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Growth of Scots pine (*Pinus sylvestris* L.) on forest and former agricultural lands in Krynki Forest District

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Abstract

The paper shows differences in morphological and anatomical features of the Scots pine (*Pinus sylvestris* L.) growing on former agricultural and forest lands. It was found that at the same age and in the same climatic conditions Scots pines from former agricultural land had larger stem dimensions and needle sizes as compared with the trees growing on forest land. These results lead to an interesting conclusion connected with future afforestation and reforestiation in the Krynki Forest District.

Key words

Scots pine, height and radial growth, needle parameters, Krynki Forest District, forest and former agricultural lands

Introduction

The Krynki Forest District, where the study described below took place, is one of the districts with the biggest share of forest stands planted on former agricultural lands (so far on over 3 000 ha in this forest district), and at the same time one of few where forest stands of the Knyszyńska primeval forest with the so-called Supraśl pine enduring. The district contains most beautiful and imposing Scots pine specimens in Poland [Białobok, Boratyński 1993]. Coexistence of forest stands of such extremely different origins presents a unique opportunity to compare growth of trees belonging to both populations. The current study is preliminary and can be useful for planning the proper selection of planting material for further forestation of former agricultural lands as well as assessing perspectives of growing high quality forest stands in the future, whose value may match that of the primeval pine forest.

Material and methods

Two forest stands were selected for the study:

1. On former agricultural lands in the Ostrów forest range, compartment 88g, aged 45, on fresh mixed coniferous forest (BMśw). Characteristics: lowland flat terrain, mossy-bilberry soil cover, shrub layer

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– buckthorn, rowan, juniper on 60%, stand structure – one storied pine stand, stocking – 0.7; medium density, moderate crown closure, pine diameter at breast height 18 cm, pine height 19 m, site index 1A, stand quality 1.2, average stock 355 m^3/ha.

2. On forest lands (primeval) in the Sosnowik forest range, compartment 456c, aged 43, on fresh coniferous forest (Bśw –Św So). Characteristics: lowland flat terrain, mossy soil cover, shrub layer – spruce, birch on 60%, stand structure – one storied pine stand, under wood – 8 spruce, 1oak; stocking – 0.8; medium density, moderate crown closure, pine diameter at breast height 17 cm, pine height 19 m, site index 1A, stand quality 1.2, average stock 267 m^3/ha.

Diameter at breast height (DBH) and total height of fifty randomly selected trees from each stand were measured. From 10 trees on each area, samples of wood were taken from above the root collar with the use of Pressler drill. Dendrochronological calculations were carried out on them. Measurements of width of annual ring growth were taken with the accuracy 0.01 mm, using electronic device by Biotronik (model BEPD4) connected to a computer with „Growth" software. From five trees on each area, samples were taken at DBH level (1.3 m), using a hammer driven cylindrical punch. The samples contained at least cambium area and the last annual growth of wood. They were preserved in 70% ethanol, then cross-sections were prepared and placed on the

Fig. 1. Frequency of width at DBH level (1,3 m) in pine trees from forest and former agricultural lands in Krynki Forest District

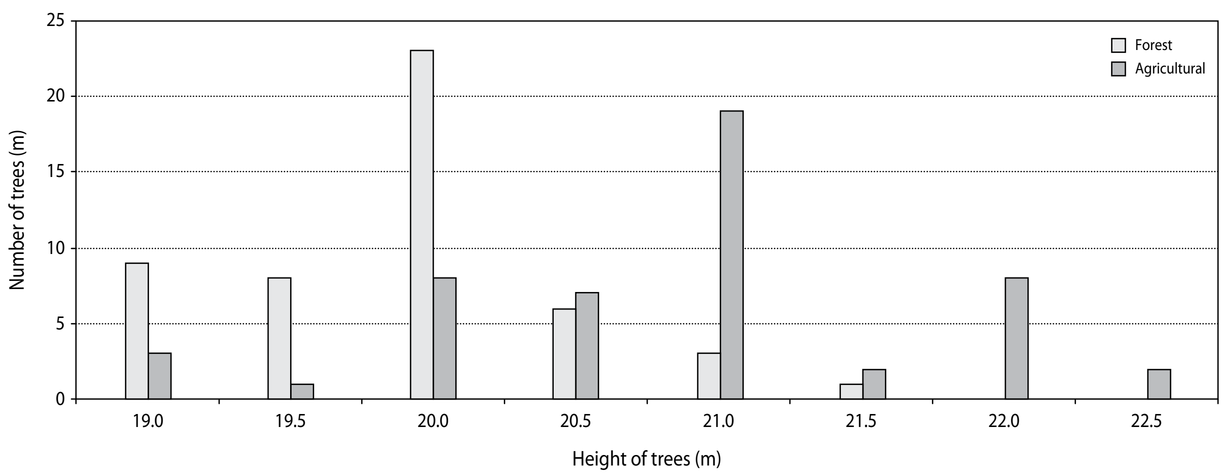

Fig. 2. Frequency of height of pine trees from forest and former agricultural lands in Krynki Forest District

microscopic glass in glycerine. The prepared cuttings were examined and measured under the microscope (microscope Olympus BX 61 with digital camera DP70).

One tree was cut per each investigated area and samples of needles were taken: 100 needles from upper, middle and lower parts of canopy. Later length (accuracy 1 mm) and weight (accuracy 1 g) of raw needles were measured. The collected needles were also used to make cross-sections at half length. The cuttings were placed on the microscopic glass in glycerine. Needle width and length and the number of resin canals were assessed.

Results

The measurements showed (fig. 1) that mean DBH in forest stands on former agricultural land was 24.3 cm, whereas on forest land – 20.4 cm. Calculated standard error allows to claim that the existing difference in mean DBH is negligible. Height measurements showed that, on former agricultural land, the lowest tree was 19 m and the heighest 22.5 m (fig. 2) As much as 38% of the specimens examined were 21 m high. On forest land, the highest tree was 21.5 m and the lowest – 19 m. Almost half of the trees were 20 m high, and only 20% went above this height. The average height of trees on former agricultural land was 20.86 m, and on forest land – 19.89 m. Calculated standard error doesn't indicate important differences of average height in the examined stands. The study on relationship of the height with DBH (fig. 3) showed that thinner primeval pine trees were higher than those growing on former agricultural land. However, when DBH was larger, the tendency was reversed, and with the highest diameter on both land types were similar. The study on annual ring growth (fig. 4) showed that the biggest radial growths on both former agricultural and forest lands were recorded between 1965 and 1972. In 1975–1982, alternating changes in growth were indicated in both stands. Since 1983 the growth of trees has stabilized and trees from former agricultural land have achieved higher parametres. Average ring width was 2.83 mm and 2.15 mm for former agricultural – and forest land, respectively, and the percentage of late wood was 44.9% and 41.4%. Radial growths in the last annual ring calculated under the microscope were 503.7 µm on former agricultural land and 462.2 µm on forest land.

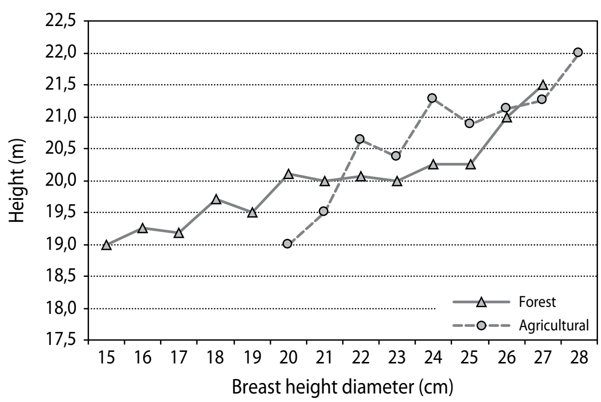

Fig. 3. Height with regard to DBH in pine trees from forest and former agricultural lands in Krynki Forest District

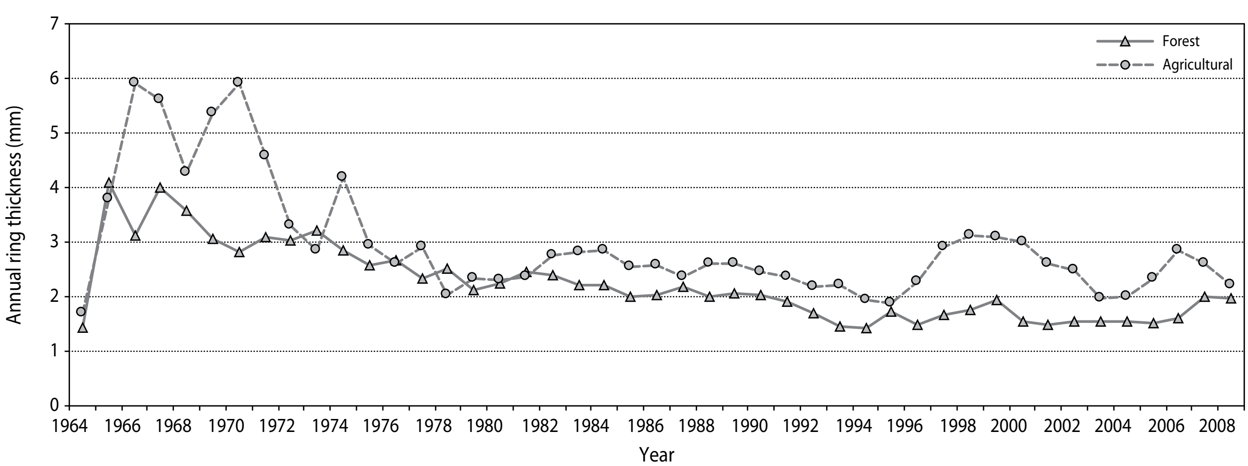

Fig. 4. Radial growth of stem during the life of pine trees from forest and former agricultural lands in Krynki Forest District

Tab. 1. Chosen features of pine trees' needles (*Pinus sylvestris* L.) growing on forest and former agricultural lands in Krynki Forest District

Lands	Part of crown	Length of needles [cm]							
		Frequency							Mean lenght of needles ±SE
		3–4	4–5	5–6	6–7	7–8	8–9	9–10	
Forest	lower	15	80	5	0				4.3 ± 0.41
Agricultural		10	47	34	9	0			4.8 ± 0.77
Forest	middle	1	17	55	26	1	0		5.6 ± 0.73
Agricultural		0	15	26	30	20	9	0	6.3 ± 1.13
Forest	upper	0	4	71	25	0	0	0	6.7 ± 0.43
Agricultural		0	1	1	49	45	3	1	8.0 ± 0.57

Lands	Part of canopy	Weight of 100 raw needles [g]	Cross section of needles ± SE		Mean number of resin canals ± SE
			Width [μm]	Thickness [μm]	
Forest	lower	0.565	1401 ± 85.9	693 ± 63.3	8.1 ± 1.40
Agricultural		0.847	1440 ± 84.1	757 ± 40.6	6.8 ± 0.92
Forest	middle	1.267	1720 ± 197.8	806 ± 103.9	10.6 ± 1.30
Agricultural		1.612	1842 ± 99.1	888 ± 57.7	11.1 ± 0.74
Forest	upper	1.758	1921 ± 139.4	851 ± 82.6	11.2 ± 1.30
Agricultural		3.709	2286 ± 66.8	1088 ± 44.6	13.6 ± 1.35

Needles were longer in pine trees from former agricultural land at all levels of canopy with the longest within the top and the shortest in the bottom part. It was found that the length of needles in both land types had close to normal location, and in primeval pine trees over 50% of needles had close to average length.

The weight of needles increased from the bottom to the top, being heavier in trees from former agricultural land, especially at the top of the canopy (respectively 1.758 g and 3.709 g per 100 needles).

On cross-sections at the middle length, the width and height of needles were measured as well as the number of reisin canals. It was found that the measured parametres increased their values towards the top of the canopy with higher ones in trees from former agricultural land.

Discussion

It was shown that the measured growth parametres at tree age 43–45 years were higher in pine trees from former agricultural land when compared with those from primeval forest. On average, trees from former agricultural land are higher by 1 m and thicker by 4 cm. However, it must be noted that the widths of primeval pines fit into a broader- and the heights in a narrower range of occurence compared to pines growing on former agricultural land. Dendrochronological study showed that primeval pines had notably narrower rings in juvenile wood (formed close to the core area), and this distinguished them from trees from former agricultural land. In subsequent years pine growth stabilized, although a tendency for bigger growth on former agricultural land was observed. Similarly, average radial growths and the width of last ring pointed out bigger growth in pines from former agricultural land. This could be caused by higher contents of nitrogen and other minerals in the soil of former agricultural land, which can have direct influence on better growth of trees (Fidler, Hohne 1965; Parsevnikov et al. 1985). The area around the forest stand studied is still farmed, which can also have influence on its fertility.

It cannot, however, be ruled out that the observed differences have genetic background, caused by years of natural selection. Hence, smaller and lighter needles can protect pine trees from damage related to weather conditions (e.g. heavy wet snowfall and so on). It can be stipulated that thick wood of primeval pine is more durable, and thus more resistant to pathogenes and mechanical damage (Fabianowski 1961; Adamowski 2008).

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References

Adamowski W. 2008**.** Sosny niebotyczne. *Matecznik*, 2, 2–4.

Białobok S., Boratyński A. 1993**.** Biologia sosny zwyczajnej. Sorus, Poznań–Kórnik.

Fabianowski J. 1961**.** Kilka uwag o badaniach dotyczących ras sosny zwyczajnej w Polsce oraz o sośnie mazurskiej. *Sylwan*, 4, 21–30.

Fiedler H.J., Höhne H. 1965**.** Beitrag zur Stickstoffdungung mittelalter Kiefernbestande (I). Archiv für Forstwesen, 14 (9), 909–931.

Parsevnikov A.L., Seryj V.S., Buchvalov JU.M. 1985**.** Effektivnost azotnych udobrenij v chwojnych lesach Komi ASSR. *Lesnoe Chozjajstvo*, 12, 21–22.