RESULTS

The crown of a tree is closely related with biological development of trees and is conditioning in some sense this development. Therefore in assesment of social position of trees in forest stand,in course of breeding works, that is thinnings in consecutive phases of development, crown with breast diameter is the basic criterium of evaluation.The crown also reflects possibilities of transpiration, which are linked with conducting surface of stem, that is with the surface of sapwood. This is verified among others by the results of experiments carried out by Vomperskij and Ivanov (1984). From the cited experiments results that there is close relation between the mass of needles and crossection of sapwood at Scots pine.

In studies the magnitude of the crown was expressed by the length (l k), area of crown projection (p k),and number of whorls of living branches (table 1).

Average diameter of stems on the height of 1.30 m above the surface of ground (breast diameter), was 15.4 cm while calculated coefficient of variation of this biometric feature was a little above 44%. Average length of the crown reached 4.67 m and calculated

Table 1
Tabela 1

Statistic characteristics of biometric features of trees of Scots pine grown in conditions of forest stand type - fresh coniferous forest

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

Maesures Miary	Biometric features of trees Biometryczne cechy drzew			
	Breast diameter of tree (cm) Pierśnica drzewa $d_{1,3\,m}$ (cm)	Crown length (m) Długość korony (m)	Area of crown projection (m^2) Pole rzutu korony (m^2)	Number of whorls (szt.) Liczba okółków (szt.)
Arithmetic mean Średnia arytmetyczna	15.4	4.67	3.921	37
Standard deviation Odchylenie standardowe	6.8	1.47	3.148	10.43
Coefficient of variation (%) Współczynnik zmienności (%)	44.4	31.5	80.3	28.4

coefficient of variation was above 31%.The area of crown projection and number of whorls of living branches was 3.92 m in first case, and 37 pieces in the second case,while coefficient of variation was 80.3% and respectively 28.4% for the second biometric feature. It is to be mentioned that obtained statistical characteristics are showing differentiation, what can be understandable in the range of ages of analysed age classes of Scots pines, that is from 23 up to 95 years.

The breast diameter exceptionally corresponds with the shares of sapwood and heartwood in volume of stems of Scots pines (table 2, and fig. 1). Correlation coefficients characterising this relation were very significant and were +0.9298 for sapwood, and +0.8589 for heartwood. The studied relation is directly proportional. The sapwood was found just at Scots pines ,which had breast diameter 9 cm, that is in studied habitat conditions in the age of 25 years (Czuraj 1990).

The correlation of crown lengths with the share of both kinds of wood is also very distinct, and this relation in respect to sapwood was directly proportional while for heartwood for the length of crown (9m) was directly, and below 9 m was indirectly proportional (table 2, and fig 2). Coefficients characterising this relation were + 0.7068 in case of sapwood and + 0.4053 in case of heartwood.

It is to be mentioned that correlation coefficient characterising interelation of share of sapwood with crown length was very significant,while for heartwood only significant.

Interrelation of share of sapwood and heartwood in stems of Scots pines and area of living crown projection is very significant. Coefficients of correlation were high and obtained values for sapwood + 0.7725, and heartwood + 0. 9216.Together with increase of of area of crown projection increased share of sapwood in stem volume and also of heartwood.After overreaching 11 m^2 of area of living crown projection was observed decreasing of sapwood share, that is occurence of indirect correlation (fig. 3).

The number of whorls of living branches correlates with share of sapwood and heartwood in stems of Scots pines grown in conditions of habitat of fresh forest (fig. 4, and table 2). The calculated coefficients of correletion are characterising above mentioned relations were also positive, and their values were + 0.6692 for sapwood, and +0.5118 for heartwood (table 2).

Recapitulating, it can be said, that each of analysed quantitative features of crowns of Scots pines correlates with very distinct way with the share of sapwood and heartwood in volume of stems of trees grown in conditions of habitat fresh forest. Taking that into account it can be stated ,that each of said features could be suitable in evaluation of share of both kinds of wood in stems of this forest creating species. But taking into account accesibility of said features the breast diameter could be most advisable.

Table 2
Tabela 2

Correlation coefficient between share of sapwood and heartwood in stems of pines grown in conditions of forest stand type - fresh coniferous forest and breast diameter of trees , and also some quantitative features of their crowns

Współczynnik korelacji między udziałem drewna bielastego i twardzielowego w strzałach sosen wyrosłych w warunkach boru świeżego, a pierśnicą drzew, a także niektórymi cechami ilościowymi ich koron

Kind of wood Rodzaj drewna	Breast diameter of tree Pierśnica drzewa $d_{1,3\,m}$ (cm)	Crown features Cechy korony		
		Crown lenght Długość korony (m)	Area of crown projection Pole rzutu korony (m^2)	Number of whorls Liczba okółków (pcs) (szt.)
Sapwood Biel	0.9298**	0.7068**	0.7725**	0.6692**
Heartwood Twardziel	0.8589**	0.4053*	0.9216**	0.,5118**

** - siginificance of dependence at P = 0,99
** - istotność zależności przy P = 0,99

* - siginificance of dependence at P = 0,95
* - istotność zależności przy P = 0,95

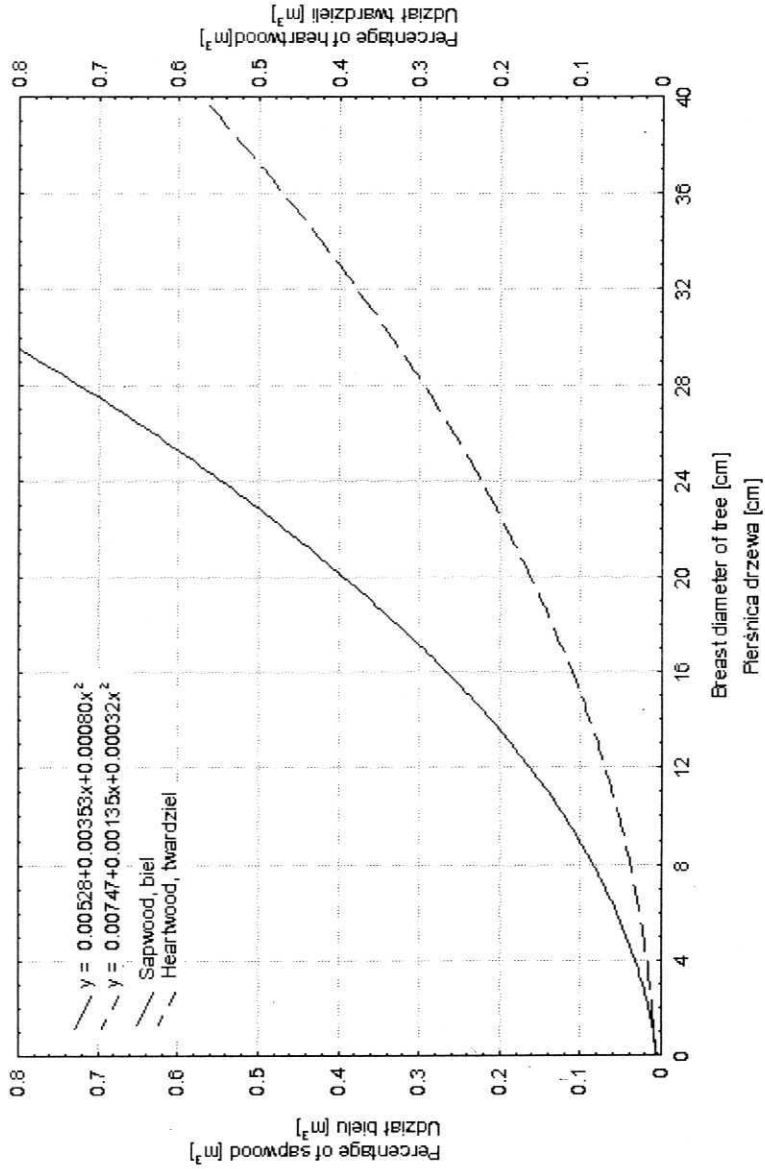

Fig. 1. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of fresh coniferous forest upon breast diameter of tree

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

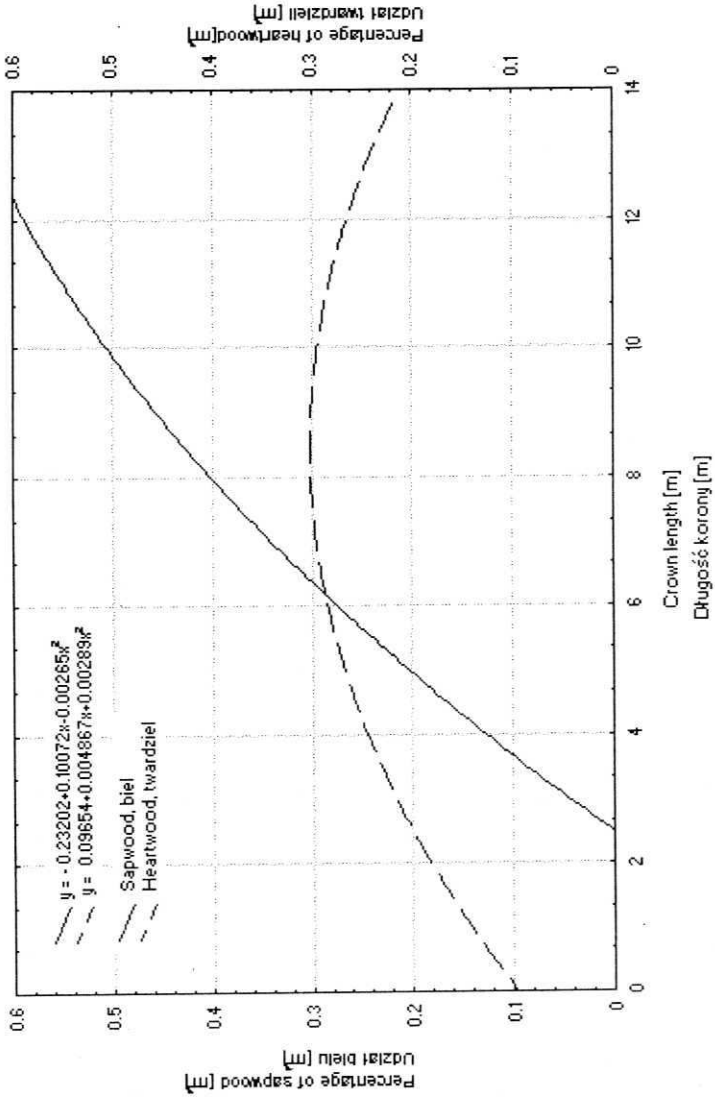

Fig. 2. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of fresh coniferous forest upon the length of live crown of tree

Rys. 2. Zależność udziału drewna bielastego i twardzielowego w strzałach sosen zwyczajnych wyrosłych w warunkach boru świeżego, od długości żywej korony

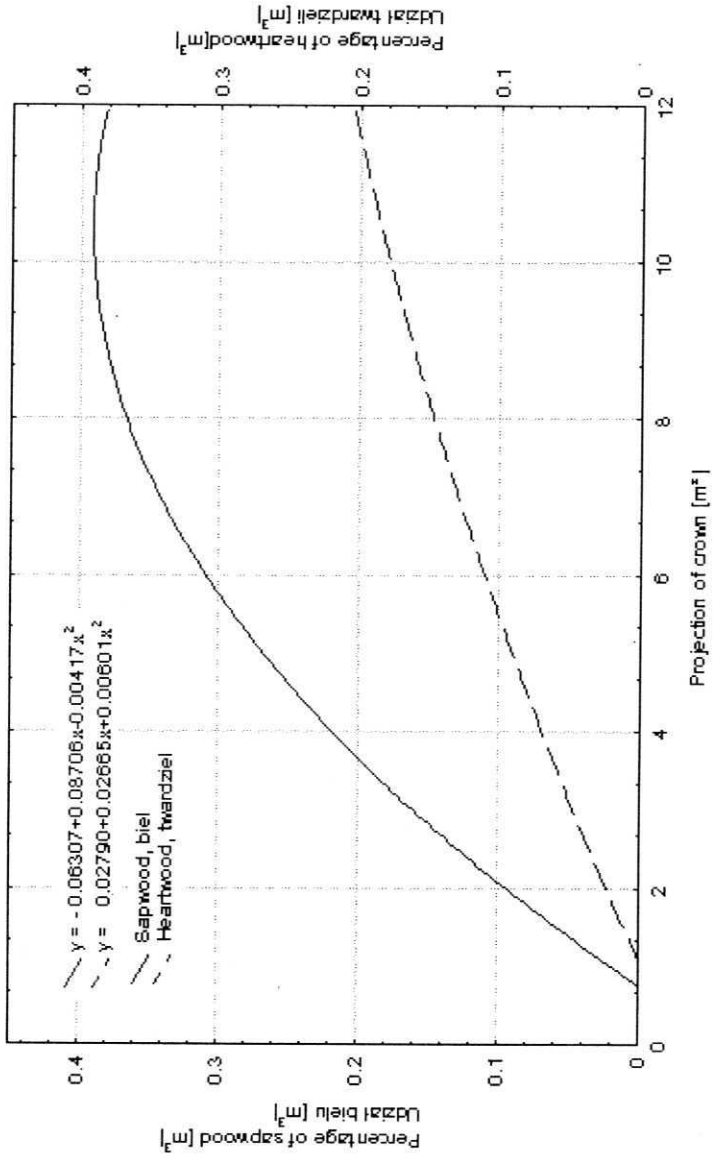

Fig. 3. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of fresh coniferous forest upon area of live crown projection of tree

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

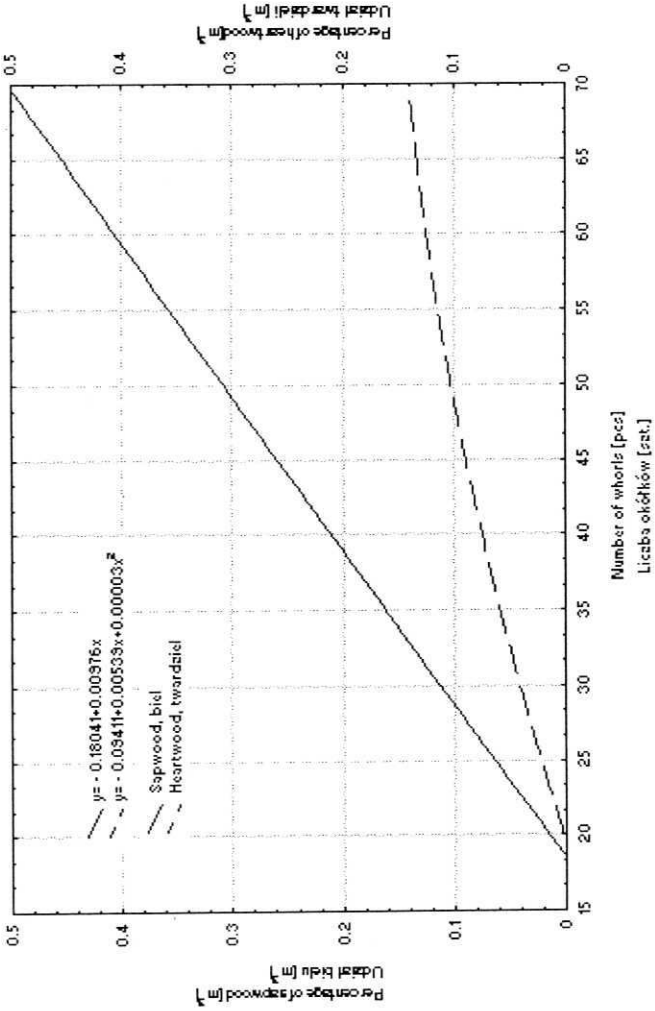

Fig. 4. Dependence of share of sapwood and heartwood in stems of Scot pines grown in conditions of fresh coniferous forest the number of whorl of live branches

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

CONCLUSIONS

The carried out experiments and obtained results allow to draw following conclusions:

1. There was stated occurence of distinct interrelations between breast diameter of trees, analysed quantitative features of their crowns, and share of sapwood and heartwood in volume of stems of Scots pines grown in conditions of habitat of fresh forest.

2. The analysed features are characterised by curvilinear relation with exception of case of interrelation of sapwood in volume of stem and number of whorls of living branches, where this interrelation is characterised by straight line.

3. Studied in this work biometric features of trees, and above all their breast diameter (due to easy accesability of measurement) could be suitable for assesment of share of sapwood and heartwood in stems of Scots pines grown in conditions of habitat fresh forest.

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WSPÓŁZALEŻNOŚĆ POMIĘDZY NIEKTÓRYMI PARAMETRAMI WZROSTU I CECHAMI DREWNA SOSNY ZWYCZAJNEJ WYROSŁEJ W WARUNKACH BORU ŚWIEŻEGO

Streszczenie

Podjęto próbę określenia kształtowania się zależności między udziałem drewna bielastego i twardzielowego w miąższości strzał sosny zwyczajnej, a niektórymi cechami biometrycznymi drzew. Badania dotyczyły analizy współzależności 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 świeżego.

Stwierdzono występowanie wyraźnych współzależności między pierśnicą drzew, analizowanymi cechami ilościowymi ich koron, a udziałem bielu i twardzieli w objętości strzał sosen wyrosłych w warunkach siedliskowego typu lasu boru świeżego. Analizowane związki cechuje zależność krzywoliniowa z wyjątkiem przypadku współzależności udziału drewna bielastego w miąższości strzały od liczby okółków żywych gałęzi, gdzie związek ten charakteryzował się zależnością prostoliniową. Rozpatrywane w pracy cechy biometryczne drzew, a przede wszystkim ich pierśnica (z uwagi na łatwość i dostępność pomiaru) mogą być przydatne do szacowania udziału drewna bielastego i twardzielowego w strzałach sosen wyrosłych w warunkach siedliskowego typu lasu boru świeżego.

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