ESTIMATION OF BASAL AREA GROWTH FOR *Melia azedarach* L. TREES GROWN IN NINEVEH

Mohammed Asim Saeed Al-Ali

College Of Agriculture And Forestry. Forestry Department . Mosul University . Iraq

Email : mohammad_asim@uomosul.edu.iq

Abstract

The aim of this study was fined a basal area growth model for individual trees in Nineveh Governorate in the north of Iraq grown in the open places such as urban trees. Trees were selected and drilled with increment borer to determine the increment. Regression analysis was used for develop the growth model. Results shows that, for *Melia azedarach* L. individual trees, there is a significant nonlinear relationship between the annual basal area growth, as the dependent variable, and the diameter at Brest height, as independent variable. The most suitable equation that we get was B.A.I. = - 0.00155602 + 0.000394616*D . Where the value of coefficient of determination is (99.9), and percentage of standard error is (0.0003).

Key words:
basal area, *Melia azedarach*, relationship, model, increment

1- Introduction

In forest management the objectives often are achieved by controlling the characteristics of a forest stand or set of stands in order to influence the growth and yield of those stands. The availability of information on diameter increment and growth patterns for individual trees is an important asset in forest management which allows the selection of species for logging or protection as well as the estimation of cutting cycles and the prescription of silvicultural treatments. Diameter increment measurements are also required to feed statistical models of forest dynamics both for modeling and simulation (Pereira da Silva et al.2002). Growth and yield models and diameter growth models in particular, are invaluable tools for forest management planning (Uzoh and Oliver 2008). Therefore, predicting growth and yields have long been at the heart of simulating the future forests.

Melia azedarach is described as a small to medium-sized shrub or tree in the mahogany family (Meliaceae). Branches are stout, with purplish bark dotted with buff-coloured lenticels. Leaves are twice to three-times compound, alternate, and puberulent to glabrous. Leaflets are 2-8cm long, serrate or crenate, dark green above, often with sparse hairs along the veins, and lighter green and generally smooth below. The inflorescence is a panicle from leaf axils and from leafless nodes on the lower part of the new growth. The perfect flowers are 5-parted. Sepals are green,1.5-2mm long. Petals are pinkish lavender, ligulate, 1-1.3cm long. Stamens are united into a cylindrical, dark purple tube, 6-8mm long, and cut at the apex into 15-25 slender teeth. Each flower has ten anthers. Flowers are fragrant. (Batcher, 2000) states that the fruit is a stalked, one seeded drupe that is greenish yellow to yellowish tan, globose, and 1-1.5cm in diameter (Burks1997).

Melia azedarach is often planted as an ornamental shade tree. It has also been used as an abortifacient, an antiseptic, a purgative, a diuretic, an insect repellent, etc. (HerbWeb 2000, in Batcher, 2000).

Uzoh and Oliver (2008) developed and evaluated a diameter increment model for individual trees of ponderosa pine throughout the species range in the United States using a multilevel, linear- mixed model. Stochastic variability was broken down among period, locale, plot, tree and within-tree components.

2-Materials and methods

The individual tree radial growth models offer a good possibility of exploring detailed management alternatives, because these models can adequately describe the forest growth dynamics (Uzoh, Oliver 2008; Subedi, Sharma 2011; Wagle, Sharma 2012).

Tree basal area growth models describe the growth dynamics of individual trees in open areas. The growth of an individual tree within the stand varies greatly due to competition from other trees. The competitive pressure of any tree within a pavilion varies with the species, number, size, and location of its competitors. Tree-based individual growth models are often developed to describe the growth dynamics of complex and structurally heterogeneous forest stands (Wykoff 1990; Pretzsch 2002; Uzoh, Oliver 2006; Bollandsas, Næs¬set 2009), which may be either depending on distance (Bella 1971; Biging, Dobbertin 1992; Ledermann, Stage 2001; Ri¬vas et al. 2005) or not depending on distance. (Wykoff 1990; Uzoh, Oliver 2006; Bollandsås, Næsset 2009). Long-term growth streak (longitudinal or radial growth) .For developing individual tree growth equations we need Long-term growth series data which obtained either from Permanent research plots or national forest inventory plots or from stem analysis. In addition, stump analysis data, which has been used to model the individual tree basal area growth in this study, also provides radial growth time series.

data of individual trees are needed to develop individual tree growth models. Long-term growth series data are obtained either from long-term research plots or national forest inventory plots or stem analysis. In addition, stump analysis data, which has been used to model the individual tree basal area growth in this study, also provides radial growth time series.

The individual tree radial growth models (diameter growth or basal area growth models) are useful to estimate volume growth if information on height growth is available. The individual tree radial growth models are commonly used as sub-models in a growth simulator (Sterba, Monserud 1997; Pretzsch 2002; Hasenauer et al. 2006; Lacerte et al. 2006; Gobakken et al. 2008). The models of Diameter and basal area growth for individual tree offer a good possibility of exploring detailed management alternatives, because the ability of these models to describe the forest dynamics adequately, (Martin, Ek 1984; Uzoh, Oliver 2008; Subedi, Sharma 2011; Wagle, Sharma 2012). Since basal area growth is highly correlated with volume growth, basal area growth models are preferred to diameter growth models (Wykoff 1990; Monserud, Sterba 1996; Schröder et al. 2002; Andreassen, Tomter 2003; Anta et al. 2006). Many silvicultural and management treatment, such as, thinning intensities, are based on the measurements of diameter or basal area growth. In addition, the curves of mean basal area growth are useful tools for effective management of stands as they help us for estimating the suitable time of intermediate and final harvest (Hong-gang et al. 2007).

The data was collected from (100) trees of different ages, diameters, and heights. The diameter at (1.3)meter was measured by caliber instrument. More than one measure was taken and then we find the average , then the basal area was found from the function :

$$B.A. = 0.00007854\ (Di)^2$$

where :

B.A. = basal area of the tree (m^2)
Di = diameter of the tree at breast height

3-1- Results :

Diameter increment for annual period (3 years) was measured by increment borer. double sample thickness minus from total diameter to get the inner tree diameter, then we can find the inner basal area in the same way. The annual basal area growth can be found by the equation :

$B.A.I. = B.A._{total} – B.A._{inner}$

Statistical programs was used to produce regression equations (Gregory E. and others 2016) . These equations correlated between basal area growth as depended variable and diameter at Brest height as independent variable. Statistical scales were used for chose the best equation possible for estimating the tree basal area growth :

B.A.I. = f (d.b.h.)

Where :
B.A.I. : basal area increment (m^2)
d.b.h. : diameter at Brest height (m)

The scales which is used for accuracy of the equation is, Coefficient of determination (R^2), Standard error (S.E), and the test of residual . The collected data was diameter at breast height, diameter growth for late three years using increment borer which is use the to produce basal area growth. Table (1) show the distribution of tree diameter.

Table (1) characters and distribution of diameter for studied trees

Diameter (cm)	Number of trees	Mean (cm)	Min.(cm)	Max.(cm)	S.D.
1-9	45	7	5	9	1.19
10-19	34	13.29	10	19	2.88
20-29	13	24.46	20	28	2.81
30-40	8	32	30	34	1.85

3-2- DESCUSSION:

The basal area growth model was developed independent tree within the constraints imposed by the data, i.e. without including variables describing competition, site quality, and the position of tree are available for this study. Variables such as crown ratio or crown length could be included for better results to describe basal area growth, but were also not measured.

The only recorded variables were stump diameter and the age of each tree. Therefore the individual tree basal area growth was modeled as a function of tree diameter or tree age without including spatial information. So, our models for estimating growth are distance independent. We can notice many advantages of distance independent models, One of them is that they allow for easy computation during application and rapid testing of various management alternatives (Vanclay 1994; Porte, Bartelink 2002).

The growth of tree is intrinsically an exponential process at a young age, but at after several years ago, it is constrained by two opposing forces such as external environmental resistance and an internal self-regulatory mechanism (Zeide 1989, 1993).

The basal area growth curves that we get it from estimating the parameters of the mathematical equations gave us indicator to how the growth on basal area happen. So we draw this relationship such as in the figure (1) which is explain a positive relationship between diameter and basal area growth, and explain that the maximum basal area growth rate was in a large diameter.

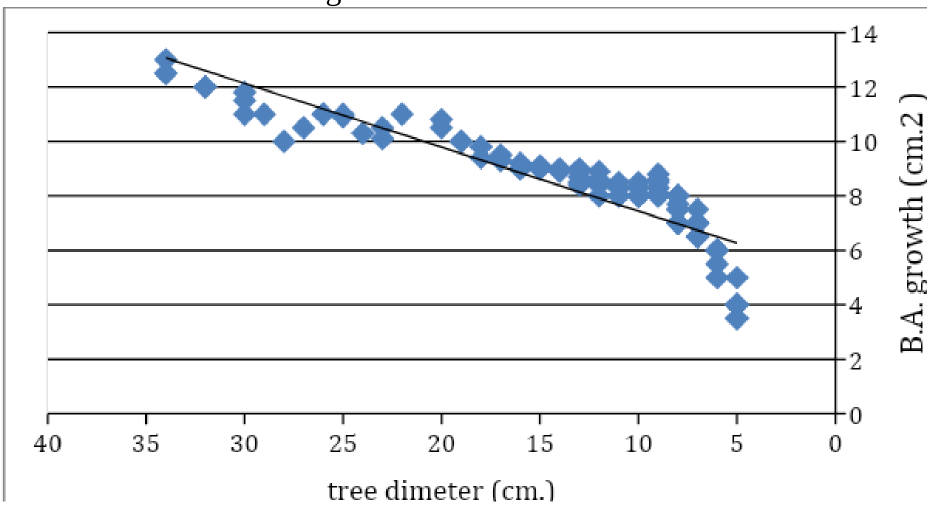

Figure (1) explain the positive relationship between diameter and basal area growth

After the regression analysis don, we get an equation which help us to estimate annual basal area increment depending on diameter :
B.A.I. = - 0.00155602 + 0.000394616*D

From this equation we can get an annual increment for three years, and by dividing it on three we will get an mean annual increment for one year, the coefficient of determination (R^2) and standard error (S.E) for the equation was (99.9) and (0.0003) respectively, residual test show us the random distribution, figure (2). This mean the ability for use the equation to estimate basal area increment.

Predicted B.A. increment

Figure (2) the random distribution of residuals

The growth rates is biological phenomena, which is led to fast and slow growth.
The growth of trees influenced by several biotic and a biotic factors (Pretzsch 2009; Vacek et al. 2009). For describe the growth pattern of individual trees we need these factors for adequately modeled.
The Influence of these factors are reflected in the characteristics of individual tree and stands, which can be measured quantitatively, such as the growth of a tree within the stand varies with stand density through the competitive stress imposed by its neighbor trees, and this tension described by a competition index (Hasenauer 2006; Pretzsch 2009; Sharma 2013).

Stand density effects usually included in the models of tree growth with the application of either distance-independent or distance-dependent modeling (Rivas et al. 2005; Pretzsch 2009). However, in this study, no carrier of density indices measure was available, because the study was about open places . Our chosen model is simple and computationally easier as it possesses only two parameters. The age as independent variable can be used in both even and uneven-aged stands. The measurement of the stump age of each tree is require for the estimation of basal area growth, Whereas an age dependent model .

References:

Anta M.B., Dorado F.C., Dieguez-Aranda U., Gonzalez J.G.A., Parresol B.R., Soalleiro R.R. (2006): Development of a basal area growth system for maritime pine in northwestern Spain using the generalized algebraic dif**542** J. FOR. SCI., *61*, 2015 (12): 535–543

Bollandsås O.M., Næsset E. (2009): Weibull models for single-tree increment of Norway spruce, Scots pine, birch and other broadleaves in Norway. Scandinavian Journal of Forest Research, 24: 54–66.
’

Gregory E. , McPherson, Natalie S. van Doorn, and Paula J. Peper (2016), Urban Tree Database and Allometric Equations U.S. Department of Agriculture Pacific Southwest Research Station 800 Buchanan Street Albany, CA 94710.

’

Hong-gang S., Jian-guo Z., Ai-guo D., Cai-yun H. (2007): A review of stand basal area growth models. Forest Studies in China, 9: 85–94.

Porte A., Bartelink H.H. (2002): Modelling mixed forest growth: a review of models for forest management. Ecological Modelling, 150: 141–188.

Pretzsch H. (2009): Forest Dynamics, Growth and Yield: from Measurement to Model. Berlin, Springer-Verlag: 664.

Rivas J.J.C., Gonzalez J.G.A., Aguirre O., Hernandez F. (2005): The
effect of competition on individual tree basal J. FOR. SCI., *61*, 2015 (12): 535–543 **543**

Sharma R.P. (2013): Modelling Height, Height Growth and Site Index from National Forest Inventory Data in Norway. [PhD Thesis.] Ås, Norwegian University of Life Sciences, Norway: 172.

Uzoh F.C.C., Oliver W.W. (2008): Individual tree diameter increment
model for managed even-aged stands of ponderosa pine throughout the western United States using a multilevel linear mixed effects model. Forest .Ecology and Management, 256: 438–445.

Vacek S., Hejcman M., Semelova V., Remes J., Podrazsky V. (2009): Effect of soil chemical properties on growth, foliation and nutrition of Norway spruce stand affected by yellowing in the Bohemian Forest Mts., Czech Republic. European Journal of Forest Research, 128:
367– 375.

Wagle B.H., Sharma R.P. (2012): Modelling individual tree basal area growth of Blue pine (*Pinus wallichiana*) for Mustang district in Nepal. Forest Science and Technology, 8: 21–27.