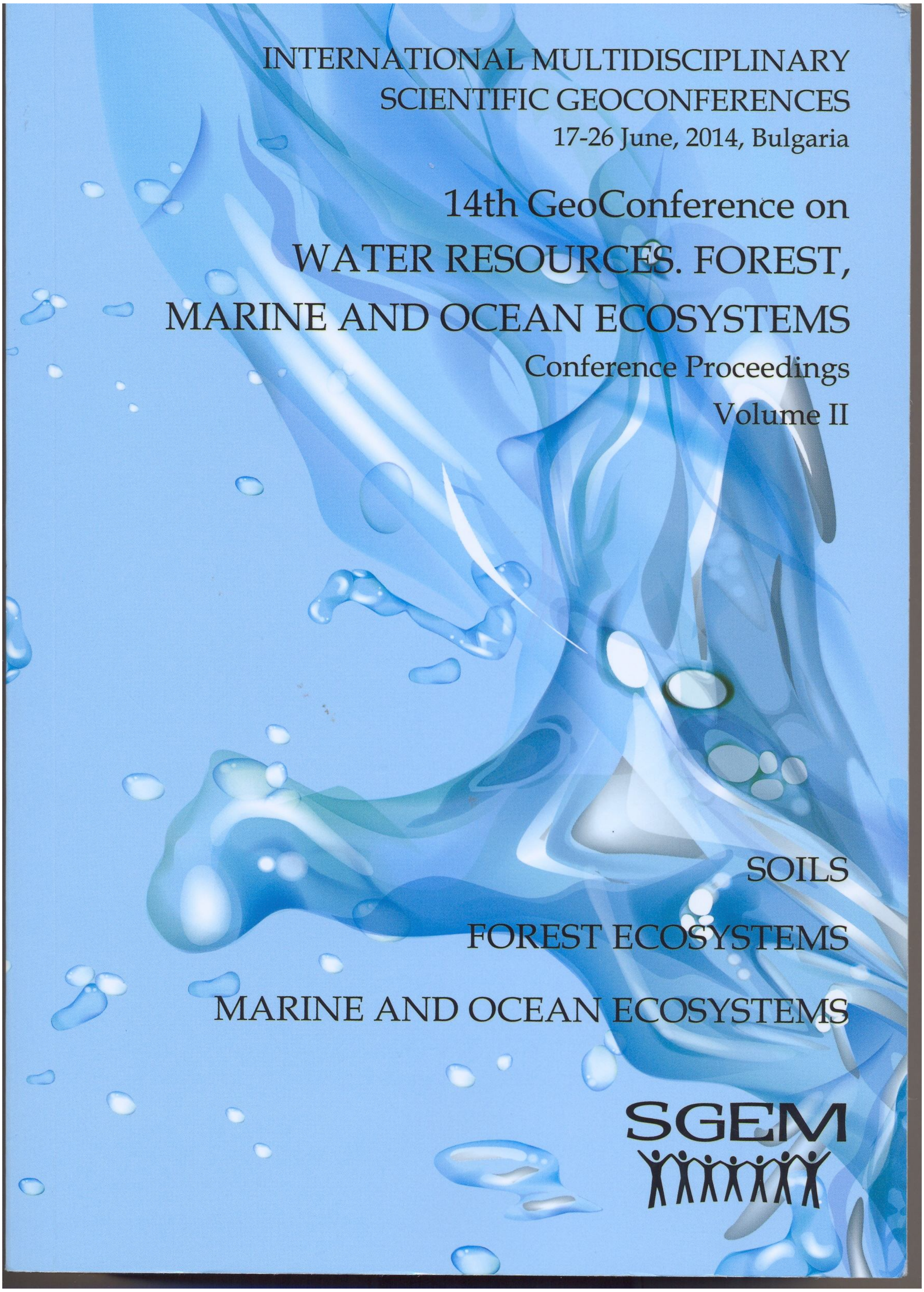

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THE PARTICULARITIES OF THE CROWNS FOR POPLAR TREES LOCATED IN ALIGNMENTS AND FORESTS

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ABSTRACT

The purpose of this paper is to analyze the main characteristics of the crowns of poplar that grows in different conditions. Thus, were studied 124 black poplar trees (*Populus nigra* L.) located in alignment and 124 white poplar trees (*Populus alba* L.) in the forest. The measured elements in the field (the stem diameter, the total height of the tree, the height of crown base and four rays of the crown) have been interpreted in such a way as to be able to determine the influence thereof on the crown-projection area. Following the interpretation of the results it appears that, in addition to the stem diameter, the conditions where the trees grow, plays a crucial role in the development of the crown.

Keywords: crown-projection area, the rays of the crown, height of the crown base.

INTRODUCTION

The growth of a tree is determined by the size, form and functioning of its crown. However, the crown of a tree does not only serve as a resource collector but as a defence method against various physical forces and, also, against the existing competition between the neighbouring trees [11]. The crowns of black poplar trees have been studied through the defects that occur, knots in particularly, inevitable characteristics of the formation process of branches [2 and 4]. With other words, to understand the forest structure, the competition between trees and the production of wood, it is useful to know the crown-projection area of trees [6 and 12]. About the crown-projection area, there have been made various studies. The most of them [6, 9, 10 and 12] were based on the checking of connections between the biometric characteristics of the studied trees (the stem diameter, the total height and the crown radii).

Shimano, in the 1997 paper [12] claims that the crown- projection area can be estimated in function of the stem (measured at 1.30m), aspect verified by applying linear models, type power, logistic and power-sigmoid models, for species of conifers and deciduous. Based on the research results, the author [12] notes that in order to establish the relationship between the diameter measured at 1.30m and the crown-projection area, the best method is the power-sigmoid model.

Researches on the crown radii estimation and the crown-projected area were made also by the Grote [6], which applied two kinds of equation. On the one hand, he applied the linear equations between the stem diameter and the length of the rays, and on the other hand, logarithmic equations between the stem diameter and the crown-projection area. Using only the stem diameter and the position of tree, a group of researchers from France [9] attempted to provide bright patterns for the crowns of the trees and, also, to reconstruct their shape using allometric relations. First, the authors established, for each species, relationships linking the stem diameter and the overall height of the trees, crown base height and mean crown radius. Then they compared two methods of reconstruction: a more simple isotropic method and a more sophisticated method, the "Crown Reconstruction by Overlap Minimisation method" and they concluded that the second method gives better results.

Based on research conducted at pine and spruce, Rautiainen and co-workers [11] found that, for the both species, the maximum radius, length and crown height depend relatively strongly on the stem diameter of trees.

To simplify the forest applications regarding the canopy cover of conifers, a group of researchers from California [5] have developed a model based on the crown rays. Using linear regressions were determined the square mean of the crowns radii, depending on which was predicted canopy cover, while the projection of the tree crown was likened to an ellipse.

The new methods of analysis for the crowns of trees are based on the interpretation of images provided by land and air scanners [7]. Thus, are provided a series of features such as the height of tree, the height of crown base, the crowns area and volume. However, the accuracy of the parameter estimates can be limited especially in the case of groups of trees.

The purpose and importance of the research

The purpose of this paper is to analyze the peculiarities of the crowns for black poplar (Populus nigra L.) and white poplar (Populus alba L.) from different areas of the country. Also, will be checked the connections between the biometric characteristics of the trees (stem diameter, tree height and height of crown base) and the crown dimensions, realising comparisons between those two species.

The importance of the theme lies in the fact that both species, the white poplar and black poplar, are native species [13 and 14], with rapid growths and high productivities at early ages (up to 16-18 m3/an/ha). Due to the area of spreading from Romania (white poplar occurs, usually, in the plains and low hills, and black poplar is found spontaneous in the meadows and the wet depressions from the plains and hilly, on the river valleys) and the ecological amplitude which is relatively wide, the two poplar species can be planted both in alignment and in river valleys, supporting floods in good conditions, as long as the water does not stagnate [3]. From the morphological point of view, the two studied species are characterized by the trees of first size, with wide and heavily branched crowns [3], which becoming rare in old age.

Study area

The research was conducted in two locations, characterized by different particularities of the climate.

Were analyzed a white poplar forest (*Populus alba* L.) from Dolj County, located in production unit U.P. I Cârna, administered by the Segarcea Forest District (Dolj Forest Department). The production unit (U.P. I Cârna) is situated along the Danube and present altitudes ranging between 26 m and 41 m. The studied area is comprised in the province Cfax (IIAps1), characterised by a humid temperate climate, with the warmest summers and the sweetest winters.

For the black poplar (*Populus nigra* L.) was analysed an alignment situated in the Feldioara locality, Braşov County. The study area falls within the provincial climatic sector with oceanic influences, in the climatic land of hills and highlands, the climatic area of the Transylvanian Basin, in the district of forest [1].

Research Methodology

To evaluate the characteristics of the crowns were analysed 124 black poplars (in the alignment from Feldioara locality) and 124 white poplars (in one forest from Segarcea Forest District).

For each tree were measured the biometric characteristics (the stem diameter and the tree height), the height of crown base and four radii for crown, oriented on the cardinal directions (north, east, south and west).

For the measurements executed on the field were used specific tools. It is mentioned that the diameters were measured at a height of 1.30 m using a forest calliper with 100 gradations. The heights and the lengths were measured using the apparatus TruPulse TM 200. The cardinal directions have been established with compass.

The measurement of the radii length of the crown involved targeting to the trunk of the tree from the crown extremity, for each cardinal direction. To determine the crown-projected area, the crown of the tree was likened to an ellipse [5 and 6]. The ellipse radii were calculated as the arithmetic average between the lengths of those two radii, on opposite cardinal directions. Thus, the first arithmetic average was applied between the lengths of the radii from the north side and south side, and the second average, for the radii at east and west.

For the interpretation of the results were utilised the simple linear regression and various equations, accessed from the Microsoft Office package.

Results and Discussion

The diameters of the analyzed trees varies between 22 ... 80cm for the white poplars located into the forest and 30 ... 74cm for the black poplars located into the alignment. The distribution of the analyzed trees on diameter classes (Figure 1) indicates that, in the forest, prevail the trees with diameters of 26 ... 50cm (80%), and in the studied alignment, the predominant diameters are between 36 ... 55cm (81 %).

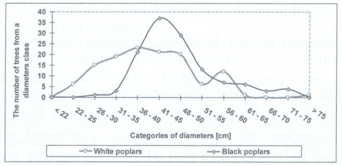

Figure 1. The distribution of trees on the diameter classes

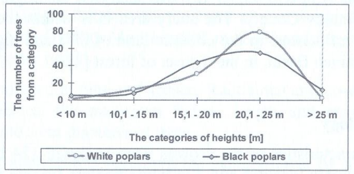

Figure 2. Framing the trees by categories of heights

The measurements show a clear difference between the values of height of crown base for two situations analyzed (Figure 3). While the height of crown base for the black poplars varies between 1.6 ... 5.5m, in the forest, for the white poplars, it can reach up to 14m. Also, it is observed the large number of trees with heights of crown base up to 3m (93%) for the black poplars and a relatively uniform distribution at white poplars for those values. In the latter case, 81% of specimens present heights of crown base up to 6m.

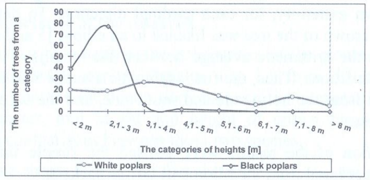

Figure 3. The distribution of the trees according with the height of crown base

One aspect that can be considered as characteristic of the crown is their height. In the present study, this parameter was calculated as the difference between the total height of the tree and the height of crown base, using a formula (1), which was shown in a study realized by Piboule and co-workers [9], where H_B is the height of crown base, H – the total height of the tree and L – crown height.

$$H_B = H - L \tag{1}$$

After calculations, it obtains heights of 6 ... 24m for the crowns of white poplar trees and 4.7 ... 24.3m for the crowns of black poplar trees. As can be seen in Figure 4, at the trees located in the forest prevail the crowns with heights between 10 ... 20m (93%), and in the studied alignment the heights of the crowns varies at 15m to 22.5m (83%).

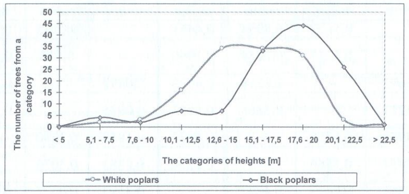

Figure 4. The distribution of trees according to the crown height

Crown radii are other items of great importance in the crowns characterization. If it analyzing the lengths of radii, comparative for the two studied cases, it is found that the values for the black poplars (from the alignment) are much higher than in the case of white poplars (from the forest). Thus, the maximum radii vary from 7.6m to 9.4m for the black poplars, while for the white poplars are up to 3m. The same situation is found also for the minimum radii, meaning that at the trees located into alignment, values are 0.7 ... 1.4m, and only 0.5m for the trees located into the forest.

To check the influences on the length of the radii, exercised by the stem diameter, the total height, the height of crown base and the crown height, was used the simple linear regression [8]. In the case of trees located into the forest, the values of the coefficients of determination are very low, $R^2 = 0.2108$ being the maximum. This was the result of the correlation between the stem diameter (the independent variable) and the length of the radius from the south side (the dependent variable), between the two variables there is a link low intensity (simple correlation coefficient r = 0.46). At the trees located into the alignment, it was found that the stem diameter has the greatest influence on the radii from east (R2 = 0.5372), south ($R^2 = 0.5043$) and west ($R^2 = 0.4787$), while in the north side, the coefficient of determination reach 0.3547 only. Simple correlation coefficients resulting indicate ties of medium intensity between these variables (r = 0.5 ... 0.75). For the same trees (black poplars), the length of the southern radius is influenced by the total height and by the crown height with 48% ($R^2 = 0.4815$, in the first situation and $R^2 = 0.4768$ for the second). Between those two variables there is a link of low intensity (r = 0.69).

The simple linear regression was applied also to verify possible links between the lengths of the radii. As expected, the specific conditions of development of the trees (different between the forest and the alignments) leading to the distinct values of coefficients of determination and of the simple correlation (Table 1). Thus, for the black poplars located into alignment were found low and medium ties between variables (r = 0.4461 ... 0.6218), while in the forest of white poplars are in the best case low intensity ties (r = 0, 0585 ... 0.3593).

Table 1. Correlations between the lengths of the radii on cardinal directions

The dependent variable		The independent variable							
		Black poplars (alignment)				White poplars (forest)			
		The north radius	The eastern radius	The south radius	The west radius	The north radius	The eastern radius	The south radius	The west radius
The north radius	r	–	0,5672	0,4954	0,4461	–	0,0592	0,1958	0,3593
	R^2	–	0,3217	0,2454	0,1990	–	0,035	0,0383	0,1291
The eastern radius	r	0,5672	–	0,6218	0,4623	0,0592	–	0,3280	0,0627
	R^2	0,3217	–	0,3866	0,2137	0,0035	–	0,1076	0,0039
The south radius	r	0,4954	0,6218	–	0,4827	0,1958	0,3280	–	0,0585
	R^2	0,2454	0,3866	–	0,2330	0,0383	0,1076	–	0,0034
The west radius	r	0,4461	0,4623	0,4827	–	0,3593	0,0627	0,0585	–
	R^2	0,1990	0,2137	0,2330	–	0,1291	0,0039	0,0034	–

The different conditions of the development of the studied trees had a great influence on the projection-crown area. Thus, the projected-crown area for the white poplars from the forest is much smaller (0.2 ... 17.9m^2) than that of black poplars from the alignment (6.74 ... 162.85m^2). The minimum value of the projection-crown area (0.2m^2) it justified by that the tree has not crown on the directions east and south, while in the north and west side presents radii of only 0.5m lengths. Following the work methodology, the radii of the ellipse have been calculated as an arithmetic average with 0.25m final result.

As mentioned by Grote in his work from 2003 [6], the ways of estimation of projected-crown area are based on linear and logarithmic equations. The linear equations are applied in other studies also [5]. On the other hand, although Shimano [12] has used various types of functions, he concluded that the power functions are the most representative type.

In Figure 5 are presented the distributions of the projected-crown areas and are drawn the lines of tendency for the logarithmic, linear and power equations. It is noted that in the alignment of black poplars, the greatest influence of the stem diameter on the projected-crown area is obtained when is used the linear equation (R2 = 0.7696) and the lowest value for the power type equation (R^2 = 0, 6916). At the trees located into the forest, the situation is reversed, meaning that the maximum value of the coefficient of determination is obtained when is applied a power type equation (R^2 = 0.3156) and the lowest value in applying a linear equation (R2 = 0.2642).

In the case of applying the simple linear regression, the projected-crown areas of the trees located into the forest are influenced less than 10% by the total height, by the crown base height or by the height of crown. In the alignment of black poplars, the influence is less than 33%.

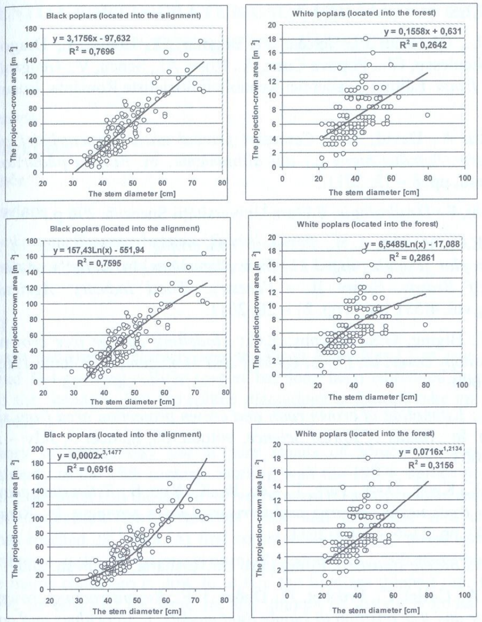

Figure 5. Various types of equations applied

CONCLUSIONS

The interpretation of the data it shows that the greatest influence on the development of the trees and their crowns, it has the specific conditions of development that greatly differs between the alignments and the forests, where competition intervenes between individuals. This influence is exercised also on the crown base height because the pruning can reach up to 14m in the forest, while in the alignments does not exceed 3m.

The development conditions have a lot of influence on the lengths of the radii because in the forest those have lower values, leading at small projection-crowns areas, while at the trees from the alignment the situation is contrary.

ACKNOWLEDGEMENT

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THE POTENTIAL FOR COMPLETE BIOMAS UTILIZATION IN THINNING YOUNG STANDS OF NORWAY SPURCE

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ABSTRACT

In the northern hemisphere Norway spruce (Picea abies Karst.) as one of the most productive and fast-growing conifer species has long been cultivated over vast areas. According to the literature data the spruce plantations in Europe take up some 6 to 7 million hectares.

In the territory of present-day Latvia pure stands of spruce were established in woodlands already in the 19th century. Starting with the 1980s, spruce plantations for short rotation cultivation (till the age of 40 years) were on a larger scale established also in abandoned agricultural lands. Between 2000 and 2012, the area under similar plantations has reached 28,700ha. At first commercial thinnings at the age of 15 years the number of trees in the plantations is normally reduced to 1,500 stems•ha-1. In such a situation the major challenge is how to utilize the biomass thinned out. In the given study we have investigated the structure and amount of woody biomass that may be recovered in thinning 15-year pure stands of spruce.

According to the field data, the weight of above-ground biomass of one tree in 15-year pure stands of spruce is on average 142.9kg (100%), of which stemwood makes 65.7 kg (46.0%) and tree foliage 76.9kg (53.9%), respectively. The biomass of green branches comprises the fraction of needles (38.1 kg or 49.5%) and young shoots (7.2kg or 9.4 %), which in biomass studies is known as tree foliage. In 21 to 25-year pure stands of spruce the above-ground biomass of one tree weighs on average 372kg (100%), of which stemwood is 244.5 kg (65.7%) and tree foliage 117kg (31.5%), respectively

In similar spruce plantations the number of trees removed in the first commercial thinnings is 1,210 trees ha-1 with the yield of pulpwood 27.1m3ha-1, or stem biomass 21.5t ha-1, and tree foliage 17.8t ha-1. When thinning 21to 25-year plantations, on average 877 trees ha-1 are thinned out, with the yield of pulpwood 109m3ha-1, or stem biomass 86.3t ha-1, and tree foliage 21.6t ha-1. The profit calculations, when utilizing also tree foliage, show that in thinning 15 to16-year spruce plantations the gross profit is 1.8 times higher, compared to the case when only pulpwood is utilized. For 21 to 25-year plantations this increase in gross profit is 1.2 times higher compared to utilizing pulpwood alone.

Keywords: Norway spruce (*Picea abies* (L.) Karst.), plantation cultivation of spruce, above-ground biomass, stemwood, tree foliage, economic gain.