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EFFECT OF THE AGE OF THE MATERNAL PINE *PINUS SYLVESTRIS* L. ON THE GROWTH AND DEVELOPMENT OF PROGENY STANDS

Ryszard Miś, Jan Kukuła, Andrzej Węgiel
Poznań University of Life Sciences

Abstract. The paper presents the results of investigations carried out on the experimental plot which was established in 1914 by professor Busse from Tharandt. The objective of the experiment was to determine the age of maternal trees on the growth and development of progeny stands. The study describes the course of investigations as well as the results obtained during the consecutive periods. The presented results refer to seven provenances of Scots pine derived from the stands of the following forest districts: Zielonka, Bolewice and Brójce. The experimental surface was established on the Trzciel Forest District in Poland. Busse's principal methodological assumption was to employ in his experiment seeds of trees of different age (16 to 170 years old). The presented paper discussed the results obtained during the period from 1965 to 2006. Two provenance groups were identified on the basis of statistical differences and similarities: older maternal stands – more favourable characters of progeny growth and development: IV, V, VI (101-170 years of age) and younger maternal stands – less favourable characters of progeny growth and development: I, IIb, III (16-80 years of age).

Key words: *Pinus sylvestris*, progeny stands, Busse's experiment, Trzciel Forest District

INTRODUCTION

Professor Busse established the experimental surface in 1914 on the territory of the current Trzciel Forest District of the Regional Directorate of State Forests in Szczecin with the aim to check the impact of the age of maternal trees of Scots pine on the growth and development of progeny stands. Details of the methodological assumptions of the established experiment as well as research results were described in consecutive publications [Busse 1924, 1925, 1926, 1930, 1931, 1937, Wyrwiński 1925]. After the Second World War, thanks to Polish foresters, the experimental surface preserved fully its scientific value because it was excluded from ordinary economic management. Until 1961, the experimental area was under the care of Wojciech Wilusz, the head forester of

Corresponding author – Adres do korespondencji: Prof. dr hab. Ryszard Miś, Department of Forest Management of Poznań University of Life Sciences, Wojska Polskiego 71 C, 60-625 Poznań, Poland, e-mail: misr@up.poznan.pl

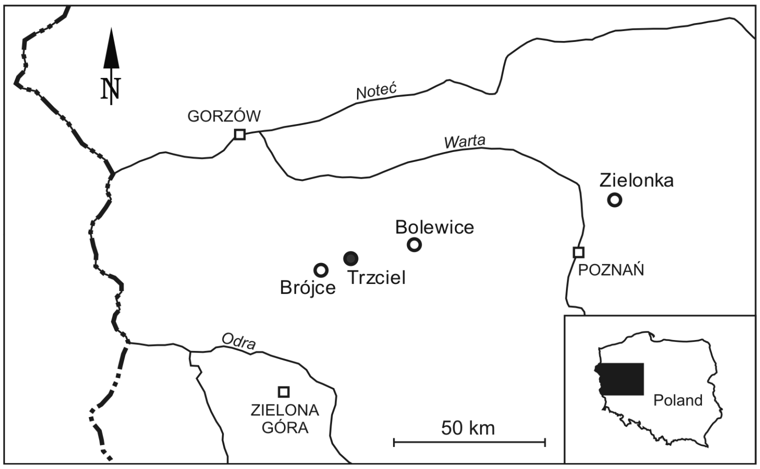

Fig. 1. Localization of experimental plot (Trzciel) and parent pine stands (Brójce, Bolewice, Zielonka)
Rys. 1. Lokalizacja powierzchni doświadczalnej (Trzciel) oraz drzewostanów matecznych (Brójce, Bolewice, Zielonka)

Table 1. General characteristic of parent pine stands
Tabela 1. Ogólna charakterystyka drzewostanów matecznych

Symbol of origin Symbol pochodzenia	Average age of parent trees (age range) Średni wiek drzew matecznych (zakres wieku)	Sites of collecting seeds Miejsce zbioru nasion			Origin of parent trees stand Pochodzenie drzewostanów matecznych
		forest range nadleśnictwo	compartment oddział	date data	
I	16 –	Zielonka	247	March 1914 marzec 1914	sown siew
IIa	50 (45-55)	Bolewice	158b 162	March 1914 marzec 1914	158b – sown and planted – siew i sadzenie 162 – natural regeneration – odnowienie naturalne
IIb	47 (44-50)	Zielonka	242d	March 1914 marzec 1914	planted sadzenie
III	74 (68-80)	Zielonka	252b, 256a, 256b	February 1914 luty 1914	planted sadzenie
IV	112 (101-123)	Zielonka	143b	March 1914 marzec 1914	not established nieokreślone
V	140 (120-160)	Bolewice	101	January and February 1914 styczeń i luty 1914	natural regeneration odnowienie naturalne
VI	170 –	Brójce	140	March 1914 marzec 1914	natural regeneration odnowienie naturalne

the Trzciel Forest District and it was on his initiative that the workers of the Forestry Faculty of the Agricultural University of Poznań carried out field inspection of the plot. In June 1965, following formal agreement with the Regional Directorate of State Forests in Żary, the supervision over the experimental area was taken over by the Department of Forest Management of Agricultural University of Poznań chaired by professor Bolesław Zabielski. In 1965, the first preliminary measurements were carried out in order to determine urgent thinning operations and then to select dimensions of mean sample trees for increment studies. More details concerning the history of the experimental surface as well as first research results obtained after World War II can be found in publications by Wilusz [1968], Miś [1968], Zabielski and Miś [1970, 1973], Wilusz and Giertych [1974], Miś and Zabielski [1989], Gołojuch et al. [1998]. During the entire period of supervision over the experimental surface systematic control of the health condition of trees was carried out, numbers, dimensions and volume of dying and dead trees were registered and the current and mean volume increments in individual experimental plots were determined. Following the strong thinning carried out in 1965, later on only dying and dead trees as well as test trees for increment analyses were felled.

The aim of this study was to determine the effect of different age of maternal trees on the condition of selected traits of progeny stands 92 years after the experiment's establishment.

METHODS

In his experiment, Busse used seeds collected from seven groups of maternal stands differing with regard to the meat ages of trees: (16 years old), IIa (50 years old), IIb (47 years old), III (74 years old), IV (112 years old), V (140 years old) and VI (170 years old). The above stands were growing on the territories of the following forest districts: Brójce, Bolewice and Zielonka (Fig. 1, Table 1). Seeds were collected during the period January-March 1914 and sowed in a nursery on April, the 28th of the same year. Seedlings were planted out from April the 20th to 28th 1915 on 28 parcels (0.0443 ha each) distributed according to the random design block system (7 provenances × 4 replications). In 2006, breast height diameters of all trees and heights of 15-20% of trees on individual experimental parcels were measured. Breast height diameters were determined on the basis of arithmetic means from two measurements conducted in N-S and E-W directions with 1 mm accuracy. Tree heights were measured using a hypsometer with 0.5 m accuracy. Whole tree volumes were determined on the basis of volume tables of standing trees [Czuraj et al. 1960]. The sum of single tree volumes was determined for individual experimental parcels and groups of maternal trees. Because identical measurements were carried out in years: 1965, 1986 and 1996, it was possible to determine current volume increments in periods: 1965-1986, 1986-1996 and 1996-2006. This increment was calculated according to the formula:

$$ZB = V_k - V_p + U,$$

where:

- V_k – stand volume at the end of the period,
- V_p – stand volume at the beginning of the period,
- U – volume of trees which were removed from individual parcels during the natural process before the end of the period.

Table 2. Number of trees (N), average DBH ($\bar{d}$), average height ($\bar{h}$), cross-section area (G), volume (V) and mean volume of a single tree ($\bar{v}$) found in October 2006

Tabela 2. Liczba drzew (N), przeciętna pierśnica ($\bar{d}$), przeciętna wysokość ($\bar{h}$), pole powierzchni przekroju (G), zasobność (V) i miąższość pojedynczego drzewa ($\bar{v}$) pomierzone we wrześniu 2006 roku

Symbol of origin Symbol pochodzenia	Symbol of plot Symbol parceli	N	$\bar{d}$ cm	$\bar{h}$ m	G m^2	V m^3	$\bar{v}$ m^3
I	A-1	31	24.8	23.2	1.55	16.57	0.53
	D-3	30	23.9	23.5	1.41	15.35	0.51
	B-5	30	23.2	23.6	1.34	14.71	0.49
	C-7	37	21.6	22.2	1.40	14.59	0.39
	mean – średnia		**23.3**	**23.1**	**1.43**	**15.31**	**0.48**
IIa	D-2	35	24.4	25.3	1.71	20.01	0.57
	A-3	29	26.4	25.3	1.65	19.01	0.66
	C-5	43	22.4	24.5	1.79	20.73	0.48
	B-1	32	26.1	25.0	1.77	20.43	0.64
	mean – średnia		**24.6**	**25.0**	**1.73**	**20.05**	**0.58**
IIb	D-7	36	22.7	21.7	1.56	15.79	0.44
	B-3	29	24.8	23.4	1.46	15.54	0.54
	C-1	35	23.8	23.8	1.63	18.06	0.52
	A-5	34	24.8	24.2	1.72	19.19	0.56
	mean – średnia		**24.0**	**23.3**	**1.59**	**17.15**	**0.51**
III	D-1	30	24.9	24.9	1.54	17.36	0.58
	C-3	34	23.8	24.0	1.58	17.46	0.51
	A-4	39	24.9	23.6	1.97	21.57	0.55
	B-6	33	23.6	23.1	1.51	15.91	0.48
	mean – średnia		**24.3**	**23.9**	**1.65**	**18.08**	**0.53**
IV	C-6	37	22.3	22.7	1.51	16.03	0.43
	B-7	40	24.3	23.1	1.97	20.92	0.52
	D-4	37	24.5	24.3	1.84	20.62	0.56
	A-2	32	25.7	25.0	1.72	19.94	0.62
	mean – średnia		**24.2**	**23.8**	**1.76**	**19.38**	**0.53**
V	D-6	41	24.1	23.6	1.96	21.37	0.52
	A-6	32	27.0	24.3	1.91	20.99	0.66
	C-4	39	23.7	24.3	1.79	20.15	0.52
	B-2	38	25.0	24.6	1.97	22.49	0.59
	mean – średnia		**24.9**	**24.2**	**1.91**	**21.25**	**0.57**
VI	A-7	32	26.5	23.5	1.85	20.06	0.63
	D-5	42	24.3	24.1	2.01	22.28	0.53
	B-4	36	23.6	24.5	1.66	18.71	0.52
	C-2	39	23.9	23.8	1.80	19.92	0.51

mean – średnia	**24.5**	**24.0**	**1.83**	**20.24**	**0.54**

The volume of removed trees (U) was determined by the section method measuring the diameter of each tree in the middle of 1-meter sections.

The provenance of IIa was left out from the performed comparative analyses due to differences in site conditions in comparison with the remaining provenances which were considered as identical [Wilusz and Giertych 1974]. The evaluation of the remaining provenances was based on the comparison of the following tree traits: mean tree breast height diameter ($\overline{d}$), mean tree height ($\overline{h}$), cross section area (G), volume (V), mean volume of a single tree ($\overline{v}$) and periodical increment of tree volume of a given provenance (ZB). The significance of differences of mean values was estimated at the level of p = 0.05. In addition, the statistical analysis of similarities of selected traits of the examined provenances of Scots pine was also carried out.

RESULTS

The results of the measurements taken in September 2006 are presented in Table 2. The order of provenances (with the exception of provenance IIa) in accordance with the diminishing mean value of individual traits is as follows:

$\overline{d}$ – V (24.9 cm), VI (24.5), III (24.3), IV (24.2), IIb (24.0), I (23.3);
$\overline{h}$ – V (24.2 m), VI (24.0), III (23.9), IV (23.8), IIb (23.3), I (23.1);
G – V (1.91 m^2), VI (1.83), IV (1.76), III (1.65), IIb (1.59), I (1.43);
V – V (21.25 m^3), VI (20.24), IV (19.38), III (18.08), IIb (17.15), I (15.31);
$\overline{v}$ – V (0.57 m^3), VI (0.54), IV (0.53), III (0.53), IIb (0.51), I (0.48).

The sequence of provenances indicates unequivocally increase of mean values of four of the analysed traits together with age of maternal trees. The statistical characteristics of the tree breast height diameter and volume of the examined provenances is presented in Table 3, while the cross section diameter and the volume of the growing stock – in Table 4. It is evident from these Tables that the variability of these traits was connected with the provenance of trees.

Table 5 collates the number and volume of trees removed from individual parcels in years 1965-2006. The data served to calculate values of mean volume increments in periods: 1965-2006 and 1997-2006 (Table 6). On this basis, the authors determined the following order of provenances according to the diminishing tree volume increment in the period from 1065 to 2006: provenance V – 9.30 m^3/ha/year; VI – 8.55; IV – 8.43; IIb – 7.86; III – 7.68; I – 6.54; and for the period from 1997-2006: provenance VI – 11.15 m^3/ha/year; V – 10.73; IV – 9.07; I – 8.13; III – 7.58; IIb – 7.26.

Trees derived from older stands were characterized by a greater mean volume increment in both of the discussed periods. The results of the test of significance of differences of the examined valuation traits between the examined provenances are presented in Table 7. The results of this test indicate significant differences between the group of provenances from older stands (IV, V and VI) and the group of provenances from younger stands (I, IIb and III). The obtained results were corroborated by the analysis of similarities for each trait separately (Fig. 2) as well as by the multi-trait analysis of provenance similarities (Fig. 3). The results of statistical investigations prove that the progeny of older maternal stands (112-170 years old) is characterized by more favourable traits than those of the progeny derived from younger stands (16-74 years old).

Table 3. Statistical characteristic of DBH and tree volume
Tabela 3. Charakterystyka statystyczna pierśnicy i miąższości drzew

Symbol of origin Symbol pochodzenia	Number of trees Liczba drzew	DBH – Pierśnica			Volume – Miąższość		
		$\bar{x}$	s_x	$s_x\%$	$\bar{x}$	s_x	$s_x\%$
		cm	cm	%	m^3	m^3	%
I	128	23.3	5.128	22.03	0.48	0.245	51.31
IIa	139	24.6	5.560	22.63	0.58	0.273	47.29
IIb	134	24.0	5.662	23.64	0.51	0.269	52.46
III	136	24.3	5.115	21.03	0.53	0.237	44.56
IV	146	24.2	5.579	23.10	0.53	0.265	49.97
V	150	24.9	5.471	22.00	0.57	0.268	47.27
VI	149	24.5	5.073	20.71	0.54	0.250	46.06
Total – Ogółem	982	24.3	5.381	22.18	0.53	0.260	48.50

$\bar{x}$ – average, s_x – standard deviation, $s_x\%$ – variable index.
$\bar{x}$ – wartość średnia, s_x – odchylenie standardowe, $s_x\%$ – współczynnik zmienności.

Table 4. Statistical characteristic of cross section area and stand volume
Tabela 4. Charakterystyka statystyczna pola powierzchni przekroju i miąższości drzewostanu

Symbol of origin Symbol pochodzenia	Number of plot Liczba parcel	Cross section area Pole powierzchni przekroju			Stand volume Miąższość drzewostanu		
		$\bar{x}$	s_x	$s_x\%$	$\bar{x}$	s_x	$s_x\%$
		cm	cm	%	m^3	m^3	%
I	4	1.43	0.089	6.24	15.31	0.907	5.92
IIa	4	1.73	0.063	3.66	20.05	0.751	3.74
IIb	4	1.59	0.110	6.90	17.15	1.773	10.34
III	4	1.65	0.215	13.04	18.08	2.435	13.47
IV	4	1.76	0.195	11.11	19.38	2.269	11.71
V	4	1.91	0.083	4.33	21.25	0.971	4.57
VI	4	1.83	0.144	7.89	20.24	1.487	7.35
Total – Ogółem	28	1.70	0.195	11.47	18.78	2.420	12.89

$\overline{x}$ – average, s_x – standard deviation, s_x% – variable index.
$\overline{x}$ – wartość średnia, s_x – odchylenie standardowe, s_x% – współczynnik zmienności.

Table 5. Number (n) and volume (V) of felled trees in the years 1965-2006
Tabela 5. Liczba (n) i miąższość (V) drzew usuniętych w latach 1965-2006

Symbol of origin Symbol pochodzenia	Symbol of plot Symbol parceli	Years – Lata					
		1965-1996		1997-2006		1965-2006	
		n	V m^3	n	V m^3	n	V m^3
I	A-1	51	6.04			51	6.04
	D-3	83	5.78	1	0.37	84	6.15
	B-5	76	4.79			76	4.79
	C-7	72	4.86			72	4.86
	sum – suma	**282**	**21.47**	**1**	**0.37**	**283**	**21.84**
IIa	D-2	75	6.58	1	0.11	76	6.69
	A-3	44	7.30	1	0.14	45	7.44
	C-5	88	6.19			88	6.19
	B-1	54	5.18			54	5.18
	sum – suma	**261**	**25.25**	**2**	**0.25**	**263**	**25.50**
IIb	D-7	78	6.57			78	6.57
	B-3	68	6.01			68	6.01
	C-1	53	5.03			53	5.03
	A-5	68	5.43			68	5.43
	sum – suma	**267**	**23.04**			**267**	**23.04**
III	D-1	76	6.20	2	0.42	78	6.62
	C-3	70	5.41			70	5.41
	A-4	43	3.20	1	0.19	44	3.39
	B-6	69	4.49			69	4.49
	sum – suma	**258**	**19.30**	**3**	**0.61**	**261**	**19.91**
IV	C-6	78	4.26	2	0.26	80	4.52
	B-7	72	5.43			72	5.43
	D-4	71	6.05			71	6.05
	A-2	41	5.34			41	5.34
	sum – suma	**262**	**21.08**	**2**	**0.26**	**264**	**21.34**
V	D-6	77	5.65			77	5.65
	A-6	43	3.83			43	3.83
	C-4	60	5.69			60	5.69
	B-2	65	6.71	1	0.14	66	6.85
	sum – suma	**245**	**21.88**	**1**	**0.14**	**246**	**22.02**
VI	A-7	67	5.94			67	5.94
	D-5	62	4.35	5	0.87	67	5.22
	B-4	62	5.28	1	0.60	63	5.88
	C-2	58	4.81	1	0.11	59	4.92

sum – suma	**249**	**20.38**	**7**	**1.58**	**256**	**21.96**
Total Ogółem	**1 824**	**152.40**	**16**	**3.21**	**1 840**	**155.61**

Table 6. Volume increment in the period 1965-2006 and 1997-2006
Tabela 6. Przeciętny przyrost miąższości w okresach 1965-2006 i 1997-2006

Symbol of origin Symbol pochodzenia	Symbol of plot Symbol parceli	Stand volume Miąższość drzewostanu m^3/ha			Volume of felled trees Miąższość drzew usuniętych m^3/ha		Increment m^3/ha/year Przyrost m^3/ha/rok	
		1965	1996	2006	1965- -2006	1996- -2006	1965- -2006	1996- -2006
I	A-1	236.6	338.4	382.7	139.5		7.14	4.43
	D-3	233.2	264.9	354.5	142.0	8.5	6.58	9.81
	B-5	186.7	253.2	339.7	110.6		6.59	8.65
	C-7	215.1	240.6	337.0	112.2		5.85	9.64
	mean – średnia	**245.1**	**217.9**	**353.5**			**6.54**	**8.13**
IIa	D-2	260.1	347.2	462.1	154.5	2.5	8.91	11.74
	A-3	252.8	400.2	439.0	171.8	3.2	8.95	4.20
	C-5	261.6	342.4	478.8	143.0		9.00	13.64
	B-1	205.9	375.5	471.8	119.6		9.64	9.63
	mean – średnia	**245.1**	**366.3**	**462.9**			**9.13**	**9.81**
IIb	D-7	186.6	274.6	364.7	151.7		8.24	9.01
	B-3	227.1	340.3	358.9	138.8		6.76	1.86
	C-1	216.7	339.6	417.1	116.2		7.91	7.75
	A-5	227.5	338.9	443.2	125.4		8.53	10.43
	mean – średnia	**214.5**	**323.3**	**396.0**			**7.86**	**7.26**
III	D-1	239.2	321.0	400.9	152.9	9.7	7.87	8.96
	C-3	225.3	362.2	403.2	124.9		7.57	4.10
	A-4	227.4	405.4	498.2	78.3	4.4	8.73	9.72
	B-6	208.4	292.1	367.4	103.7		6.57	7.53
	mean – średnia	**225.1**	**345.2**	**417.4**			**7.68**	**7.58**
IV	C-6	205.0	284.2	370.2	104.4	6.0	6.74	9.20
	B-7	246.5	356.0	483.1	125.4		9.05	12.71
	D-4	249.7	365.4	476.2	139.7		9.16	11.08
	A-2	232.9	427.7	460.5	123.3		8.77	3.28
	mean – średnia	**233.5**	**358.3**	**447.5**			**8.43**	**9.07**
V	D-6	236.8	379.7	493.5	130.5		9.68	11.38
	A-6	205.5	378.2	484.8	88.4		9.19	10.66
	C-4	249.0	358.8	465.4	131.4		8.69	10.66
	B-2	291.9	420.5	519.4	158.4	3.2	9.64	10.21
	mean – średnia	**245.8**	**384.3**	**490.8**			**9.30**	**10.73**

VI	A-7	278.4	362.5	463.3	137.2		8.05	11.08
	D-5	246.0	406.1	514.5	120.6	20.1	9.73	12.85
	B-4	246.4	328.7	432.1	135.8	13.9	8.04	11.73
	C-2	238.0	373.3	460.0	113.6	2.5	8.39	8.92
	mean – średnia	**252.2**	**365.1**	**467.5**			**8.55**	**11.15**

Table 7. Results of significant difference test for four characteristic (DBH, volume of tree, cross section area, stand volume)
Tabela 7. Wyniki testu istotności różnic dla czterech cech (pierśnica, miąższość drzew, pole powierzchni przekroju, zasobność)

Symbol of origin Symbol pochodzenia	I	IIb	III	IV	V	VI
DBH of tree – Pierśnica						
I	–	0.3087	0.1160	0.1785	***0.0139***	0.0586
IIb	0.3087	–	0.5773	0.7561	0.1511	0.3900
III	0.1160	0.5773	–	0.7968	0.3850	0.7711
IV	0.1785	0.7561	0.7968	–	0.2507	0.5756
V	***0.0139***	0.1511	0.3850	0.2507	–	0.5544
VI	0.0586	0.3900	0.7711	0.5756	0.5544	–
Volume of tree – Miąższość drzew						
I	–	0.2904	0.0914	0.0904	***0.0043***	***0.0352***
IIb	0.2904	–	0.5253	0.5335	0.0720	0.3002
III	0.0914	0.5253	–	0.9810	0.2485	0.6978
IV	0.0904	0.5335	0.9810	–	0.2302	0.6747
V	***0.0043***	0.0720	0.2485	0.2302	–	0.4332
VI	***0.0352***	0.3002	0.6978	0.6747	0.4332	–
Cross section area – Pole powierzchni przekroju						
I	–	0.1280	***0.0460***	***0.0051***	***0.0002***	***0.0012***
IIb	0.1280	–	0.5906	0.1280	***0.0077***	***0.0363***
III	***0.0460***	0.5906	–	0.3085	***0.0246***	0.1035
IV	***0.0051***	0.1280	0.3085	–	0.1770	0.5133
V	***0.0002***	***0.0077***	***0.0246***	0.1770	–	0.4698
VI	***0.0012***	***0.0363***	0.1035	0.5133	0.4698	–
Stand volume – Zasobność						
I	–	0.1525	***0.0373***	***0.0039***	***0.0001***	***0.0008***
IIb	0.1525	–	0.4605	0.0868	***0.0037***	***0.0217***

III	***0.0373***	0.4605	–	0.3043	***0.0189***	0.0955
IV	***0.0039***	0.0868	0.3043	–	0.1455	0.4915
V	***0.0001***	***0.0037***	***0.0189***	0.1455	–	0.4234
VI	***0.0008***	***0.0217***	0.0955	0.4915	0.4234	–

Statistically significant differences are marked ($p < 0.05$).
Zaznaczone różnice są istotne ($p < 0,05$).

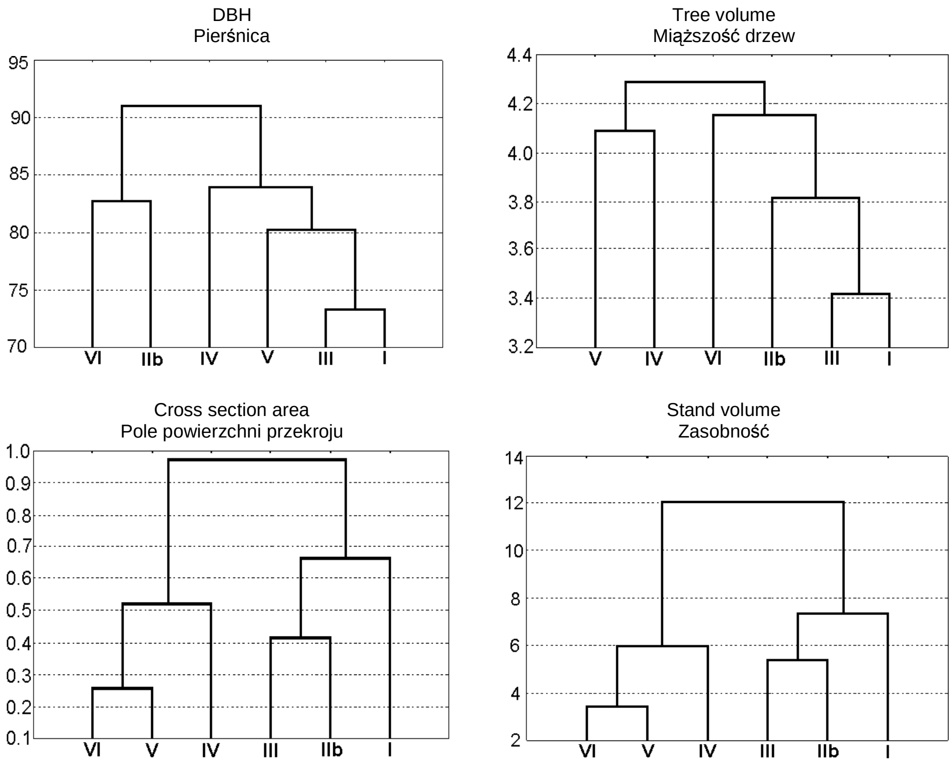

Fig. 2. Analysis of similarities of examined provenances
Rys. 2. Analizy podobieństwa badanych pochodzeń

DBH, tree volume, cross section area, stand volume
Pierśnica, miąższość drzew, pole powierzchni przekroju, zapas

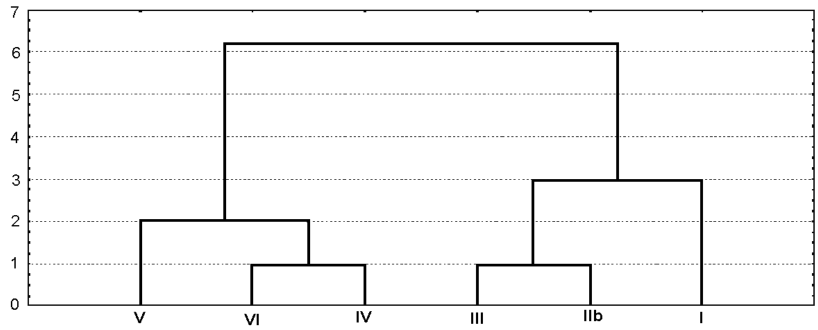

Fig. 3. Multivariate analysis of similarities of examined provenances
Rys. 3. Wielocechowa analiza podobieństwa badanych pochodzeń

RECAPITULATION AND CONCLUSIONS

The obtained results illustrate the current state of six traits of trees growing on the experimental surface 92 years after its establishment. The trees derive from seven maternal stands differing in age. Professor Busse collected cones from those stands and determined the weight of 1000 seeds as well as their germination power [Busse 1924]. He put forward a hypothesis then that the value of seeds obtained from young pine trees growing on poor sites cannot be assessed lower than the value of seeds obtained from older trees and he decided to verify it experimentally. The results of the consecutive measurements and observations carried out by Busse [1924, 1925, 1926, 1930, 1931 and 1937] proved that:

- Seeds collected from stands of younger age classes (mean age: 16-74 years old) were bigger and heavier than the seeds collected from stands of older age classes (mean age: 112-170 years old).
- The initial seedling development depended directly on the seed weight and, indirectly, on the stand age from which seeds were collected – the bigger and heavier the seeds and the younger the maternal tree, the faster and better was the seedling development.
- The size of seedling drop out was bigger in the case of the progeny of older stands than in the progeny of stands of younger age classes.

The Department of Forest Management of the Agricultural University of Poznań started investigations on the experimental surface established by Busse in 1965. Initially, these investigations focused on the following problems:

- Structural traits of the examined provenances 52 years old taking into consideration the following four tree classification systems: Kraft, Ilmurzyński, selective and Loetsch [Miś 1968].
- Tree growth retrospection employing the method of full section analysis of 283 felled mean sample trees [Zabielski and Miś 1970].

The statistical evaluation of tree numbers in biological classes proved in 18 out of 19 cases that – at the age of 52 – differences in the tree frequency and breast height diameter allocated to the same biological classes but of different provenances were non-significant.

The increment investigation carried out on felled mean sample trees revealed that progeny stands were then still before the culmination of their current and mean increment. With the exception of the IIa provenance (Bolewice), the most favourable volume increment dynamics was observed in trees derived from the oldest maternal stands – more than 100 years of age (VI, V and IV). However, at that time it was not yet possible to prove statistically the existence of the tree age most favourable for seed collection. It was decided that further observations and measurements were necessary.

Investigations conducted in consecutive periods [Miś and Zabielski 1989, Gołojuch et al. 1998] confirmed that the development of trees derived from seeds collected from the trees of the oldest age class was the most favourable, again with the exception of IIa provenance derived from the Bolewice Forest District (45-55 years of age). Already at the beginning of the experiment, this provenance was regarded by Busse as unsuitable for comparisons with the remaining provenances as it derived from a maternal stand growing in better site conditions. The correctness of that attitude was confirmed by the results obtained during consecutive periods of investigations.

The research material obtained in 2006 as well as the performed analyses allowed drawing the following conclusions:

1. Ninety two years after the establishment of the experiment, statistical confirmation of the correctness of the working hypothesis that the age of trees intended for seed collection is a factor which has a significant impact on the growth and development of progeny stands.

2. On the basis of the statistical results of differences and similarities of the examined traits in progeny trees, two groups of provenances can be distinguished:
– older maternal stands comprising the following provenances: IV (101-123 years old); V (120-160 years old) and VI (170 years old),
– younger maternal stands comprising the following provenances: I (16 years old); IIb (44-50 years old) and III (68-80 years old).

3. The results of the performed experiment confirm the need to apply long periods of observations and measurements when assessing the silviculture value of provenances of forest tree species.

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WPŁYW WIEKU SOSNY MATECZNEJ *PINUS SYLVESTRIS* L. NA WZROST I ROZWÓJ DRZEWOSTANÓW POTOMNYCH

Streszczenie. Praca zawiera wyniki badań na powierzchni doświadczalnej założonej w 1914 roku przez prof. J. Bussego z Tharandtu. Celem doświadczenia było określenie wpływu wieku drzew matecznych na wzrost i rozwój drzewostanów potomnych. W pracy opisano przebieg badań i wyniki uzyskiwane w kolejnych okresach. Wyniki te odnoszą się do siedmiu proweniencji sosny zwyczajnej pochodzącej z drzewostanów nadleśnictw: Zielonka, Bolewice, Brójce. Powierzchnia doświadczalna położona jest na terenie Nadleśnictwa Trzciel – Regionalna Dyrekcja Lasów Państwowych w Szczecinie. Podstawowym założeniem metodycznym Bussego było użycie w doświadczeniu nasion drzew tego samego pochodzenia (wschodniego poznańskiego), lecz zebranych z drzew o różnym wieku (od 16 do 170 lat). Opracowanie prezentuje wyniki uzyskane w okresie lat 1965-2006. Dopiero po 90-ciu latach od założenia doświadczenia otrzymano statystyczne potwierdzenie słuszności hipotezy, że wiek drzew przeznaczonych do zbioru nasion ma istotny wpływ na wzrost i rozwój drzewostanów potomnych. Na podstawie statystycznych różnic i podobieństw wyodrębniono dwie grupy prowieniencji: starsze drzewostany mateczne – bardziej korzystne cechy wzrostu i rozwoju potomstwa: IV, V, VI (101-170 lat), oraz młodsze drzewostany mateczne i mniej korzystne cechy wzrostu i rozwoju potomstwa – I, IIb, III (16-80 lat).

Słowa kluczowe: *Pinus sylvestris*, drzewostany potomne, eksperyment Bussego, Nadleśnictwo Trzciel

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