Annals of Warsaw University of Life Sciences – SGGW
Forestry and Wood Technology No 72, 2010: 374-377
(Ann. WULS–SGGW, For and Wood Technol. 72, 2010)

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

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Abstract: *Biometrical characteristics of mature pine stands differing in terms of quality, growing under site conditions of fresh mixed broad-leaved forest* In was attempted in this study to characterise two stands with similar taxation characteristics, differing in terms of their technical quality index. On experimental plot L_3 (technical stand quality index - 3) trees were characterised by a generally bigger diameter at breast height, lower height, longer and wider crowns and had less pruned stems. Observed differences, except for relative height of the first snag on the stem, were statistically significant. It was of interest that a high proportion of timber classes A and B was found on plot L_2. Fresh mixed broad-leaved forest is not an optimal site for Scots pine. Thus this result has to be verified on the basis of further studies.

Keywords: Scots pine, biometrical characteristics, technical quality, fresh mixed broad-leaved forest

INTRODUCTION

Technical quality is an element in the stand description of mature stands. It is defined, among other things, on the basis of the minimum, average diameter at breast height outside bark. Moreover, the minimum length of the buttress with no defects and the proportion of trees meeting this condition are also considered. The determined index is, among other things, a reflection of silvicultural measures affecting many morphological traits of trees and stands.

In tending interventions, particularly thinning, the crown is a significant criterion in tree evaluation. It facilitates e.g. the evaluation of vitality and growth trends at all development phases of trees [Jaworski 2004]. The size of the crown, specifically its length, affects increment in diameter. In the opinion of Król [2006] it is also correlated with timber quality. From the economic point of view specific traits of tree stems have a permanent effect on the value of timber. Leibundgut [1972] expressed an opinion that quality requirements for timber in the distant future may not be forecasted. However, this objection is treated as justified only in relation to the evaluation of the importance of individual quality attributes, since irrespective of the practical purpose most quality traits will always be unchanged. Only their importance changes, which varies at individual methods of wood utilisation and the proportion of high quality assortments is an important element in the revenue of a forest economy unit. This argument is confirmed in view of the current forestry policy, treating production quality as one of many priorities.

In view of these facts it seems justified to conduct a comprehensive analysis combining easily measurable 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

The selection of model stands was based on a data base, which was created on the basis of stand description for mature pine stands in the Babki Forest Division. Two stands were selected, being identical in terms of their quality and stocking, similar in age, similar in average diameter at breast height and height, and differing in terms of their quality indexes (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
L_2	5,79	So	99	0,8	37	28	I	2
L_3	2,25	So	89	0,8	36	26	I	3

Within each the selected stands one representative mean sample plot was established at an area of 0.5 ha. In each of the 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 on each of them. Moreover, the height of the first snag on the stem (h_t) was also recorded. On the basis of crown diameter measurements their projection area (p_k) was calculated. Each of the trees was classified also in terms of their quality and dimensions [PN-92/D-95017].

Collected data were subjected to statistical analysis, defining 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 the non-parametric statistics.

RESULTS

On the model plots the number of trees was similar (tab. 2). The stocking density index according to Reinekie (SDI) for the stand, in which the representative plot L_2 was established, was 456, while for the stand with plot L_3 it was 548. Despite the fact that the number of trees per unit area was comparable and the SDI value was markedly higher, trees coming from L_3 were thicker ($d_{1,3}$). However, the recorded difference was not statistically significant. Similarity as in case of height, this time in L_3 trees were on average lower than those coming from L_2 by 1.2 m (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
L_2	136	34,5	4,9	14,1	26,0	2,3	8,9	0,25	0,07	27,4	4,3	0,9	21,6	15,0	6,8	45,2	0,28	0,09	33,1
L_3	141	37,9	6,8	18,1	24,8	3,2	12,7	0,33	0,09	26,1	4,9	1,3	27,0	20,0	10,5	52,4	0,24	0,12	49,4

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

The proportion of individual quality and dimensional classes of timber differed markedly for the analysed plots. It was stated that in plot L_2 the proportion of class A was 39.7%, class B - 44.9%, which in relation to plot L_3 were values higher by 22.7% and 10.9%, respectively. In case of classes C and D an opposite dependence was found. In L_2 in relation to L_3 the proportion of class C was lower by 22.3%, while for class D it was by 11.2% (Fig. 1).

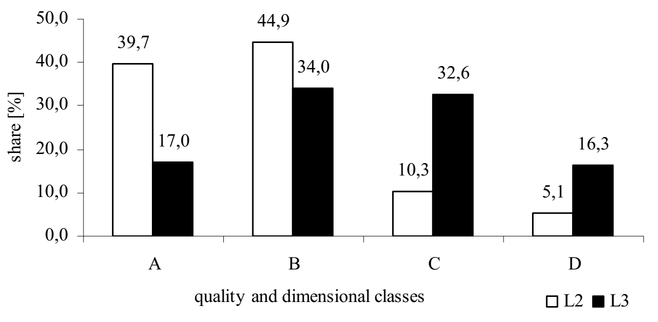

Fig. 1. Proportions of timber in quality and dimensional classes

When comparing quantitative traits of stems and crowns between individual experimental plots it was stated that on L_3, irrespective of the quality and dimensional class, trees were thicker ($d_{1,3}$), while in classes B, C and D they were lower (h). Trees grown in plot L_2 were characterised by relatively shorter crowns of a smaller diameter. It was also stated that the relative height of the first snag on the stem was higher in trees from class A in plot L_3, while in the other classes it was in trees on plot L_2 (tab. 3, tab. 4).

Table 3. Selected quantitative traits of stems and crowns of trees in quality and dimensional classes in plot L_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	54	38,2	3,5	9,1	26,1[2]	2,5	9,5	0,27[1]	0,08	29,4	4,6[2]	1,0	22,0	17,2[1]	7,9	46,0	0,28[1]	0,10	35,5
B	61	31,4	3,7	11,9	25,6[2]	1,9	7,5	0,23	0,05	23,7	4,0[2]	0,8	20,1	12,9	5,3	40,7	0,29	0,10	32,4
C	14	34,8[2]	5,1	14,5	27,0[2]	3,3	12,1	0,28[1]	0,06	22,2	4,5	0,8	18,6	16,5	6,5	39,6	0,27	0,05	19,1
D	7	32,7[2]	2,8	8,5	25,9	1,7	6,5	0,26[1]	0,07	26,3	4,2[2]	0,8	18,6	14,1[1]	5,0	35,4	0,27	0,11	42,1

n - number of cases; x - mean; sd - standard deviation; vc - variability coefficient

[1] - differences between L_2 and L_3 statistically significant at $p<0,05$

[2] - differences between L_2 and L_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 L_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	24	43,5	5,1	11,8	26,3[2]	3,3	12,5	0,35[1]	0,08	24,2	6,0[2]	1,2	19,3	29,3[1]	10,9	37,2	0,33[1]	0,11	32,4
B	48	36,1	5,3	14,7	24,4[2]	3,2	13,3	0,33	0,08	23,8	4,8[2]	1,2	24,1	19,1	9,5	49,7	0,28	0,09	30,4
C	46	36,8[2]	7,0	18,9	24,7[2]	3,2	13,0	0,33[1]	0,09	26,9	4,5	1,0	23,0	16,4	7,3	44,5	0,19	0,12	61,2
D	23	37,9[2]	8,2	21,5	24,2	2,4	9,7	0,34[1]	0,11	31,6	4,7[2]	1,7	35,5	19,3[1]	12,2	63,4	0,16	0,10	61,6

n - number of cases; x - mean; sd - standard deviation; vc - variability coefficient

[1] - differences between L_2 and L_3 statistically significant at $p<0,05$

[2] - differences between L_2 and L_3 statistically significant at $p<0,01$

CONCLUDING REMARKS

Plots on which measurements were taken were characterised by a low stocking density index (SDI < 600), with its higher value found for L_3. Trees grown in this stand were thicker (at breast height – $d_{1,3}$) and at the same time lower in classes B, C and D, in comparison to trees older by 10 years from plot L_2. They had wider and longer crowns and they were less pruned. The size of the crown is correlated with the dynamics of tree increment [Lemke 1966; Zajączkowski 1973], which according to Pazdrowski [1992] is in turn connected with the quality of their stems at cutting age. Trees, which at young age increase in diameter more dynamically, supply lower quality timber.

Analysis conducted in this study, combining traits of stems and crowns of trees with technical quality, in relation to the quality and dimensional classification of round wood, currently binding and applied in practice, showed a statistically significant difference between selected quantitative traits. The observed differentiation between L_2 and L_3, despite a comparable number of trees per area unit, was probably the effect of different growth and development conditions of trees at young age (spacing, intensity of tending intervention). It may also be assumed that it is an effect of genetic variation, particularly characteristic of Scots pine [Giertych, Oleksyn 1992; Kosińska et al. 2007]. Trees respond to changes, which occur in their environment [Oleksyn et al. 1998]. Through long-term evolution populations have developed within species, adapted to local growth and development conditions. Transfer of plant material in locations with relatively different conditions may result in the expected production results being unsatisfactory [Barzdajn 2006].

It is of interest that a high proportion of timber classes A and B was found in plot L_2. Fresh mixed broad-leaved forest is not a recommended site type for Scots pine culture. Conditions with a relatively high moisture content usually do not promote production of pine timber of high quality. Thus this result has to be verified on the basis of a bigger number of experimental plots.

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Streszczenie: *Charakterystyka biometryczna dojrzałych drzewostanów sosnowych zróżnicowanych pod względem jakości, wyrosłych w warunkach siedliskowego typu lasu LMśw* W pracy podjęto próbę scharakteryzowania dwóch drzewostanów o zbliżonych cechach taksacyjnych, zróżnicowanych pod względem wskaźnika jakości technicznej. Na powierzchni doświadczalnej L_3 (wskaźnik jakości technicznej drzewostanu - 3) drzewa cechowały się generalnie wyższą pierśnicą, niższą wysokością, dłuższymi i szerszymi koronami oraz posiadały słabiej oczyszczone pnie. Zaobserwowane różnice, z wyjątkiem względnej wysokości położenia na pniu pierwszego tylca, były statystycznie istotnie. Interesujący fakt stanowi również wysoki udział surowca klasy A i B na powierzchni L_2. LMśw nie jest optymalnym siedliskiem dla sosny zwyczajnej. Wynik ten musi być zatem zweryfikowany na podstawie dalszych badań.

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