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FOREST INFORMATION TECHNOLOGY
Programming III

DIAMETER AT BREAST HEIGHT (DBH) AND THINNING INTENSITY (A DEVELOPED PROGRAMME TO SIMULATE FUTURE DBH)

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ABSTRACT

Tree stand require effective management in order to actualize the required results. Trees in a stand grow larger in diameter over time and therefore potentially become more valuable, but time is a two-edged sword because it takes time to grow large diameter trees for high-value products, and there is a financial cost of time; in addition, the longer a tree remains in the forest increases its risk of experiencing volume or value loss due to damage, wood decay, wood. This therefore makes age of stand to be a considerate factor when planning about forest management.

INTRODUCTION

The task of silviculture consists in shaping forests in such a way that timber is being efficiently produced, the biological productive base of forests is being maintained and improved and the services rendered by forests remain usable by humans in a sustainable manner. The multitude of objectives of silvicultural management depending on the respective site has resulted in a multitude of silvicultural operations that is in differentiated treatment and regeneration methods. Thinning is an important means to achieve silvicultural objective and has received considerable attention in forest research. Thinning causes reduction of density and associated reduction in resource use and competition, which increase the growth of the remaining trees and reduces their mortality rate. Also, photosynthetic rate is highly enhanced in leaves of the lower and middle strata of the canopy through thinning. Thinning is also considered as a mean of capturing tree mortality, providing early financial return, increasing future merchantable volume and financial value of timber. Moreover, thinning intensity enables to keep volume growth, which depends too on the species, stand development stage and site.

Density decreases irrespective of method and intensity of thinning. Space created by thinning increase tree growth regardless of the implied thinning method since competition is reduced and increase resources for the trees. In general, the heavier the thinning intensity, the higher the decrease of density and the lower the competition.

MATERIALS AND METHODS

I. STUDY AREA AND FORMULAR

The data was sampled from tree stand in Neuendorf,a town in the state of Brandenburg in Germany with latitude 52° 53' 30" N and longitude 14° 3' 26" E. The study area has installed triplet of pure and mixed stand growing on the same site conditions. These comprise of Oak and Pine as major species. The data on dbh were recorded earlier and informed about the average dbh of the removed trees which is integral factor in calculating the thinning intensity.

The growth models code for prediction of DBH by thinning intensities were developed using equation which considers the previous growth status (West et al. 1999). The coefficients μ and ß were estimated according to the thinning intensities. By applying this DBH growth model, future tree DBH can be predicted. The equation is;

$$\mathbf{DBH_n = DBH_o.} \left(\frac{AGEn}{AGEo}\right)^{(\alpha.(T1+1))^{\beta}}$$ where DBH_n (predicted future dbh), DBH_O(current dbh), AGEn(future considered age),AGEo(current stand age), α and β(growth coefficient), TI(thinning intensity)

II. FUNCTIONALITY OF THE PROGRAMME

The programme is designed to predict the dbh of trees in a stand. It considers age, thinning intensity and the current dbh of the tree as the factors to function to inform the forester of the dbh of the future stand.It therefore simulates the future dbh based on the current age, thinning intensity and the dbh of the trees in the stand. The thinning intensity highly affects the growth enhancement factor. The programme is not developed with a loop function, therefore it requires an input at every stage till the final dbh is predicted. And therefore cannot take the entire tree stand dbh and display their results. It functions to predict individual tree dbh according to the information fed to the system. It is highly dependent on the age, dbh and thinning intensity ratio to function, any absence of these parameter will malfunction the programme.

RESULTS AND DISCUSSIONS

I. THINNING INTENSITY AND GROWTH ENHANCEMENT FACTOR

Distributions of DBH in 2019 of tree stand with age of 87 years, and analyzed the change in relationship between DBH and thinning intensity. After analyzing the growth-promoting effect in terms of thinning intensities and stands, the effect of thinning on DBH was very clear. The growth of individual trees can be expressed by increments in the diameter (Sterba et al. 2002). In the field of forest management, stand age, site productivity, and density are generally considered as the essential factors affecting forest growth (Monserud 1984), since the statistical and biological relationships between these factors and growth are obvious. Tree age is an important variable for predicting radial growths because tree growth mainly depends on tree or stand age (Woo et al. 2007). In addition, the size of the tree is considered as an important factor affecting tree growth (Coomes and Allen 2007). Many vegetation simulator models such as PROGNOSIS , the European distance-independent tree growth models, BWIN (Nagel 1999) and PROGNAUS , usually depict individual tree growth as a function of initial tree size. Based on the assumption that annual radial growth and height growth depend mainly on tree age and initial tree dbh.This makes it very considerate to factor dbh and age into predicting

the future outcome of treatment on the stand. This makes it very considerate to factor dbh and age into predicting the future outcome of treatment on the stand.

It was also realized that, thinning was very beneficial to the already large size trees and this was as a result of the increase of dbh was seem higher in large trees. The data show that differences in growth increased with greater dbh classes. Regardless of the thinning intensity, it promotes the growth of large trees more strongly than that of small trees. Large trees probably have a greater capacity for resource acquisition, and are thus better able to take advantage of the increase in resource availability that is created after thinning and eventually to use these resources for growth. The thinning intensity affected the dbh much than the age of the stand, and this implies tree growth is more affected by thinning intensity although in a previous study, Coomes and Allen (2007) evaluated the ways in which size can affect diameter growth of mountain beech.

In conclusion, the effect of thinning on DBH growth by using a DBH growth model was generalised, which considers thinning intensities and tree age. The suggested model may be appropriate to predict changes in DBH with the thinning intensity, but has some errors and these can be corrected by future studies to define very robust programme to aid in forest management. Figure 1 clearly shows how results were very similar and some were even accurate.

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FIGURES

I. Statistics of the table.

	ID	PRE THINNED	DBH PROJECTION	FIELD COLLECTED DBH
count	20.000000	20.000000	20.000000	20.000000
mean	12.650000	37.065000	37.519500	37.489500
std	8.151687	6.116008	6.191386	6.265108
min	1.000000	27.800000	28.140000	28.100000
25%	6.500000	33.625000	34.040000	33.700000
50%	11.500000	37.000000	37.455000	37.275000
75%	18.250000	41.375000	41.882500	42.182500
max	27.000000	47.100000	47.680000	48.100000

II.Visualising field measured dbh and using the dbh predictor.