Distribution of Intermediate and Mature Wood on the Longitudinal Cross Section of the Tree Trunk and Selected Biometric Traits of Scots Pine (*Pinus sylvestris* L.)

ARKADIUSZ TOMCZAK, WITOLD PAZDROWSKI AND TOMASZ JELONEK

August Cieszkowski Agricultural University of Poznan, Department of Forest Utilization, Poland
Ul. Wojska Polskiego 71A;60-625 Poznań; Phone +48 61 8487754; Fax +48 61 8487755;
e-mail:atomczak@au.poznan.pl

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Abstract

The study presents an analysis of the occurrence of transition and mature wood in the stem profile of Scots pine trees. For this purpose, 10 experimental plots were established in the Miastko Forest District, which comprised two forest site types, fresh coniferous forest and fresh mixed coniferous forest, as well as five age classes, *i.e.* class II, III, IV, V and VI, and in each plot three model trees were selected. Correlations were found *e.g.* between the height of the tree, the length and diameter of its crown and the vertical range of the occurrence of transition and mature wood. The described correlations may be used as an easy method for the determination of the vertical range of the occurrence of transition and mature wood. In addition, it has been demonstrated that in the stem profile both the transition and mature wood is formed in this zone of the stem on which the live part of the crown is set.

Key words: *Pinus sylvestris*, biometric traits, transition wood, mature wood, stem profile, crown

Introduction

One of the typical characteristics of woody plants - both coniferous and hardwood - includes changes in wood properties observed at the cross stem section in the direction from the pith to its circumference. Taking into consideration both traits of the macro- and microstructure, as well as the structure of wood tissue cell walls, a decrease is observed in the width of the annual increments and, in the case of conifers, an increase in the proportion of late wood, an increase in the length of tracheids as well as the thickness of cell walls (Zobel and Sprague 1998, Fabisiak 2005).

Towards the stem pith and towards the crown the fibril helix in the tracheid walls and wood fibres becomes less steep, the cellulose content is lower, stronger shrinkage is observed during drying, as well as lower wood density is found (Hejnowicz 1973, 2002). A similar correlation is observed in physical and mechanical wood properties along the pith ray (Pazdrowski 2004, Pikk and Kask 2004; Tomczak and Pazdrowski 2004, Jakubowski *et al.* 2005). Changes in the wood structure are manifested in different wood zones, *i.e.* juvenile, intermediate and mature wood, differing in their physico-mechanical properties and macro- and microstructure.

In the cross stem section juvenile wood is situated in its centre, *i.e.* closest to the pith. Transition wood develops and its ring surrounds juvenile wood, while mature wood is formed as the last type of wood. Because of the sequence in which individual types of the wood tissue are formed and the continuous growth in height of trees, juvenile wood is found in the near-pith zone from the base to the top of the tree. Transition and mature wood are found only at a certain stem length (Fig. 1).

The heterogeneous nature of wood structure is significant primarily from the point of view of biology, but also in terms of the optimal utilisation of timber. Usually, most of the tree biomass is utilised, with the stem being the most valuable part. The tree stem is made up of juvenile, intermediate and mature wood; however, it should be remembered that it is only in its butt end part that all these three types of wood will be found. In the upper part, only juvenile and transition wood are found, whereas in the top part, it is only juvenile wood. It results in a considerable variation in the average wood tissue characteristics found at

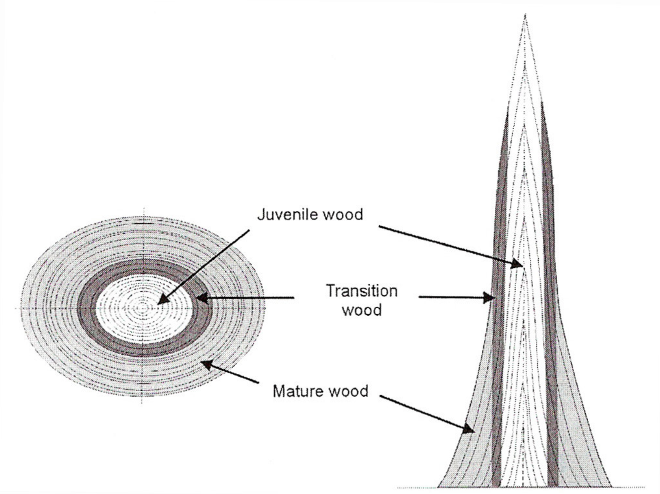

Figure 1. Distribution of juvenile, transition and mature wood on cross stem section and stem profile

different tree heights (Helińska – Raczkowska and Fabisiak 1994, Burdon *et al.* 2004). Once the distribution of juvenile, intermediate and mature wood along the tree stem is known and this distribution may be assessed by means of simple methods, it will be possible to determine the functional properties of different parts of tree stems.

The aim of the study was to determine the range of transition and mature wood in the stem profile of Scots pine (*Pinus sylvestris* L.) trees from different age classes and to determine the interdependence between the analyzed traits and selected biometric characteristics of trees.

Materials and methods

Experiments were conducted in the Miastko Forest District, which is situated within the administrative area of the Szczecinek Regional Directorate of State Forests (RDSF). The region is situated in the 1st Baltic Natural Forest Region, a province of the Drawsko-Kaszubski Lake District. Two forest site types, *i.e.* fresh coniferous forest (FCF) and fresh mixed coniferous forest (FMCF), were analyzed in this study. Under these natural forest conditions, mentioned site types are typical of Scots pine and cover the largest percentage of the area among all forest site types in the Miastko Forest District (FCF – 19.7% and FMCF – 40.6%) (Forest Management Plan for the Miastko Forest District 1995; Principles of Silviculture 2003). In each of the forest site types, one first quality stand was selected in age classes II, III, IV, V and VI (Tab. 1). Thus a total of 10 experimental areas were selected, with one experimental plot of 0.5 ha representative for a given stand being established in each. Breast height diameters of all growing trees were measured at the adopted 2 cm diameter sub-classes, together with heights of trees selected proportionally to the number of trees in individual diameter sub-classes. Having collected the required empirical material, model trees were selected using the Urich I dendrometric method (Grochowski 1973). On the basis of tree classification in the stand proposed by Kraft (1884), three model trees were selected in each experimental plot. In accordance with the social structure of production stands of older age classes and the use value of tree stems, as it was emphasized by Kokociński (2004), one predominant, one dominant and one co-dominant tree were selected in each experimental plot. The effect of the social position of tree in the stand on the cyclic heterogeneity of the wood tissue is manifested primarily in quantitative traits, while it does not influence the occurrence of juvenile, intermediate and mature wood in the horizontal and vertical planes (Tomczak 2006). In the next step, the crown diameter of standing trees was determined. Then, model trees were felled and the length of their entire stems as well as the live part of their crowns[1] were measured. The difference between these values constituted the height of the point on the stem, on which the first live branch (measuring from the base of the trunk) was found. Material for further experiments was collected in the form of discs from the base of the stem of felled trees. From each mean sample tree material was collected from the base of the stem, constituting its kerf plane, and next at a distance of 1m. Successive discs were cut every 2 m up to the top of the tree. Selected elements of wood macrostructure, *i.e.* the width of early wood and late wood zones, were measured on prepared material in successive annual growth rings. The direction of measurements was from the pith to stem circumference, separately for the four geographical directions, *i.e.* north,

Table 1. Description of the study sites

age class	age	site quality	stand area [ha]	Mean DBH [cm]	Mean height [m]
2	39	FCF	13.18	21	18
	34	FMCF	24.13	15	16
3	51	FCF	4.71	22	21
	52	FMCF	1.26	20	20
4	73	FCF	10.44	28	24
	73	FMCF	3.17	33	24
5	85	FCF	5.79	37	27
	91	FMCF	2.52	39	27
6	108	FCF	1.45	33	25
	112	FMCF	6.36	36	26

[1] The live crown was assumed to be this part of the crown on which leaved shoots were found.

south, east and west. The width of early and late wood was measured in individual annual rings by using an increment meter. This manually operated device calculates individual values constituting successive boundaries between early and late wood on the measured section. After the data had been transferred to a computer the width of early and late wood was obtained for each annual diameter increment. Next the ratio of the width of late wood to the width of early wood was calculated in individual annual rings for each disc and tree. Values calculated in this way were the basis for distinguishing the zones of juvenile, transition and mature wood.

The share of late wood in successive annual rings in the stem increases with the distance from the pith, with the change being more marked when the stem is no longer within the range of the crown (Hejnowicz 2002). By observing the dynamics of changes in the share of late wood the volume of individual wood zones at cross stem section was determined relatively accurately. Initially observed changes occur very dynamically (juvenile wood, intermediate wood), only to stabilize after a certain age is reached (mature wood). The duration of the juvenile and transition periods depends on many external and internal factors. They include first of all genetic factors, growth rate of trees, site, planting spacing, geographical location, the position of the tree in the stand and crown size (Peszlen 1995, Haygreen and Bowyer 1996; Jakubowski and Pazdrowski 2003, Fabisiak 2005). For the above mentioned reasons the analysis determining the size of the juvenile and transition wood zones was conducted individually not only for each tree, but also for each level from which discs were collected.

Using the data from individual heights the range of transition and mature wood in stem profiles was determined and the share of the above-mentioned zones along stems was calculated. The share of intermediate or mature wood in the stem profile constitutes the range of analyzed wood types, measured from the base of stem to the point defined according to the adopted methodology, expressed in absolute values. It was assumed that the maximum range of the zone will be defined by the end of a 2m section, for the center of which the zone of transition or mature wood was found. The obtained results were processed statistically and regression equations as well as coefficients of determination were calculated.

In the study, a number of coefficients were also applied, which are absolute relative values:

* P_g/L_s – ratio of the position height of the first live branch on the stem to stem length;

* Z_d/L_s – ratio of the vertical range of mature wood to stem length;

* Z_p/L_s – ratio of the vertical range of transition wood to stem length.

Results

Table 2 presents statistical characteristics of selected biometric traits of Scots pine trees from different age classes. Arithmetic means, standard deviations and variability coefficients were calculated for tree heights, vertical ranges of mature and transition wood, for the length and diameter of tree crowns (the live part) as well as the position height of the first live branch on the stem.

The mean values of the vertical range of mature wood varied among trees from age class II, III and IV, whereas in age classes V and VI these values were identical. In relation to the vertical range of intermediate wood the differences were analogous to those for mature wood, except that this value for the trees from age class VI was lower than for the trees from age class V. This fact was probably associated with the mean tree height of analyzed trees in age class VI, which was lower than the mean obtained for class V (Tab. 2). Crown length in classes II, III and IV was smaller than the values recorded for trees from age classes V and VI. In this respect a very clear division into two groups, *i.e.* younger (age classes II, III and IV) and older (age classes V and VI) may suggest that the process of self-pruning of stems in mature trees is no longer dynamic, as a result of which the mean crown length may increase. As to the crown diameter, it was found that this value in terms of age classes

Table 2. Statistical characteristics of dependent and independent variables comprising tree biometric traits and the range of mature and intermediate wood in Scots pine trees from different age classes

Tree biometric elements		Measures of location and dispersion	Age class II (21-40)	III (41-60)	IV (61-80)	V (81-100)	VI (101-120)
Tree height [m]		Mean	17.5	21.0	23.4	25.7	23.8
		Standard deviation	1.92	2.88	1.06	2.13	2.31
		Coefficient of variation	10.94	13.71	4.53	8.31	9.74
Vertical range [m]	Mature wood	Mean	8	14	17	18	18
		Standard deviation	2.45	2.17	3.79	1.03	2,04
		Coefficient of variation	30.62	16.06	22.32	5.63	11,24
	Transition wood	Mean	10	17	19	21	20
		Standard deviation	2.07	2.34	2.71	2.35	2,45
		Coefficient of variation	19.99	14.03	14.41	11.44	12,25
Selected crown biometric traits [m]	length	Mean	6.4	6.2	6.5	8.5	8,7
		Standard deviation	1.70	2.68	0.58	1.82	1,40
		Coefficient of variation	26.44	43.18	8.89	21.50	16,16
	diameter	Mean	2.5	3.7	3.8	4.9	5,3
		Standard deviation	0.66	0.85	0.61	1.68	0,77
		Coefficient of variation	26.14	22.92	16.16	34.12	14,63
Position height of the first live branch on the stem [m]		Mean	11.2	14.7	16.7	16.4	15.2
		Standard deviation	1.31	3.06	0.32	1.62	1.20
		Coefficient of variation	11.74	20.77	1.93	9.88	7.95

increased gradually (Tab. 2). The point, at which the first live branch was found, changed in age classes, which should be associated with the continuous increment in height of trees, as well as rate of self-pruning. The value obtained for age class VI was probably correlated with the height of trees and, as it was emphasized earlier, with the reduced dynamics of self-pruning.

Figure 2 presents graphically the development of axial heterogeneity in different age classes. The lower stem sections, referred to as zone 3, are made up of juvenile, transition and mature wood. The middle sections, designated as zone 2, are made up of juvenile and transition wood tissue, whereas the top section, designated as zone 1, consists only of the juvenile type of wood tissue. The values obtained for zone 3 constitute, in fact, the relative value of the vertical range of mature wood. In the case of the youngest analysed age class, the range of zone 3 approximately made up 53% of the tree height recorded then, while in the youngest age class it was about 79%. The proportion of zone 2 (juvenile and intermediate wood) in consecutive age classes, *i.e.* from class II to VI, decreased gradually. The same situation occurred with regard to zone 1. In age class II about 30% of height in the top part will be composed of juvenile wood, while in class VI it will be approx. 12% (Fig. 2).

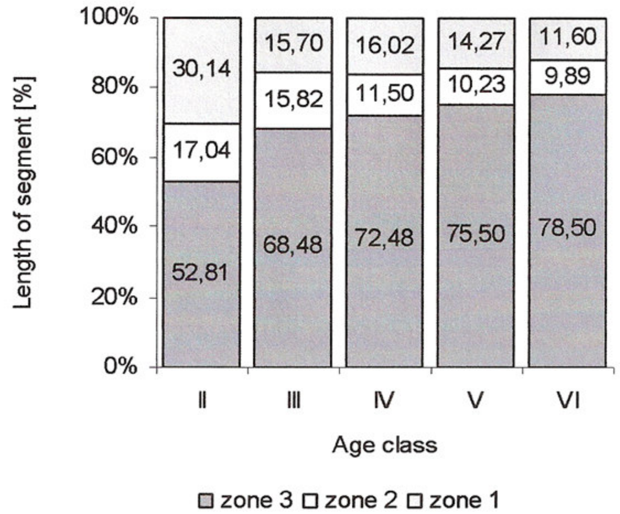

Figure 2. Percentages of stem segments made up from different zones in the tree height in terms of age classes

In order to maintain its stability, the tree should develop evenly and the size of its individual elements (crown, trunk and root) should be closely correlated. Figures 3a and 3b show graphically the interdependences between crown length and diameter, and tree height. A curvilinear interdependence was found to exist between the analysed traits and the value of the coefficient of determination R^2 was higher in the case of the correlation between crown diameter and height (0.6015). In the case of the correlation between crown length and height, this value was found to be 0.4470.

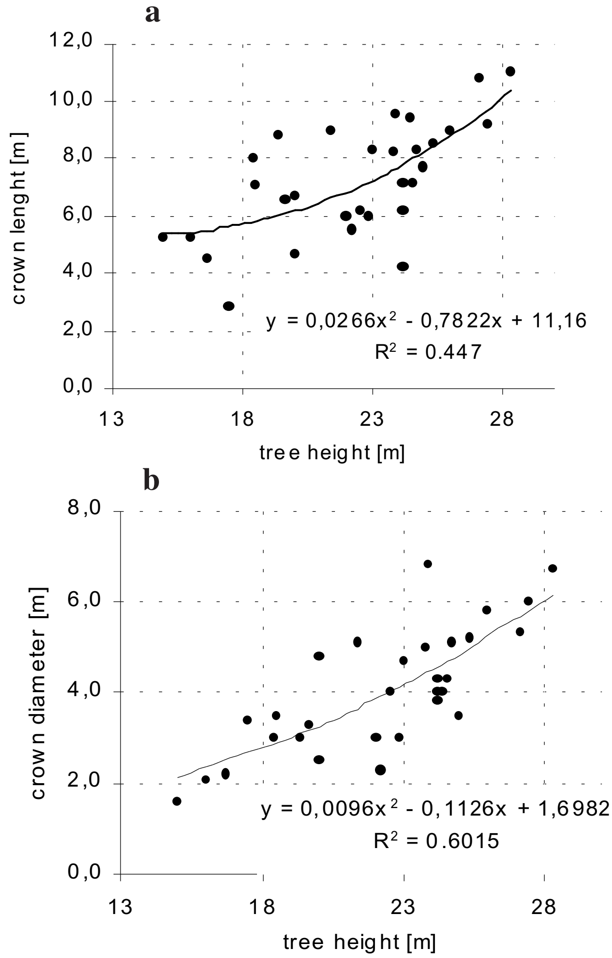

Figure 3. Interdependence between crown length (a) and diameter (b) and tree height

Figure 4 presents changes in crown diameter and length depending on the age of trees. It is evident that with age both the diameter and length of the live crown increased and the plotted curves representing the trend line of these traits in relation to age are almost parallel. The results presented graphically in Figures 3a, 3b and 4, as well as the obtained coefficients of determination confirm the existence of correlations between the individual biometric characters of trees.

The obtained values, *i.e.* tree height, crown length and diameter are associated directly with the conditions of growth and development of trees, of which the size of the space where it grows appears to be of paramount importance. The space in which a given tree grows, and first of all light availability, that is a major requirement in the case of Scots pine – can influence

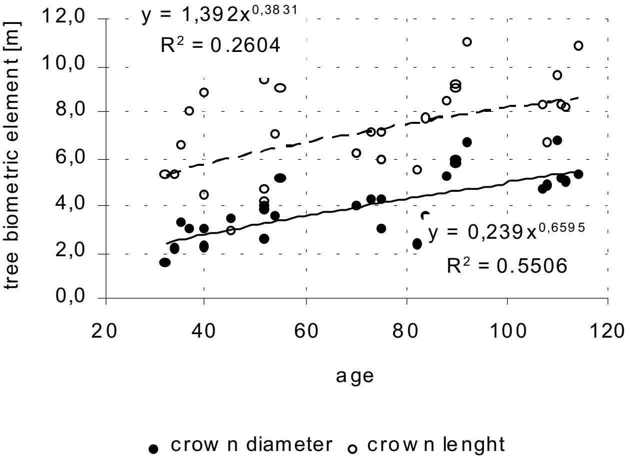

Figure 4. Changes in the crown diameter and length with the age of trees

the shape and size of the crown. Silvicultural operations carried out in commercial stands reduce the number of trees per unit area in order to intensify the production of wood tissue. Guidelines for these operations are confined within certain regulations, within which there is a considerable degree of freedom and room for subjectivism. This type of approach as well as individual traits may be responsible for a low correlation between crown length and tree age in comparison with the correlation between crown diameter and age. The value of the coefficient of determination $R^2$of 0.2604 is relatively low, making it possible only to determine the trend found in the population of analyzed specimens.

The presence of juvenile wood in the form of a cylindrical column around the pith is the result of a prolonged effect of the apical and lateral meristems on the development of wood in the area of the live crown. As the tree crown moves higher with the growth of the tree, the effect of the apical meristem on the cambium outside the crown area gets weaker and the formation of mature wood begins (Panshin and De Zeeuw 1980, Hejnowicz 2002). This regularity is confirmed by the results presented graphically in Figure 5. Curves plotting the trend of changes in tree height as well as changes in the vertical range of mature and transition wood are almost identical. The distance of the terminal bud responsible for the regulation of growth processes also in the lower parts of the stem, from intermediate and mature wood, is similar in each tree age interval. The distance from the stem top seems to be a very important factor because both the intermediate and mature wood are also produced in the zone of live crown. The curve of the trend determining changes in the position of the first live branch on the stem is characterised by a smaller inclination in comparison with the curves determining individual ranges of the analysed zones. Therefore, it may be assumed that intermediate wood appears within the live crown as early as in the 30th year of tree life, whereas mature wood – at the age of about 70 years (Fig. 5). The claim that mature wood is formed exclusively outside the live crown zone is probably imprecise.

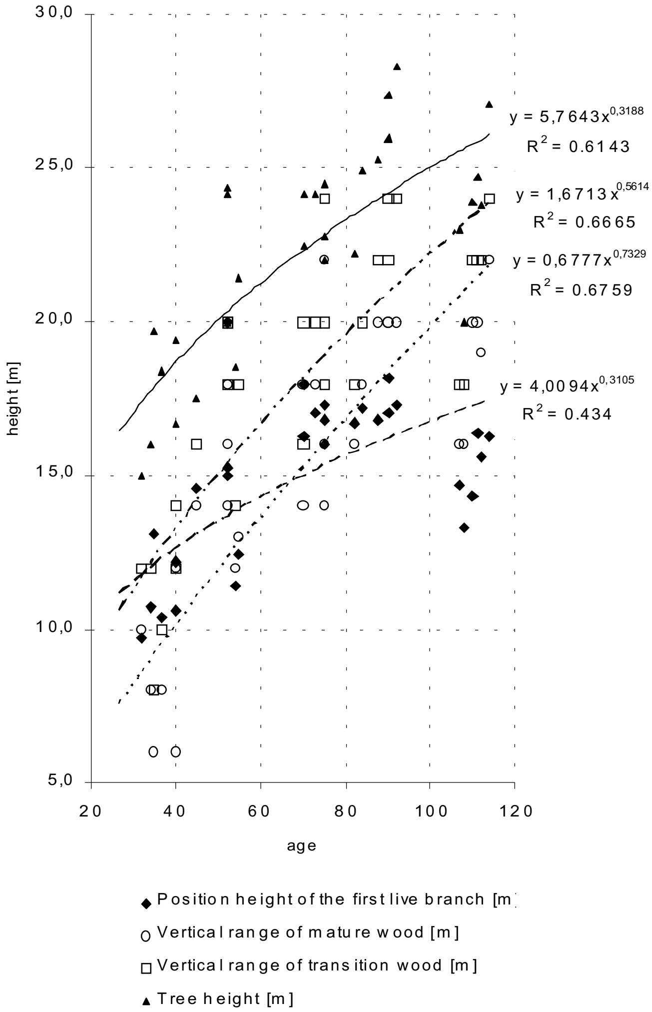

Figure 5. Axial distribution range of mature and intermediate wood in stems and selected biometric traits of pine trees in terms of age

The above arguments were also confirmed when the employed values were changed from absolute to relative. After determining the values of individual coefficients the ratio of position height of the first live branch on the stem to tree height (P_g/L_s), the ratio of the vertical range of mature wood to tree height (Z_d/L_s) and the ratio of the vertical range of intermediate wood to tree height (Z_p/L_s) were listed in the table. It was found that coefficient P_g/L_s had identical values in age classes II, V, and VI. This means that irrespective of age of tree, the proportion of the distance of the first live branch from the tree base is similar in value. In the case of a stand with significant closure, access to sunlight and resulting tree height are likely to have a significant effect on crown size. Trees seem to adjust the dimensions of their crowns not only to the conditions of growth and development, but also to the dimensions of the supporting element, i.e. the stem. This assumption is also corroborated by the results presented in Figures 3a and 3b. The value of coefficients Z_d/L_s and Z_p/L_s increases with age of tree (Table 3).

Table 3. Statistical characterisation of coefficients Pg/Ls, Zd/Ls and Zp/Ls in Scots pine trees of different age classes

Coefficient	Measures of location and dispersion	Age class II (21-40)	III (41-60)	IV (61-80)	V (81-100)	VI (101-120)
Pg/Ls	Mean	0.64	0.70	0.72	0.64	0.64
	Standard deviation	0.07	0.12	0.04	0.05	0.03
	Coefficient of variation	11.21	17.06	5.86	7.75	4.85
Zd/Ls	Mean	0.47	0.65	0.73	0.74	0.76
	Standard deviation	0.18	0.07	0.16	0.07	0.02
	Coefficient of variation	39.07	10.21	21.37	8.89	2.95
Zp/Ls	Mean	0.70	0.84	0.84	0.86	0.88
	Standard deviation	0.17	0.06	0.09	0.03	0.05
	Coefficient of variation	24.31	6.83	10.42	3.88	5.89

The range of mature wood in the stem profile is probably correlated with the rate of tree increment in height. A faster growth rate may result in higher dynamics of mature wood formation. The period of growth and formation of juvenile and intermediate (maturing) wood, in the case of Scots pine, is limited to a dozen or so of the annual diameter increments. The formation of the longest possible increment in height within a year may lead to the increase (by the same value) in the vertical range of mature wood (assuming that the period of formation of juvenile and transition wood at each height is a constant value). The interdependences between the vertical range of mature and intermediate wood and tree height, presented in Figures 6a and 6b, make it possible to draw the following conclusion: the analysed correlation is of curvilinear nature and its strength depends on the value of the coefficient of determination, which states that the vertical range of mature wood depends on the tree height in 70%, whereas the vertical range of intermediate – in 76% (Figs. 6a, 6b).

As far as the other tree biometric elements analysed in this study are concerned, *i.e.* the length and diameter of the live crown, they exhibit a smaller strength of the correlation with ranges of individual types of wood in comparison with tree height (Figs. 7a, 7b, 7c, 7d).

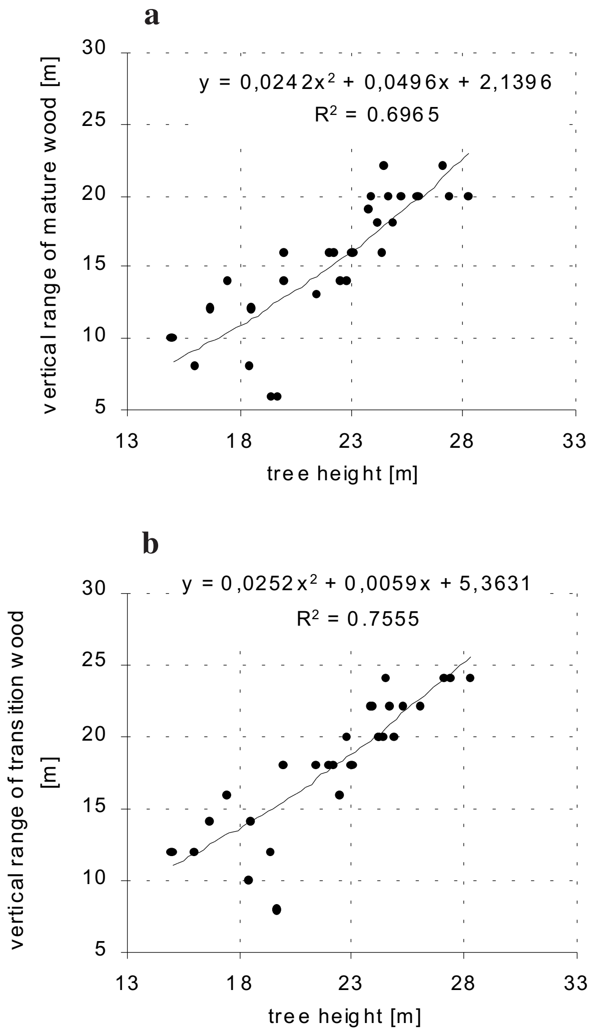

Figure 6. Dependence of: a/ the vertical range of mature wood and b/ the vertical range of transition wood on the tree height

The correlation value between the vertical range of mature wood and crown length was found to be particularly low and the coefficient of determination was only 0.1203. The value of the coefficient of determination was slightly higher, *i.e.* 0.1720, in the case of the correlation between the vertical range of intermediate wood and crown length (Fig. 7a, 7b). Thus it may be stated that these results for the analyzed group of trees, due to the low values of coefficients of determination, are insignificant or even random and have no effect on the range of intermediate or mature wood in the stem profile.

The crown diameter was found to affect the vertical range of mature wood in 48%, while that of intermediate wood – in 50%. Therefore, these values were similar (Figs. 7c, 7d).

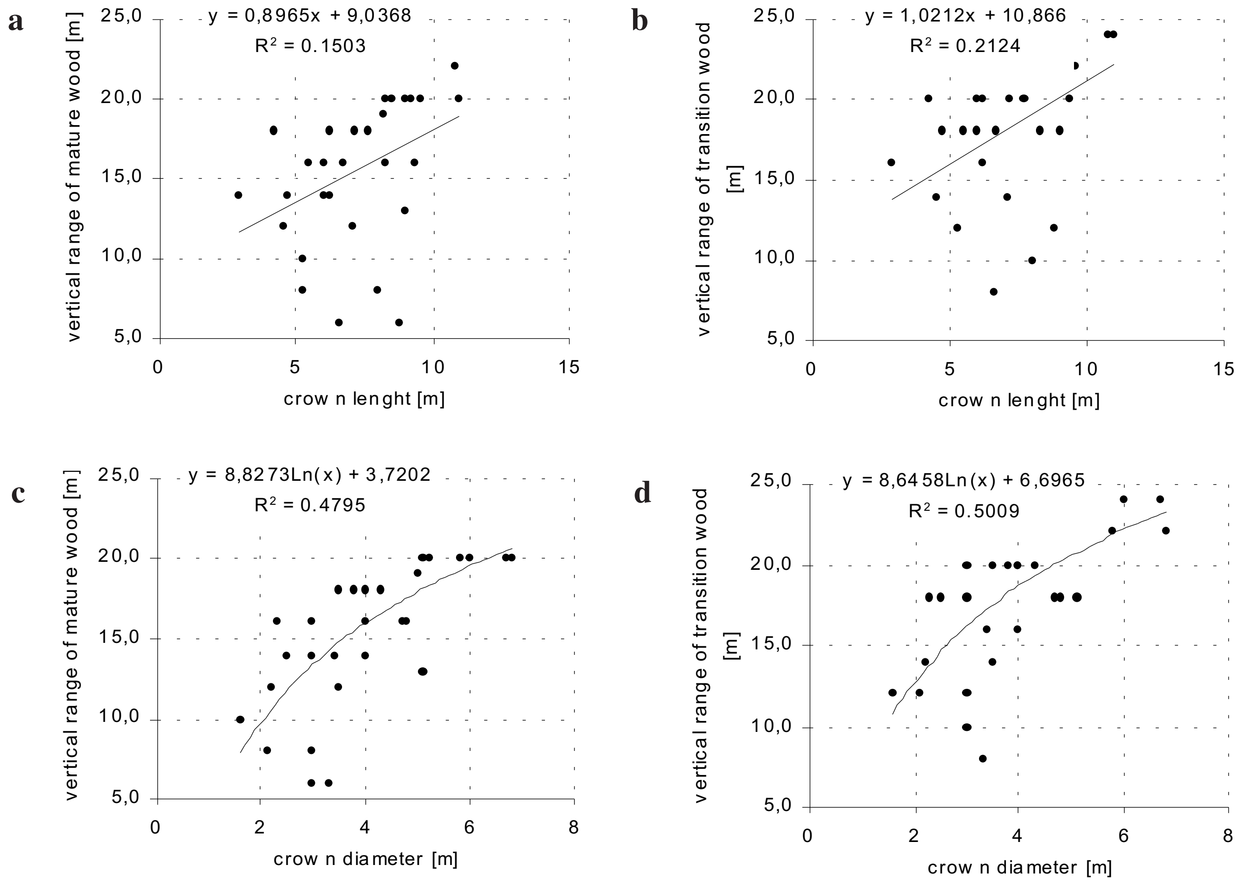

Figure 7. Dependence of vertical range of mature wood on: a/ crown length, c/ crown diameter and dependence of vertical range of intermediate wood on: b/ crown length, d/ crown diameter

Discussion

Changes that take place on the stem profile in terms of the occurrence of intermediate and mature wood are the result of the change in the structure and properties of wood tissue occurring on the cross stem section. The dynamics of these changes may be influenced, among others, by the growth and development conditions of trees in the stand (Fabisiak 2005) and be manifested in the social position of trees as well as individual biometric characters of trees. In the case of commercial stands, following the performed silvicultural operations, the social structure of the community underwent considerable transformations and, therefore, trees growing in the stand had to adjust to the artificially created conditions. Changes observed in selected biometric traits of Scots pines growing in production stands reflect the process of tree development as well as mutual correlations between its individual parts, *i.e.* the stem and crown. External traits such as crown size, expressed by its length or width, as well as tree height must be reflected in wood tissue traits, from which the tree stem is built. This is the supporting element which has to withstand considerable loads, both its own and those resulting from the action of external static and dynamic factors. Increased strength is reflected in changes of micro- and macrostructure of wood tissue, both in the horizontal and vertical planes of the stem.

Processes taking place in woody plants are regulated by hormones. The main elements responsible for the development of hormones are terminal buds. With the assistance of auxins, stimuli are sent to the bottom segments of the stem controlling the moment of the initiation of spring growth of trees, the moment of transformation of early wood into late wood, as well as the time of growth suppression in autumn (Thörnqvist 1993). In addition, they are also responsible for the formation of different wood zones, varying with regard to their properties, *i.e.* juvenile, transition and mature wood. It is evident from Figure 5 that the distance between the point, in which the development of intermediate and mature wood begins, is similar in trees of different ages. Probably, at the same distance from the tip, auxin concentration reaches boundary values, beyond which initially intermediate wood is formed, followed by the formation of mature wood. On the basis of the above argument, the authors analysed the interdependence that can occur between an easily measurable tree biometric trait, namely its height, and the range of the analysed types of wood tissue. It turned out that relying on tree height it is possible to estimate with considerable probability the occurrence of the intermediate and mature wood in stem profiles. In addition, it is evident from Figure 5 that the dynamics of the movement of the crown towards higher portions of the stem differs from the dynamics of changes that occur in proportions of intermediate and mature wood in stem profile. On the same basis it was also found that mature wood begins to develop in the region of live crown when the tree reaches the age of 70 years. It is quite likely that this phenomenon is influenced by a number of factors, of which the following need to be mentioned: changes in the dynamics of the height increment, aging processes and a decline in the activity of terminal buds or the aging process of the external portions of wood tissue (Grzeczyński and Spława – Neyman 1980). They can influence the development of wood tissue properties as indicated by e.g. investigations on the macro- and microstructure of wood tissue carried out by Helińska – Raczkowska and Fabisiak (1994), in which they found changes in the tracheid dimensions of juvenile wood depending on the height of the position of analysed wood samples.

The observed phenomenon, in which the distance from the tree top to the point, in which first the development of intermediate wood and later - of mature wood begins, appears to be crucial for these processes in comparison with the size of the tree crown. Crown size may be a useful tree biometric trait in determining the proportion of juvenile wood in stems, as it was confirmed by studies carried out by Pazdrowski and Jakubowski (2000) and Jakubowski and Pazdrowski (2003). However, selected crown biometric characters – due to their low coefficients of determination – are of little value for the determination of the vertical range of intermediate and mature wood. This remark is particularly true with regard to crown length, where the obtained value of the coefficient of determination amounted to 0.17 in the case of the correlation with the range of transition wood and to 0.12 for mature wood. Higher values of the coefficients of determination were obtained between crown diameter and vertical ranges of mature and intermediate wood. Nevertheless, they were by far lower in comparison with the coefficients obtained for the ranges and tree heights.

Different parts of felled tree stems are classified differently. The lower segment of the stem usually constitutes the most valuable utilised part of trees of older age classes. The decisive factors in this regard include: dimensions, a high proportion (in comparison with the higher sections of the stem) of knotless wood and a high proportion of mature wood. Also higher sections of older trees are utilised which, due to their diameters, are classified as medium-sized wood. In stands of younger age classes, cordwood constitutes a high percentage of the harvested wood. Useful characters of stems may be determined also in the case of standing trees, as their value may be assessed on the basis of selected stem biometric traits. In the future this approach may facilitate the selection for processing of a batch of timber from trees with specific biometric traits, characterised by properties expected by the customer.]

Conclusions

• Curves, characterising in the examined group of trees changes with age in tree height and in the vertical range of intermediate and mature wood, show similar dynamics of these changes. The distance on the stem from the tree top (terminal bud) of the point, in which first intermediate and next mature wood is formed, is similar at different ages of trees. Presumably the distance from the terminal stem growth regions is crucial in wood tissue formation and the development of vertical wood heterogeneity.

• The authors found a curvilinear interdependence between the vertical range of intermediate wood and tree height, where the value of the coefficient of determination R^2 reached 0.76, and between the vertical range of mature wood and tree height, where the value of the coefficient of determination amounted to 0.70. Due to the value of the coefficient of determination, in relation to selected crown traits it was found that crown diameter may be useful in the determination of the vertical range of intermediate or mature wood, while the length of live crown is useless in this case and thus should not be applied.

• Tree height is a biometric trait which should be used to estimate the vertical range of intermediate or mature wood in the stems of Scots pine trees.

• Both crown length and diameter exhibit an interdependence with tree height. Probably the dimensions of individual tree elements, *i.e.* in this case the crown and tree height must be closely correlated in order to ensure stability of tree anchorage and resistance to such external factors as winter or snow.

• Both transition and mature wood is formed in the zone of live crown. Transition wood tissue within the live crown area of the stem is formed starting from the age of 30 years, while for mature wood it is from the age of 70 years.

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РАСПРЕДЕЛЕНИЕ ПЕРЕХОДНОЙ И СПЕЛОЙ ДРЕВЕСИНЫ НА ПРОДОЛЬНОМ СЕЧЕНИИ СТВОЛА ДЕРЕВА, И ИЗБИРАТЕЛЬНЫЕ БИОМЕТРИЧЕСКИЕ ЧЕРТЫ СОСНЫ ОБЫКНОВЕННОЙ (*PINUS SYLVESTRIS* L.)

А. Томчак, В. Паздровски и Т. Елонэк

Резюме

В работе предпринята попытка проанализировать появление на продольных сечениях ствола сосны обыкновенной переходной и спелой древесины. С этой целью были выбраны 12 опытных участков на территории надлесничества Мястко, в состав которых входили два типа местопроизрастания леса, т.е. свежий бор и смешанный свежий бор, а также пять классов возраста, т.е. II, III, IV, V, VI, на которых были выделены по три модельных дерева. Было определено также существование зависимости между высотой дерева, длиной кроны, диаметром кроны и вертикальным диапазоном появления переходной и спелой древесины. Охарактеризованные зависимости могут послужить одним из наиболее простых методов определения вертикального диапазона спелой и переходной древесины. Доказано, что переходная и спелая древесина на продольном сечении дерева образуются в той области ствола дерева, на которой находится часть живой кроны.

Ключевые слова: *Pinus sylvestris*, древесина переходная, древесина спелая, сечение продольное ствола, крона дерева