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THE VARIABILITY OF BIOMETRIC PARAMETERS IN THE SECOND YEAR OF CULTIVATION OF SCOTS PINE ON THE POST ARABLE GROUND

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Summary

The aim of the study was to estimate the variability of biometric parameters in the second year of cultivation of Scots pine on the post arable ground. Planting were carried out on the basis of post arable ground located in the Faculty Agro and Hydrometeorology Observatory of the Wrocław University of Environmental and Life Sciences. Scots pine plants in the second year of cultivation increased in height from 43.1 cm to 53.39 cm, 10,29 cm, i.e. 24 % ie. The growth rate of pine was the highest in the first part of the growing season (until June 14), when the plant height increased by 7.69 cm, accounting for about 75% of the total, the annual increment in height. The second biometric parameters studied – the diameter of the trunk – increased in the second year of growing pine from 13.16 mm to 23.36 mm (by 10. 2 mm, ie. about 77 %).

Key words: Scots pine, afforestation, growth dynamic

INTRODUCTION

In Poland, in accordance to the objectives of environmental policy, economic and social towards to increase forest resources, mainly through afforestation of inefficient poor quality classes agricultural land (Koreleski 2003). It is assumed that the Scots pine (*Pinus sylvestris* L.) should be the primary species for poor land, for afforestation (Kocjan 1997). The nursery produces mostly annuals plants of this species. Sometimes, however, it is also justified by the production of older, good seedlings. This may result from the need to use them – as planting material – in particularly at difficult renewal conditions such as highly weeded or highly degraded soils (Kłoskowska 1992). The size of the biomass is directly dependent on the height and thickness (diameter) of the trees, and therefore are rightly considered the two most common biometric elements (Orzeł 2007).

The aim of the study was to evaluate of the variability of biometric parameters in the second year of cultivation of Scots pine on the post arable ground.

Figure 1. Location of the faculty Agro and Hydrometorology Observatory of the Wrocław University of Environmental and Life Sciences. Source: own study

MATERIAL AND METHODS

The study was performed on the post arable ground located in the Faculty Agro and Hydrometeorology Observatory of the Wrocław University of Environmental and

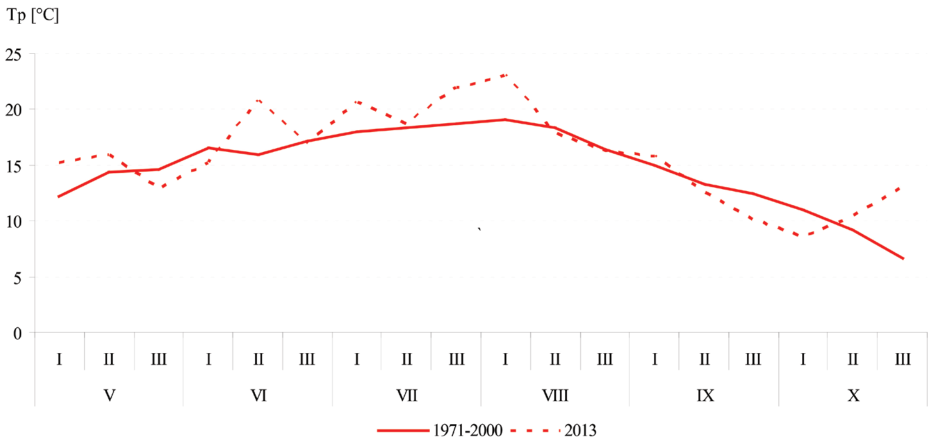
Life Sciences. The Observatory is situated in the South-Western part of Poland, within the Silesian Lowlands, on the outskirts of the city of Wrocław (lat. 51°07', long. 17°07', el. 120 ma.s.l.) (Fig. 1). The area of the Observatory is separated from the city centre by a complex of parks, stadiums, meadows and fields, and also by the Odra-Widawa Canal. Typologically, alluvial soils proper dominate in the area of the Agro – and Hydrometeorological Observatory, typical soils of river valleys. Those are predominantly sandy sediments – in the surface layers most often fine-grained loamy sands, deeper giving way to weakly loamy sands and loose sands, with thinner interlayers of loamy sands and sandy loams, less frequently gravelly sands. The sandy Holocene sediments overlie boulder loam with granularity of fine-sandy loam, less often of common loam (Żyromski et al. 2015). The field water capacity in the 0-100 cm horizon is 217 mm and the soils are characterised by a high capillary rise capacity. With ground water table at the depth of 100 cm, the surface horizons contain 18% of water relative to the volume. The wilting point for plants is ca. 5% (Żyromski 2001).

Biennial used for planting seedlings of Scots pine originating from Milicz Forestry nursery. Pines were planted in the early spring of 2012 in the truss 1.4 x 0.8 m on the area of 155 m^2 (Fot. 1a). For the limitation of weeds expansion and too intensive soil drying the space between the plants was covered with geotextile. To increase soil acidity the soil surface was covered with pine bark in an amount of 37 l/m^2.

Biometric measurements (force characteristics of growth) of pine trees covered in plant height [cm] and stem diameter [mm]. Measurements were made in the 2013 season, which was the second year of cultivation, from May to October. The measurement were performed every two week on the group of 40 randomly selected and signed plants, every time the same, excluding those in external rows. Fot. 1b presents the experimental site in spring and in autumn.

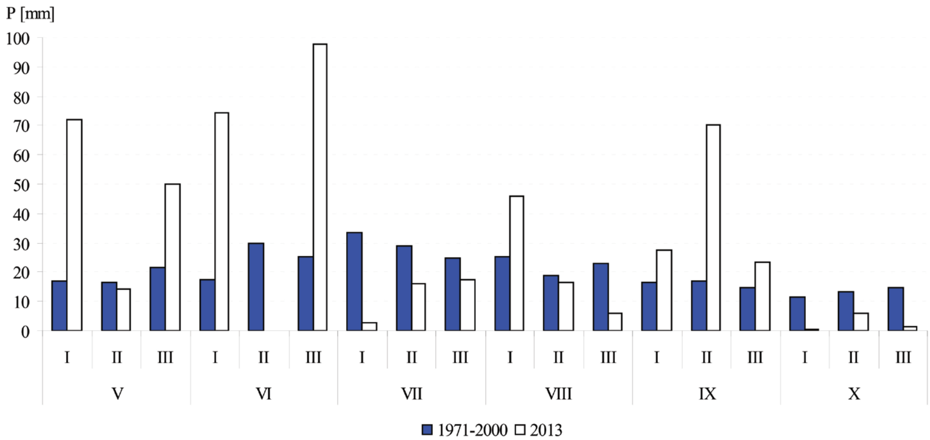
a. **b.**

Photo 1. Scots pine planting on the area of the faculty Agro and Hydrometeorology Observatory in spring (a) and in autumn (b) 2013. Source: A. Żyromski



Source: own study

Figure 2. The decadal variability of mean air temperature (Tp) in °C in 2013 in relation to the normal values of the multi – year period 1971÷2000.



Source: own study

Figure 3. The decadal variability of precipitation sums (P) in mm in 2013 in relation to the normal values of the multi – year period 1971÷2000.

The results are described statistically by determining the minimum, maximum, mean, median and standard deviation using the EXCEL spreadsheet.

The characterisation of the weather conditions in the year 2013 was performed for decade periods of summer half-year, starting from the 1st decade of May and continued to the 3rd decade of October. The multi-year period of

1971÷2000 was adopted as the normative period to which the values of the selected meteorological elements from the particular years of the experiment were referenced. The characterisation of the thermal conditions was conducted on the basis of the standard recommended in Poland by the IMGW-PIB, while the precipitation conditions were characterised on the basis of the classification by Łabędzki and Bąk [2014]. The estimation of the groundwater table levels in the years selected for the analyses was conducted with relation to the normal levels in accordance to the study by Biniak-Pieróg [2014] based on the normal multi-year period of 1971÷2000.

Based on the mean decade air temperatures and their deviations from the multi-year values, the analysed summer half-year can be classified as warm with the mean temperature 15.9°C with very warm decades dominated. Fig. 2. presents the variation of decadal average air temperature values during measurements period in 2013. Mean decadal air temperature values varied from 8,6°C for the 1st decade of October to 23.1°C for the 1st decade of August.

The rainfall conditions of the entire summer half-year in the year 2013 corresponded to the very wet period with precipitation sum of 541.3 mm. During that period extremely wet and wet decades were observed most abundantly and the highest decadal precipitation occurred for the 3rd decade of June and amounted 98 mm. Also high comparable values of precipitation sums amounted about 70 mm per decade were observed in the 1st decade of May and June and in the 2nd decade of September (Fig. 3).

The next agrometeorological element under analysis was the level of groundwater table in the area of the experiments. The depths of the groundwater table in the summer half-year of 2013 amounted – 122 cm and was classified as high according to the adopted normative by Biniak-Pieróg (2014). Fig. 4 presents the decade states variability of groundwater form May to September in relation to the normal values for the multi-year period of 1971÷2000. Detailed analysis of the mean decade depths of groundwater table revealed that for a major part of the summer half-year the groundwater table was at depths corresponding to very high, medium high and high states, from the 1st decade of May till the 3rd decade of July, and from the 2nd decade of September till the 3rd decade of October. At other times those depths corresponded to the normal states.

RESULTS AND DISCUSSION

The height of the Scots pine trees – during the second season of the cultivation – increased by 10.29 cm, i.e. 24 % (Fig. 5). The highest increase of the height occurred in the beginning, shorter part of the season – between May 25 and June 14 (22 days). In this period the height of the Scots pine trees increased from 43.1 cm to 50.79 cm, i.e. by 18 %. In the remaining, longer part of the season (119 days) this increase equaled only 6 %. Statistical characteristics of the measured parameters of Scots pine growth are presented in Table 1. Differentiated dynamics of the height increase may be explained by different pluvio-thermal conditions during the vegetation period of the Scots pine (Fig. 1). For comparison, in the experiment carried out in 2008-2009 by Klimek and Rolbiecki (2011) on the Scots pine growth in 2-year cultivations on the afforested post-military area and on the forest soil in District Żołędowo, the height of the trees equaled 58.5 cm and 51.7 cm, respectively. In the trials of Szabla (2007) the height of Scots pine trees in 2-year cultivations on a post-arable ground was as follows: 42.2 cm, 39.2 cm, 33.3 cm and 32.2 cm for seedlings with mycorrhiza of *Hebelomacrustuliniforme*, *Laccaria bicolor*, without mycorrhiza (covered root system) and without mycorrhiza (discovered root system), respectively. The increase of the height in case of the last trees was lower by 31% from those with mycorrhiza of *H.crustuliniforme*.

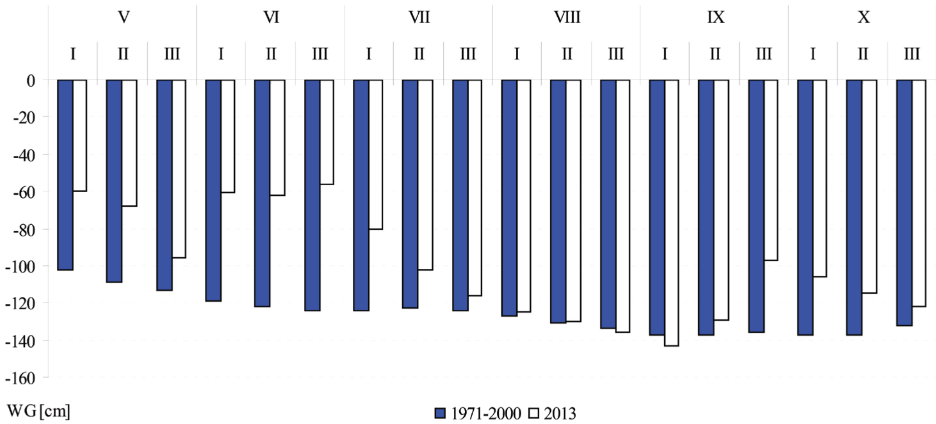
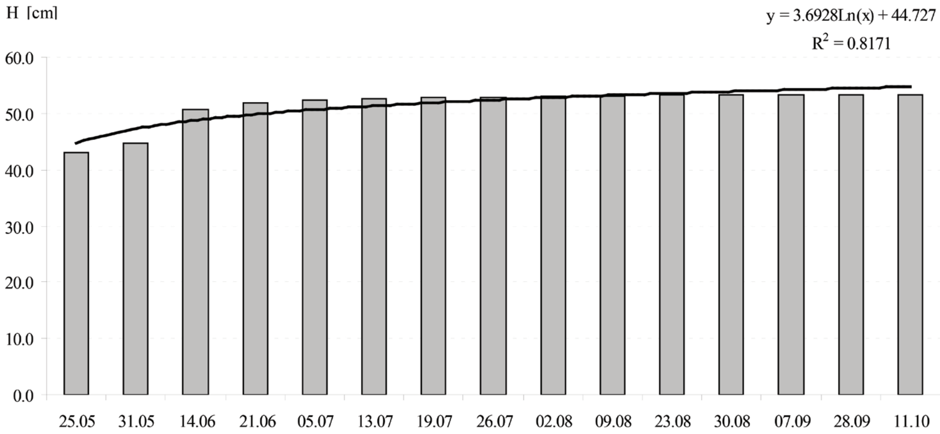


Figure 4. The decadal variability of groundwater levels (WG) in cm in 2013 in relation to the normal values of the multi – year period 1971÷2000.

Table 1. Statistical characteristics of the measured parameters of Scots pine growth in the second year of cultivation. Source: own study

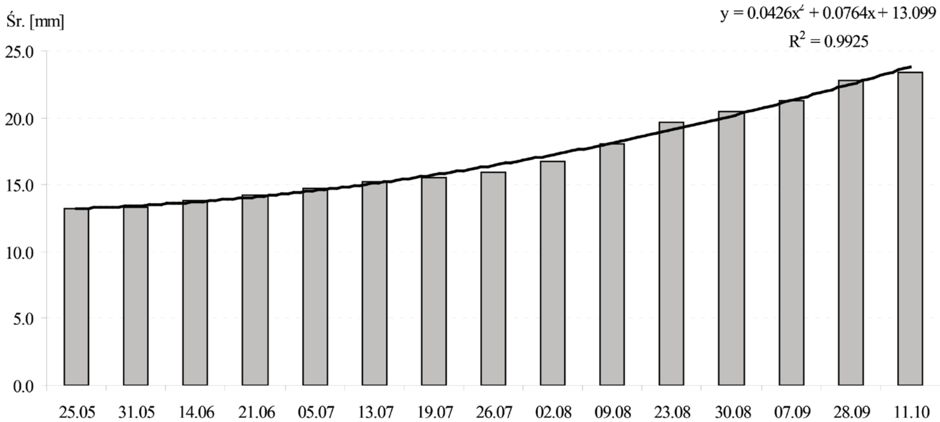
Growth parameters	Value				
	min.	max.	average	median	SD
Height	43.10	53.39	51.59	52.78	3.19
Trunk diameter	13.16	23.36	17.23	15.96	3.48



Source: own study

Figure 5. Variability of height of Scots pine plants in the second year of cultivation during the vegetation season.

The diameter at root collar in the second year of Scots pine cultivation increased from 13.16 mm to 23.36 mm (Fig. 6). In the previous trial conducted in 2008-2009 by Klimek and Rolbiecki (2011) on the Scots pine growth in 2-year cultivations on the afforested post-military area as well as on the forest soil, the diameter of the trees equaled 15.3 mm and 14.4 mm, respectively.



Source: own study

Figure 6. Variability of diameter of Scots pine stalk in the second year of cultivation during the vegetation season.

In the experiments of Szabla (2007) the diameter of Scots pine trees in 2-year cultivations on a post-arable soil was the following: 13.8 mm, 9.2 mm, 7.9 mm and 5.9 mm for seedlings with mycorrhiza of *H.crustuliniforme, L. bicolor*, without mycorrhiza (covered root system) and without mycorrhiza (discovered root system), accordingly. As you can see, the increase in the diameter of the root collar in case of the trees from seedlings with mycorrhiza *H. crustuliniforme* was 134% higher than that of trees from seedlings with discovered root system (without mycorrhiza).

RECAPITULATION

It was found that Scots pine plants in the second year of cultivation increased in height from 43.10 cm to 53.39 cm (by 10.29 cm, i.e. 24 %). The growth rate of pine was the highest in the first part of the growing season (until June 14), when the plant height increased by 7.69 cm, accounting for about 75% of the total, the annual increment in height. The second biometric parameters studied – the diameter of the trunk – increased in the second year of growing pine from 13.16 mm to 23.36 mm (by 10.2 mm, ie. about 77 %). Covering the surface between the plants with geotextile and with mixed pine bark fulfilled the expectations concerning complete elimination of weeds, what was observed during the whole pine vegetation season in 2013 (Photo 1). At the same time limiting unproductive water loss from the soil contributed to the balanced growth of plants. Differentiated dynamics of the height and the diameter increase may be explained by various pluvio-thermal conditions during the vegetation period of the Scots pine plants.

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