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Examining Statistical Distributions and Statistical Behavior of Stem Tapers of Fagus Sylvatica in Municipal Forest of Naoussa

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ABSTRACT

The aim of the present research is the study of the statistical behavior of ninety-three tapers. Tapers are classified into three categories depending on whether they use measured diameters at relative or absolute heights in the tree trunk. In each taper, measures of central tendency, measures of dispersion and a measure of skewness were examined. Each taper was examined if it fits normal distribution or not. It emerged that in the first category all tapers approached the normal distribution. In the second category, eight of the ten tapers are satisfactorily reaching the normal distribution, while in the third category thirty-seven out of seventy-eight are satisfactorily reaching the normal distribution. Data used in the research were collected in the Municipal Forest of Naoussa from 300 trees of Fagus sylvatica using random sampling.

KEYWORDS

Descriptive Statistics, Distributions Forest Biometry, Naoussa, Stem Taper, Stem Volume

INTRODUCTION

Stem is a dynamic part of tree. Stem affects total growth of tree, the economic value and the status of the tree in a cluster. Taper is the term used to describe the decrease in tree stem diameter with increasing height. Technically it is a rate, with units of centimeter / meter or inches / feet. According to Grey (1956) taper is the rate of change in diameter in relation to the increase in height along the tree stem. Taper can be used in taper equations as a variable in order to estimate volume of a tree or diameter of a tree stem at any height (Goodwin, 2009; Ikonen et al., 2006; Larsen, 2017; West, 2009).

A taper is affected by many factors such as species, genotype, age, silviculture treatments, stand density, weather conditions, especially wind, the size of live crown and the distribution of the live crown along the stem (Larson, 1963). Major stand treatments that alter stand density, such as thinning, pruning, and fertilization are expected to affect taper through subsequent changes in both crown size and crown class (Muhairwe et al., 1993). For example, thinning reduces stand density and allows individual trees more space to expand their crowns. In heavily thinned stands trees will grow like

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open – grown trees and will have big crowns and look more conical in shape, showing high taper particularly for the trees base (Thomson & Barclay, 1984) Also, a tree in a windy area is more tapered than a tree in a non-windy area. Anuchin (1970) mentioned that taper varies in different portions of the stem, being fairly large near the butt on account of the root swelling, diminishing toward the middle and increasing again toward the top. According to Assmann (1970) stem taper is a complex trait that varies substantially depending on genetic factors (within and among-species), environmental factors (inter alia soil type, hydrology, altitude and climate), forest management practices and interactions between all of these factors.

The difference between the diameters of two cross sections separated by a distance of 1 meter along the stem is absolute taper. In this research the mean taper was used in all taper calculations. Mean taper is equal to the difference between the large diameter d_1 and small diameter d_2 divided by their distance L (Equation 1):

$$\alpha = \frac{d_1 - d_2}{L} \tag{1}$$

Anuchin (1970) made detailed measurements of over 4,000 logs and established a direct relationship between the mean taper and the log diameter. Prodan (1965) calculated mean taper to estimate the total stem volume and also used the following formulas for taper:

$$\alpha = \frac{d_{0.1h} - d_{0.5h}}{0.4h} \tag{2}$$

$$\alpha = \frac{d_{1.3}}{h} \tag{3}$$

$$\alpha = \frac{d_{1.3} - d_{0.5h}}{0.5h - 1.3} \tag{4}$$

where $d_{1.3}$ is the stem diameter at 1.3 meters from the ground, $d_{0.1h}$ is the stem diameter at 0.1 of the total high of the tree, $d_{0.5h}$ is the stem diameter at 0.5 of the total high and h is the total height of the tree.

The knowledge of taper will improve the understanding of species in several ways (Maraseni et al., 2007). It will help to improve estimation of log volume, which could be used for estimation of stem volume. Furthermore, it will help to estimate the amount of sawn timber, as for a given volume severely tapered logs will provide less sawn timber than less tapered logs. Also, by knowing the taper, the forest managers can have better information about the growing condition of the trees.

According to Van Laar & Akca (2007) knowledge of taper is important in order forest managers require information about the diameter of the bole at fixed distances from the base of the tree, for example, to predict the recovery of saw logs of different diameter and length or the yield of poles of varying dimensions, for trees of different dbh and height.

According to Kozak (1988) by knowing tapers, taper functions can be used. Kozak (1988) mentions that taper functions are known to provide estimates of over and under bark diameter in every high along the stem, to estimate the total stem volume, to estimate a part of the stem volume, and to estimate the high where is a specific diameter.

Understanding stem form and its dynamics over time is an important tool for identifying the appropriate moment in which thinning or final felling should be carried out in forest plantations.

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