THE INCREMENT OF SESSILE OAK AND COMMON BEECH FORESTS IN THE MIDDLE WATERSHED OF CRISUL REPEDE RIVER

Dorog Sorin*

**University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea; Romania, e-mail: dorogs@yahoo.com*

Abstract
The researches have had in view the determination of the radial increment of some combined sessile oak and common beech forests in the middle watershed of Crisul Repede River. Three types of sites which have the greatest weight in the area under study were taken into account. The high variability of the radial increments at the same species, respectively in different environmental conditions, lead us to a great number of annual radial increments within the same sample plots that in their turn need a statistical processing to be used. The statistical processing has had in view the determination of the following indices that characterize the width of the annual rings : the length of the dendro-chronological series, the arithmetic average of the annual ring's width, variance, standard deviation, coefficient of variation, average sensitivity and self-correlation of order I.

Key words: sessile oak, common beech, radial increment, statistical processing

INTRODUCTION

The radial increments range at different heights on the tree stem, and as a consequence, the knowing of the increasing mode has importance in the study of growth at trees and stands. Researches made by Assmann, Nedelcov, Zagreev (Giurgiu V., 1967) proved that the width of the annual ring decreases altogether with the growth in height up to 12 m, when a minimum is recorded, after which the width of the ring records a maximum in the crown.

The researches done on the wood deposition on different parts of the trunk have indicated that the width of the annual rings in the upstream are systematically less with 2-3%, in comparision with those in the downstream area (Giurgiu V., 1967). This remark is important if we have in view the systematic errors that may appear if the probes sampled with Pressler's borer are always taken from the same direction. These errors may appear with a rate of 2-10% and sometimes even more. To avoid such inconveniences and achieve correct results, there were extracted probes alternatively by changing the extraction direction for each tree.

In the even-aged stands, the radial increments present some characteristics that were taken into account both for the elaboration of the working method and the establishment of the diameter categories from which some samples were extracted with the Pressler's borer. These characteristics are the following:

- for the same category of diameters, the variation coefficients of the increments have reduced values, ranging between 20 – 30%
- within the same category of diameters, the species has a reduced influence upon the variation coefficients
- the variation coefficients of the radial increments decreases from the inferior to the superior categories of diameters, and as size order they range between 20 – 25%

- within the same category of diameters, the variation amplitude of the increments ranges somewhere between 0.1 and 1.9
- the variation coefficients of the increments for the whole stand are higher (in value) than the variation coefficients determined for the categories of diameters that are superior to the average diameter of the stand

MATERIAL AND METHODS

The statistical processing of the initial data was made by using the software Carota 2.1. (Popa I., 1999). The following statistical parameters, which represent the characterising indices of the variation of the annual ring's width, were determined as follows:

↪ the length of the dendro-chronological series which represents the number of years included in the analized time series

↪ the arithmetic mean represents the average width of the annual ring

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$ where:

- $\bar{x}$ represents the average value of the annual rings for a probe
- x_i represents the width of the annual ring in the year i
- the number of annual rings measured for a single probe

↪ variance expresses the variability degree of the dendro-chronological series

$$s^2 = \frac{\sum (x_i - \bar{x})^2}{N-1}$$ where:

- s^2 represents the variance
- $\bar{x}$ represents the average value of the annual ring for a single probe
- x_i represents the width of the annual ring in the year i
- N represents the total number of years of the dendro-chronological series

↪ standard deviation expresses the deviation degree of the individual values with respect to the arithmetic mean, and is determined by using the relation:

- $s = \sqrt{s^2}$ where:
- s represents the standard deviation
- s^2 represents the variance (dispersion)

↪the average sensitivity represents a statistical parameter specific for the dendro-chronological researches, which expresses the average percentual modification of the annual ring width with respect to the next annual ring. The high values of the sensitivity highlight the influence of the limitative factors upon the formation of the annual ring (Popa I., 2004). For the determination of this statistical parameter the following formula was used:

$$ms_x = \frac{\sum_{i=1}^{i=n-1} \frac{x_{i+1} - x_i}{\left(\frac{x_{i+1} + x_i}{2}\right)}}{n-1}$$ where:

- ms_x represents the average sensitivity
- x_i represents the width of the annual ring in the year i

- x_{i+1} represents the width of the annual ring in the year i+1
- n represents the total number of years of the dendro-chronological series

↪ the self-correlation of the order I represents the extent of the self-correlation degree belonging to the width of the annual ring in the year i with the annual ring formed in the year i+1.

For the determination of this statistical indicator, the following relation was used:

$$r_1 = \frac{\sum_{i=1}^{i=n-1}\left(x_i - \bar{x}\right)\left(x_{i+1} - \bar{x}\right)}{\sum_{i=1}^{i=n-1}\left(x_i - \bar{x}\right)^2}$$ where:

- r_1 represents the self-correlation of order I
- $\bar{x}$ represents the average value of the annual rings for a single probe
- x_i represents the width of the annual ring in the year i
- x_{i+1} represents the width of the annual ring in the year i+1
- n represents the total number of years in the dendro-chronological series

For determination of this statistical indicators we use formulas which were promote in statistical books (Chițea Gh., 1997, Giurgiu V., 1972).

RESULTS AND DISCUSSION

The regression equations of the increments with respects to their variation on the diameter categories were determined after the statistical processings with the software Carota 2.1. (Popa I., 1999).

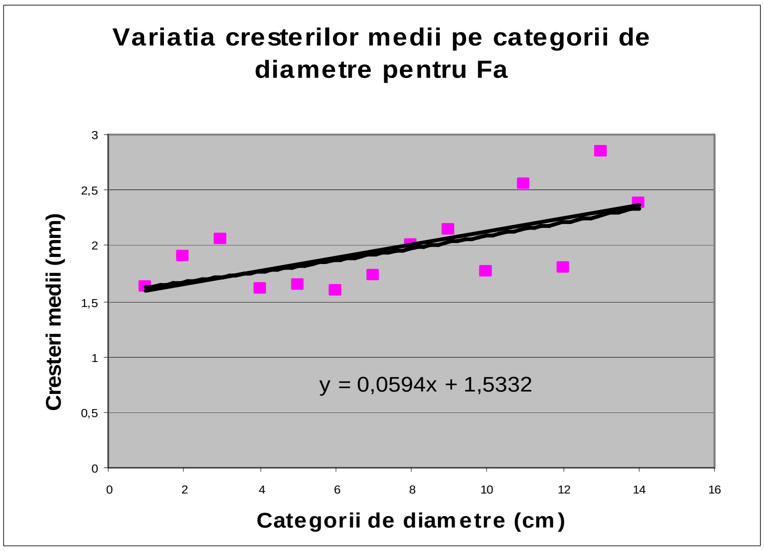

Fig. 1 – Variations of the average increments on diameter categories for common beech trees

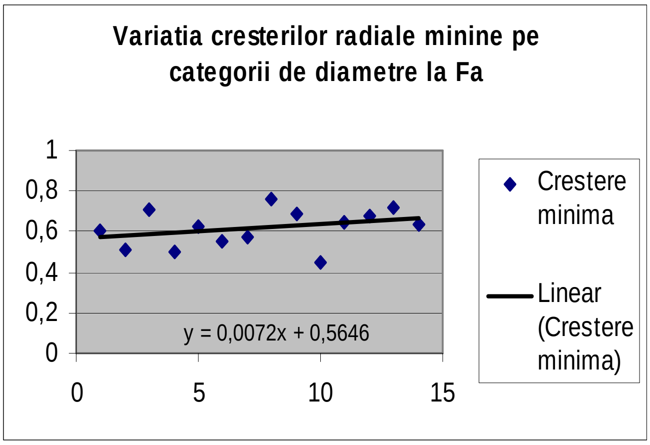

Fig. 2 – Variations of the minimum radial increments on diameter categories for common beech trees

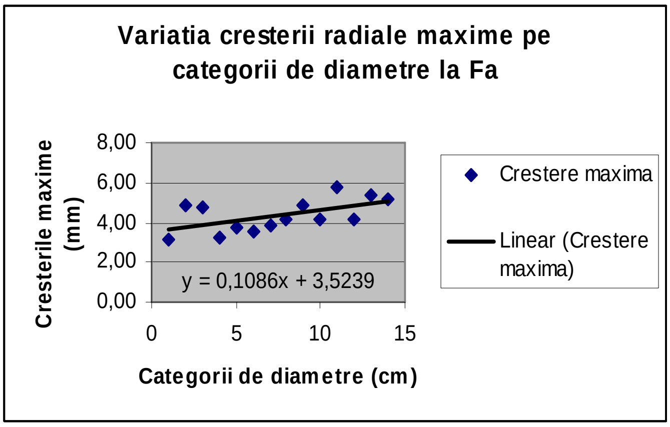

Fig. 3 – Variations of the maximum radial increments on diameter categories for the common beech trees

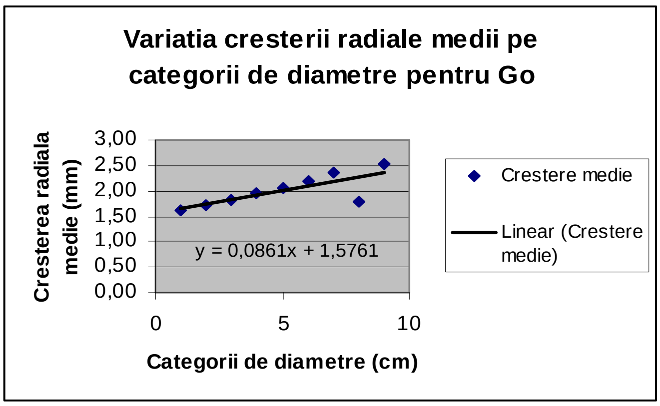

Fig. 4 – Variations of the average radial increments on diameter categories for sessile oak trees

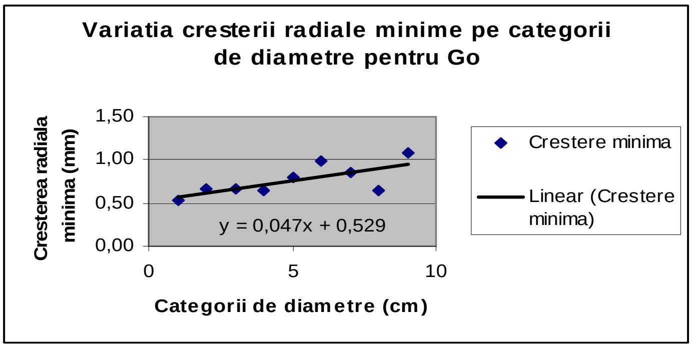

Fig. 5 – Variations of the minimum radial increments on diameter categories for sessile oak trees

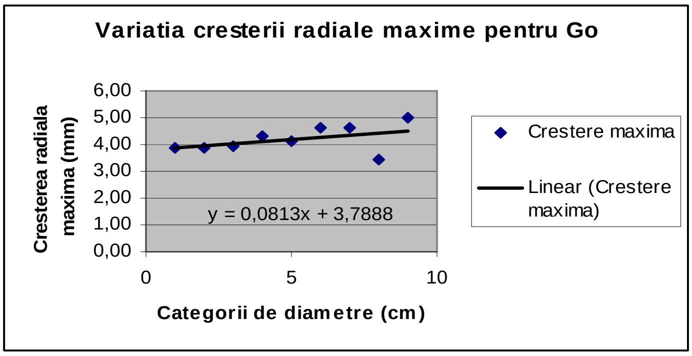

Fig. 6 – Variations of the maximum radial increments on diameter categories for sessile oak trees

The diagrams above have the same tendency regardless there are taken into account the average or minimum variations of the annual rings. The equations were obtained after the processing of data with the software Carota. The liniarity of the variations of the annual ring width was proposed and proved by Cook (Cook E., 1987, 1990).

CONCLUSION

The values of sensitivity (Briffa K., Cook E., 1990, Briffa K., P.D. Jones, 1990) are reduced, fact which indicates that both for sessile oak and common beech, the limitative factors which determine the formation of the annual rings have insignificant influence as regards their formation. However, for the sessile oak trees with the crowns at the basis of the superior ceiling, an increase of sensitivity is recorded, due to the limited quantity of light which reaches the canopy. As a tendency, the sensitivity ranges on a descending line from the inferior to the superior categories of diameters, fact that is obvious if taken into account the influence of the limitative factors upon the trees with a poor development, that is, those that accumulated less increment.

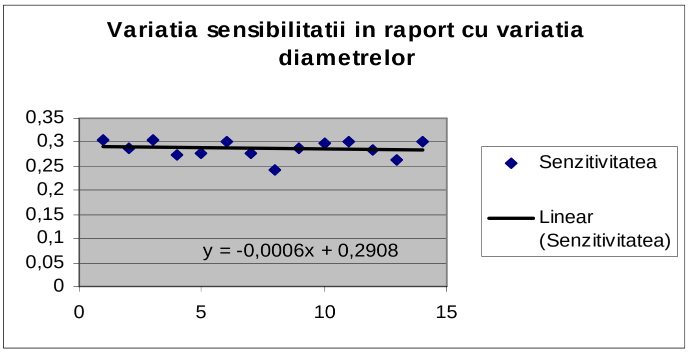

Image 7 – Sensitivity with respect to the diameter variation

Table 1

The average values of the statistical indices on different types of sites for common beech

Average values on site types	Average increment (mm)	Minimum increment (mm)	Maximum increment (mm)	Variance	Standard Deviation	Sensitivity	Self-correlation I
5243	1,88	0,59	4,29	0,72	0,81	0,28	0,58
5153	1,97	0,61	4,33	0,77	0,84	0,28	0,58
5242	0,39	0,11	0,77	0,17	0,16	0,43	0,09

Table 2

The average values of the statistical indices on site types for sessile oak

Average values on site types	Average increment (mm)	Minimum increment (mm)	Maximum increment (mm)	Variance	Standard deviation	Sensitivity	Self-correlation I
5243	1,83	0,82	3,36	0,27	0,51	0,22	0,45
5153	2,00	0,76	4,19	0,66	0,77	0,22	0,65

The data presented in the tables above highlight some important conclusions. The average radial increments for common beech and sessile oak for the two types of site (5153, 5243) are approximately equal. Thus, the reccomendation that has to be followed in the species proportionality is the exposition. The minimum radial increment for common beech is of 0.6 mm in the sites 5153 and 5243, and 0.1 mm, according to estimations, for the site 5242

Sensitivity is reduced excepting the site 5442, where it is a little higher. This statistical parameter has reduced values when the species under study are within the ecological optimum and respectively have increased values when the species under study are within the sites where the limitative factors have an influence (Popa I., 2003). The common beech and the sessile oak vegetate in their ecological optimum according to the data presented in the tables.

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