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Biometrical characteristics of mature pine stands differing in terms of quality, growing under site conditions of fresh mixed coniferous forest

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Abstract: *Biometrical characteristics of mature pine stands differing in terms of quality, growing under site conditions of fresh mixed coniferous forest* Analyses were conducted on two experimental plots, established in stands with similar taxation characteristics, differing in terms of their technical quality index. On each of them selected biometric traits were measured on all trees, i.e. diameter at breast height, height, height of the first snag and the first live branch on the stem as well as the average crown width was determined. It was found that at a similar number of trees per unit area trees from B_3 in comparison to trees from B_2 were characterised by a bigger diameter at breast height and height, and a wider and longer crown. Except for the relative crown length, observed differences were not statistically significant. No distinct trend was shown, differentiating stands on the basis of biometrical characteristics. No similar dependence was found when analysing biometrical traits of trees in quality and dimensional classes B and C. In case of classes A and C most biometrical traits turned out to be statistically significantly different.

Keywords: Scots pine, biometrical characteristics, technical quality, fresh mixed coniferous forest

INTRODUCTION

In forest utilization the estimation of the amount and quality of timber constitutes an element of preparatory work, preceding timber harvesting. In mature stands the most commonly applied method is the time-consuming measurement of diameter at breast height on all trees together with the classification of each of the trees to quality and dimensional class.

Currently information technologies offer a possibility to apply modern measurement methods, fast access to data and their on-going updating. The development of a system in quality control estimation, based on the new generation tools, will probably be one of the elements considerably facilitating management of a forest economy unit. It is assumed that such a system has to be based on such traits of trees or stands which are easily measurable. An optimal solution seems to use the already existing data bases containing stand descriptions, including average height and diameter at breast height as well as a defined technical quality. In the opinion of Król [2006] traits of the stem and crown are closely correlated with timber quality. On the basis of his studies that author proved that in mature pine stands these include e.g. crown projection area and crown length. Thus it seems justified to conduct a comprehensive analysis combining traits of stems and crowns of trees with technical quality, particularly in reference to the quality and dimensional classification of round wood, currently binding and applied in practice.

MATERIAL AND METHODS

On the basis of the stand description of the Babki Forest Division a data base was created, containing the characteristics of all mature pine stands. Next two stands were selected, characterized by an identical quality and stocking, similar age and a similar diameter at breast height and height. The differentiation between these stands was based on technical quality (tab. 1).

Table 1. Description of the study sites

symbol	area [ha]	species composition	age	stand density	$d_{1,3}$ [cm]	height [m]	quality class	technical quality
B_2	9,26	So	95	0,8	34	27	I	2
B_3	2,34	So	90	0,8	33	26	I	3

In selected stands one representative mean sample plot each was established at an area of 0.5 ha. In each of these plots all trees were numbered in succession. Next stem parameters ($d_{1,3}$ - diameter at breast height, h - height) and crown parameters (h_{pk} – height of the base of the live crown, d_k - diameter of crown projection) were measured and each of them was subjected to quality and dimensional classification [PN-92/D-95017]. Moreover, height of the first snag on the stem (h_t) was determined. On the basis of measurements of crown diameter the projection area (p_k) was calculated for each of them. All the data were subjected to statistical analysis, determining the basic measures of the position and dispersion of traits. Significance of differences between groups, due to a lack of normal distribution of traits, was tested using non-parametric statistics.

RESULTS

The number of trees on the model areas was very similar (tab. 2). The value of the calculated stocking density index according to Reinekie (SDI) for the stand with the model area B_2 was 462, while for the stand from plot B_3 it was 463. Despite the comparable number of trees per unit area, trees coming from B_3 were thicker ($d_{1,3}$) and taller (h). However, the observed differences were not statistically significant.

Trees from B_3 had relatively longer crowns with a bigger diameter, and the first snag was located lower in comparison to trees from plot B_2 (tab. 2).

Table 2. Selected quantitative traits of stems and crowns of trees

		$d_{1,3}$ [cm]			h [m]			h_k:h*			d_k			p_k			h_t:h		
	n	x	sd	vc	x	sd	vc	x	sd	vc	x	sd	vc	x	sd	vc	x	sd	vc
B_2	157	31,9	5,4	16,9	23,8	2,6	10,9	0,24	0,08	35,4	4,2	1,1	26,9	14,5	7,8	53,6	0,34	0,13	37,8
B_3	151	32,6	5,1	15,6	24,1	2,8	11,7	0,27	0,10	35,5	4,4	1,2	27,1	16,4	9,0	54,8	0,30	0,11	35,7

n – number of cases; x – mean; sd – standard deviation; vc – variability coefficient
* - marked effects are significant with p<0,05

The proportion of timber in the quality and dimensional classes A, B and D was higher on plot B_2, by 4.2, 15.1 and 0.7%, respectively. In reference to class C, it was found that its proportion was by 19.9% higher in B_3 (Fig. 1).

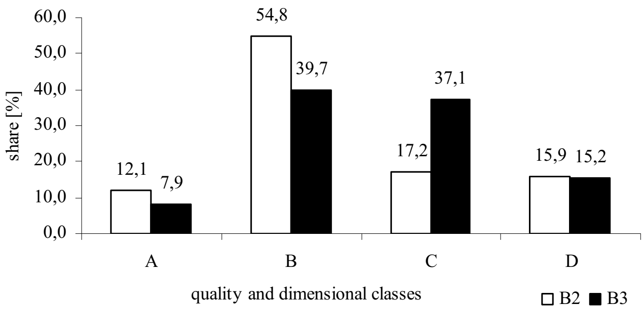

Fig. 1. Proportions of timber in quality and dimensional classes

Between trees from the compared areas, which were classified to the same quality and dimensional classes differences were found for most analyzed traits. In class A trees from B_2

were thicker and taller, while in B, C and D it was trees from plot B_3. Relatively longer crowns were found for trees grown in B_3, while in reference to class A relative crown length was the same both in B_2 and in B_3. Except for class A, wider crowns were formed by trees from B_3. Relative height of the first snag on the stem in B_2 was lower only in case of class A (tab. 3, tab. 4).

Table 3. Selected quantitative traits of stems and crowns of trees in quality and dimensional classes in plot B_2

KJW	n	$d_{1,3}$ [cm]			h [m]			h_k:h			d_k			p_k			h_t:h		
		x	sd	vc	x	sd	vc	x	sd	vc	x	sd	vc	x	sd	vc	x	sd	vc
A	19	39,3[2]	3,7	9,3	25,5[2]	2,0	7,7	0,26	0,07	27,6	5,0[2]	1,1	21,6	20,8	8,5	41,1	0,32	0,10	32,9
B	86	31,1	3,2	10,2	23,8	2,4	10,1	0,24	0,07	31,7	4,1	1,0	24,3	13,7	6,6	48,0	0,35[1]	0,12	34,2
C	27	30,7[2]	7,6	24,7	23,1[2]	3,3	14,3	0,23[1]	0,11	47,5	4,0[2]	1,4	34,3	14,0[1]	9,4	66,9	0,33[1]	0,16	47,3
D	25	30,5	5,8	18,9	23,4	2,5	10,5	0,24	0,10	39,9	4,0	1,0	25,5	12,8	7,2	56,1	0,32	0,14	43,2

n - number of cases; x - mean; sd - standard deviation; vc - variability coefficient
[1] - differences between B_2 and B_3 statistically significant at $p<0,05$
[2] - differences between B_2 and B_3 statistically significant at $p<0,01$

Table 4. Selected quantitative traits of stems and crowns of trees in quality and dimensional classes in plot B_3

KJW	n	$d_{1,3}$ [cm]			h [m]			h_k:h			d_k			p_k			h_t:h		
		x	sd	vc	x	sd	vc	x	sd	vc	x	sd	vc	x	sd	vc	x	sd	vc
A	12	36,0[2]	5,9	16,3	23,9[2]	2,1	8,6	0,26	0,07	27,3	4,5[2]	1,1	25,6	16,6	7,9	47,8	0,34	0,14	40,9
B	60	32,5	5,0	15,4	24,4	2,6	10,9	0,29	0,11	37,8	4,5	1,4	29,9	17,6	10,9	61,9	0,33[1]	0,09	26,7
C	56	32,8[2]	5,0	15,4	24,2[2]	3,2	13,2	0,26[1]	0,09	34,8	4,4[2]	1,1	25,3	16,0[1]	7,6	47,5	0,29[1]	0,11	38,0
D	23	30,9	4,3	13,9	23,5	2,7	11,6	0,27	0,08	30,4	4,1	1,0	23,1	14,0	6,8	48,5	0,27	0,13	48,1

n – number of cases; x – mean; sd – standard deviation; vc – variability coefficient
[1] - differences between B_2 and B_3 statistically significant at $p<0,05$
[2] - differences between B_2 and B_3 statistically significant at $p<0,01$

CONCLUDING REMARKS

Among the analyzed quantitative traits of stems and crowns of trees, growing in stands differing in terms of their technical quality index, statistically significant differences were found only in case of the relative length of the crown. On average longer and wider crowns were recorded for trees from plot B_3, which is an observation consistent with the proposals presented by Pazdrowski [1994] and Król [2006]. They stated that trees with wider and longer crowns are characterized by lower quality stems. This phenomenon is probably connected with the process of self-pruning, which depending on tree growth and development conditions is more or less dynamic [Jelonek et al. 2006, 2008].

As it could have been expected, the proportion of trees of high quality (classes A and B) was higher in plot B_2. Under site condition of fresh mixed coniferous forest, which is an optimal site for Scots pine, differentiation in stand quality may result from various causes. Timber quality is determined by genetic factors and by growth and development conditions of trees [Paschalis 1980; Jakubowski et al. 2005], particularly significant anthropogenic pressure. In case of mature stands it is practically impossible to review the past conditions and tending interventions.

Analyses did not show a marked trend, which would differentiate stands on the basis of biometric traits of trees (a statistically significant difference was found only in reference to the relative length of the crown). In quality and dimensional classes statistically significant differences were found for most analyzed traits only in classes A and C.

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Streszczenie: *Charakterystyka biometryczna dojrzałych drzewostanów sosnowych zróżnicowanych pod względem jakości, wyrosłych w warunkach siedliskowego typu lasu BMśw* Analizie poddano dwie powierzchnie doświadczalne, założone w drzewostanach o zbliżonych cechach taksacyjnych, zróżnicowane pod względem wskaźnika jakości technicznej. Na każdej z nich pomierzono wybrane cechy biometryczne wszystkich drzew, tj.: pierśnicę, wysokość, wysokość położenia na pniu pierwszego tylca i żywej gałęzi oraz określono przeciętną szerokość korony. Stwierdzono, że przy zbliżonej liczbie drzew na jednostce powierzchni drzewa z B_3 charakteryzowały się w porównaniu do drzew z B_2 większą pierśnicą i wysokością, szerszą i dłuższą koroną. Z wyjątkiem względnej długości korony, zaobserwowane różnice nie były jednak statystycznie istotne. Nie wykazano wyraźnego trendu, różnicującego drzewostany na podstawie cech biometrycznych. Podobnej zależności nie stwierdzono analizując cechy biometryczne drzew w klasach jakościowo – wymiarowych B i C. W przypadku klas A i C większość cech biometrycznych wykazała statystycznie istotne różnice.

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