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

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There was undertaken attempt to analyse relations between percentage of sapwood and heartwood in the wood volume of the stem and some biometric features of trees. Analysed was interdependence of both types of wood with breast diameter of trees, length of crown, area of crown projection, and number of living whorls of branches at pines grown in conditions of dry forest type.

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

INTRODUCTION

Scots pine (*Pinus sylvestris L.*) is our basic forest growing species, creating solid and mixed forest stands. Accordingly to data of (Praca zbiorowa 1995) area of forests in which occurs pine together with larch are covering 6053 thousands of hectares, what is 69,4% of general area of forests in Poland. However it is to be stressed, that the main component of the forest stands is above all the pine. It belongs to the species of very wide ecological amplitude, and due to that it can occur in extremly poor conditions that is: dry forest and also in more fertile soil like in mixed forest conditions, and also in broadleaved forest stand types (Sinadskij 1983, Assmann 1968, Przybylski 1993). In the last said, type of forest it is rather alien floristical element (Scamoni 1965).

The average precentage of dry forest in area of Polish forests is low, about 3,5% (Praca zbiorowa 1990).

Scots pine belongs to the group of trees with distinctly coloured heartwood . (Trendelenburg and Mayer-Wegelin 1955, Krzysik 1974).

The evaluation of the percentage of sapwood and heartwood in the stems of pines on the base of biometric features is very interesting problem, which could have theoretical and practical importance. Taking into account rather small percentage of dry forests in Polish forests presently this problem is to be analyzed in cognitive aspect.

The scope of this study is an attempt to state, if there exists interdependence between breast diameter of the trees due to quantitative features of their crowns, and percentage of sapwood and heartwood in stems of Scots pines grown in conditions of dry forest stand type.

EXPERIMENTS

The material of presented studies was sampled in eight Scots pine forest stands in the region of so called "Puszcza Notecka". They have grown in conditions of dry forest. The said forest stands were selected so, that their age was in the range from 23-95 years. There were selected areas representative for a given age of trees, and there were measured all breast diameters of living trees and their heights proportionally to the numbers of selected thickness classes.After establishing characteristics of the thickness-height classes for particular forest stands accordingly to the Urich II method (Grochowski 1973) , were established dimensions of sample trees , which were then selected in terrain. On every one area were selected three sample trees, that is jointly were cut down 24 trees.These trees were cut , and measured were their heights, and lengths and width of their crowns. Said measurements were made with accuracy up to 1 cm. On the base of crowns measurements were caculated projections areas of the crowns (with the use of formula for the area of the circle) Besides that was determined the number of living whorls for each sample tree.

The percentage of the sapwood and heartwood was determined with the use of sectional measurements, with the length of sections equal 1m.The measurements were taken on the discs cut out in the middle of section.

The obtained results characterizing magnitude of crowns of trees,that is length,area of projection, number of whorls of the live crown , and also thickness of the trees (breast diameter) and percentage of sapwood and heartwood in the stem of a given tree, enabled to perform analysis of interdependences between particular features. Also was undertaken attempt to establish to the what degree patricular biometric features of trees are bound with such makrostructure features of wood as sapwood and heartwood. The said relations are characterized by correlations and linear dependences.

RESULTS OF INVESTIGATIONS

Results of investigations are tabulated in the tables 1-2 and are presented on the figs. 1-4.

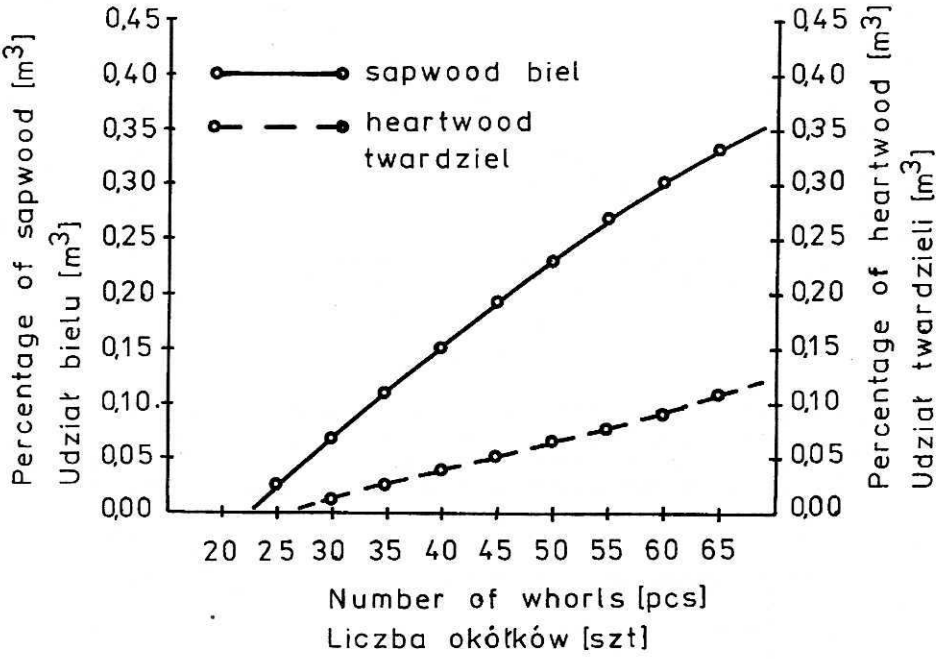

Fig.1. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of dry forest upon breast diameter of tree
Rys. 1. Zależność udziału drewna bielastego i twardzielowego w strzałach sosen zwyczajnych wyrosłych w warunkach boru suchego, od piersnicy drewna

The crown of the trees is illustrating their vital forces ,which are conditioning their further existence in forest stand in particular stages of its development. It is closely bound with their biological development, and this development is by it conditioned. Therefore in all assesments of social position of trees in forest stand , in course of executing of any breeding actions in particular development stages , basic criterium of evaluation is crown of the tree, and bound with it closely breast diameter, that is diameter on the 1.30 above ground. (Czarnowski 1989, 1990, Ilmurzyński 1980). Accordingly to the studies of Wamperski and Ivanow 1984 there exists very strong relation between the mass of needles and crossection of sapwood at Scots pine.

Taking into account this theorem attempts were made to characterize magnitude of the assimilation apparatus by the magnitude of living crown of a tree. The magnitude of the crowns was expressed as the length (lk), area of projection of crown (pk) and the number of living whorls of branches (table 1).

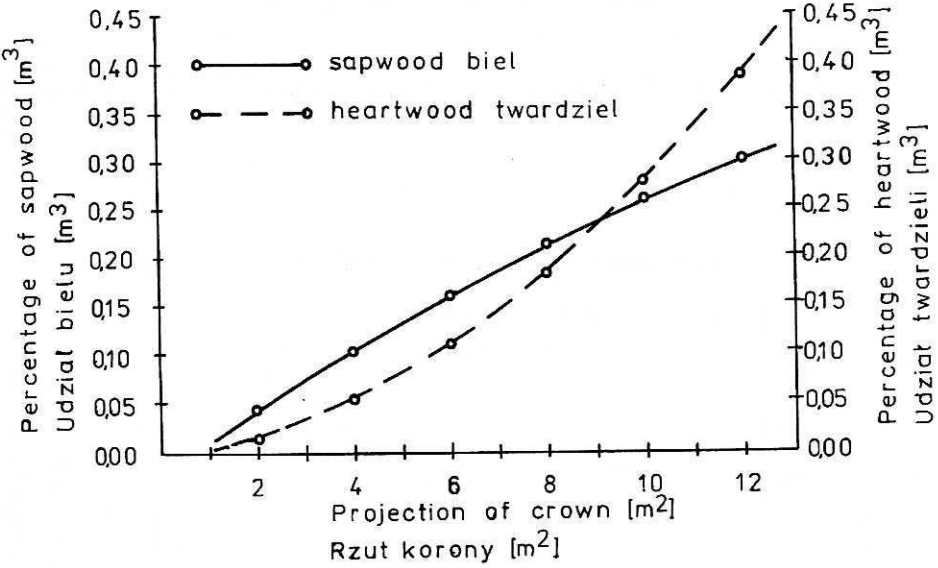

Fig. 2. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of dry forest upon the length of live crown of tree
Rys.2. Zależność udziału drewna bielastego i twardzielowego w strzałach sosen zwyczajnych wyrosłych w warunkach boru suchego od długości żywej korony

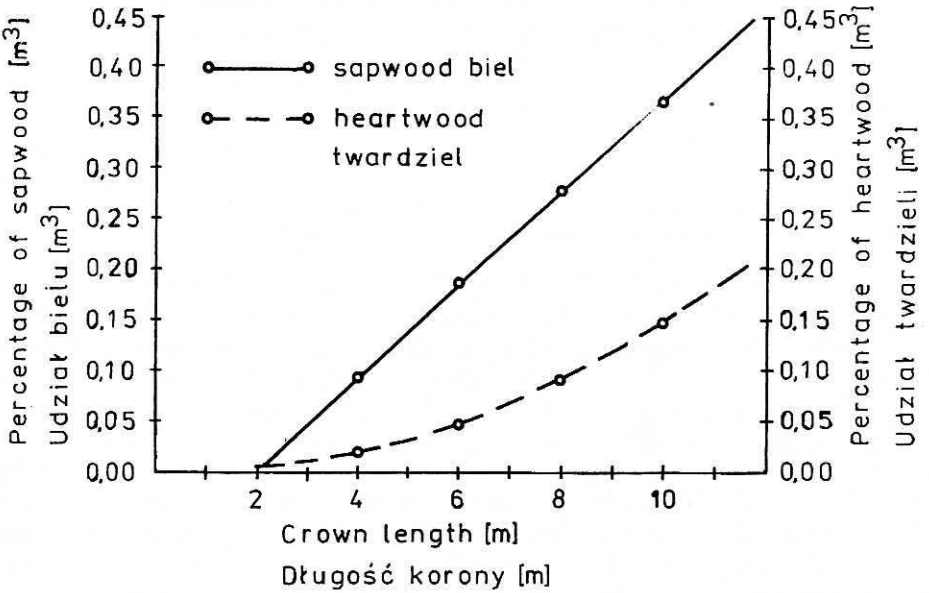

Fig. 3. Dependence of share of sapwood and heartwood in stems of Scots pines grown in conditions of dry forest upon area of live crown projection of tree
Rys. 3. Zależność udziału drewna bielastego i twardzielowego w strzałach sosen zwyczajnych wyrosłych w warunkach boru suchego od powierzchni rzutu żywej korony drzewa

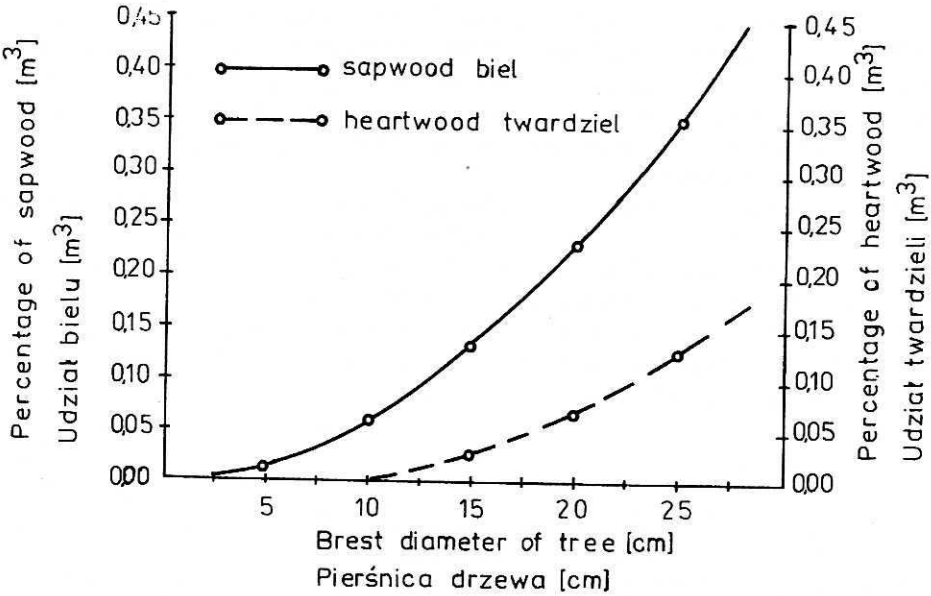

Fig. 4. Dependence of share of sapwood and heartwood in stems of Scot pines grown in conditions of dry forest upon the number of whorls of live branches
Rys. 4. Zależność udziału drewna bielastego i twardzielowego w strzałach sosen zwyczajnych wyrosłych w warunkach boru suchego od liczby żywych gałęzi

The obtained statistic characteristics of qualitative features of crowns, and breast diameters of trees (table 1) indicate for their considerable diversification in the range of analyzed age range (23 - 95 years).

Table 1
Tabela 1

Statistic characteristics of biometric features of trees of Scots pine grown in conditions of forest stand type - dry forest
Charakterystyka statystyczna cech biometrycznych drzew sosny zwyczajnej wyrosłych w warunkach siedliskowego typu lasu boru suchego

Maesures Miary	Biometric features of trees Biometryczne cechy drzew			
	Breast diameter of tree pierśnica drzewa 0 $d_{1,3m}$ [cm]	crown length długość korony [m]	area of crown projection pole rzutu korony [m^2]	number of whorls liczba okółków [pcs] [szt]
Arithmetic mean Średnica arytmetyczna	13.3	4.79	5.164	37
Standard deviation Odchylenie standardowe	6.9	1.86	4.105	11.34
Variation coefficient % Współczynnik zmienności %	51.8	38.8	79.5	30.2

The average diameter on the height of 1.30 m above ground (breast diameter) was not great and calculated variation coefficient high, and in some cases reached 52%. The average length of crowns was 4.79 m, their area of projection 5.2 m^2, and average number of whorls 37 pcs.The difference of this features of crowns was characterized by variation coefficients, and they were properly: 38.8%, 79.5% and 30.2 % .

Pines which were grown in conditions of dry forest have shown in their stems percentage of sapwood and heartwood in average 79.4% for the first, and 20.6% for the second kind of wood. The breast diameter is very distinctly correlated with share of sapwood and heartwood in the volume of the stems (table 2 and fig.1). The correlation coefficients which are characterizing this correlation were high and were + 0.9402 for sapwood and + 0.9408 for heartwood. This correlation is directly proportional.

Table 2
Tabela 2

Correlation coefficient between share of sapwood and heartwood in stems of pines grown in conditions of forest stand type - dry 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 suchego , a pierśnicą drzew a także niektórymi cechami ilościowymi ich koron.

Kind of wood Rodzaj drewna	Brest diameter of tree Pierśnica drzewa $d_{13,m}$ [cm]	Crown features Cechy korony		
		crown length długość korony [m]	area of crown projection pole rzutu korony [m^2]	number of whorls liczba okółków [pcs] [szt]
Sapwood Biel	+0.9400**	+0.7662**	+9297**	+0.8033**
Heartwood Twardziel	+0.9048**	+0.6925**	+-.9196**	+0.7055**

** - siginificance of dependence at P = 0.99
istotność zależnosci przy P = 0.99

The hertawood occured only at pines, whose breast diameter reached 10 cm , that is in this conditions of growth at the age of about 50 years (Czuraj 1990).

The interdependence between length of crowns and percentage of sapwood and heartwood is also directly proportional (table 2 and fig. 2). Calculated correlation coefficients were + 0.7662 in the first, and + 0.6925 in the second case.

Correlation coefficients characterizing dependences of percentage of sapwood and heartwood upon crown area of projection vere high and were for sapwood + 0.9297, and for heartwood + 0.9196. Together with the increase of area of crown projection they increased also in the volume of stem. (fig. 3). There is some kind of limit in this phenomenon. The pines which have area of crown projection lower than 9 m^2, have in the stem volume more sapwood

than heartwood, while in pines with the area of crown projection greater than 9 m^2, the ratio of both kinds of wood was reverse (fig 3).

The number of whorls of living branches is distinctly correlated with percentage of sapwood and heartwood in the stems of pines grown in conditions of dry forest -fig 4. The established correlation coefficients characterizing above said relations were also positive and relatively high, being + 0.8033 for sapwood and + 0.7055 for heartwood (table 2).

CONCLUSIONS

1. There was found correlation between breast diameter of trees, selected quantitative features of trees, and share of sapwood and heartwood in the volume of stems of Scots pines grown in conditions of forest stand type - dry forest .

2. The studied in this paper biometric features of trees, and above all their breast diameter, and area of crown projection could be suitable for estimation of share of sapwood and heartwood in the stems of pines grown in conditions of dry forest .

3. The obtained results indicate that there are needed further studies of the interdependence of some biometric characteristics of pine trees grown on other forest stand types and occurence of sapwood and heartwood in their stems.

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WSPOŁZALEŻNOŚĆ POMIĘDZY NIEKTÓRYMI PARAMETRAMI WZROSTU I CECHAMI DREWNA SOSNY ZWYCZAJNEJ WYROSŁEJ W WARUNKACH BORU SUCHEGO

Streszczenie

Celem badań było przeanalizowanie związków między udziałem drewna bielastego i twardzielowego w miąższości strzał, a pierśnicą drzew i niektórymi cechami ilościowymi koron. Badaniami objęto sosny, które wyrosły w warunkach siedliskowego typu lasu boru suchego.

Stwierdzono występowanie zależności między pierśnicą drzew, wybranymi cechami ilościowymi koron drzew, a udziałem bielu i twardzieli w miąższości strzał. Zależności te wyrażały się w różny sposób i ze zróżnicowaną intensywnością, stosownie do korelowanych cech. Rozpatrywane w pracy biometryczne cechy drzew, a przede wszystkim ich pierśnica oraz pole rzutu korony mogą być przydatne do szacowania udziału drewna bielastego i twardzielowego w strzałach sosen wyrosłych w warunkach boru suchego.

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