International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(3): 3852-3854
© 2019 IJCS
Received: 09-03-2019
Accepted: 13-04-2019

J Ravi
Forest College and Research Institute, Mettupalayam TNAU, Tamil Nadu, India

S Radhakrishnan
Forest College and Research Institute, Mettupalayam TNAU, Tamil Nadu, India

A Balasubramanian
Forest College and Research Institute, Mettupalayam TNAU, Tamil Nadu, India

Correspondence
J Ravi
Forest College and Research Institute, Mettupalayam TNAU, Tamil Nadu, India

Construction of yield model for *Ailanthus excelsa* grown in Cauvery delta agro climatic zone of Tamil Nadu, India

J Ravi, S Radhakrishnan and A Balasubramanian

Abstract
An experiment was conducted to construct the yield model for *Ailanthus excelsa* trees grown in Cauvery delta agro climatic zone of Tamil Nadu. Trees of different age classes ranging from 1 year to10 years were selected for the study. The instrument laser distance meter was used to measure tree height, diameter at breast height and diameter at 2 m intervals for deriving the volume. In this study, the volume of trees in age class of 9-10 years ranged between 0.088 m^3 per tree and 0.210 m^3 per tree with the average value of 0.192 m^3 per tree. The yield model constructed for *Ailanthus excelsa* grown in Cauvery delta zone of Tamil Nadu was Y= -0.041 + (0.019*Age) + (0.083*Diameter). The yield model will be helpful to the tree growers and farmers for deriving the approximate volume for *Ailanthus excelsa* trees grown in their farmlands by knowing the age and diameter and this may be useful in predicting the yield and ascertain better returns for their produce.

Keywords: *Ailanthus excelsa*, yield model, volume, cauvery delta agro climatic zone, Tamil Nadu

Introduction
Ailanthus excelsa is a deciduous tree attains height of 18 to 25 m and girth of 2.5 m with a cylindrical bole. The wood is soft, very light but fairly strong and easy to saw. (Lavhale and Mishra, 2007) [3]. This tree is widely cultivated in farmlands of Tamil Nadu and is a preferred tree for matchwood, plywood and packing cases industry. The tree is normally harvested at the rotation of 5-6 years in Tamil Nadu for its utility in matchwood industry (Rajasugunasekar, 2014) [8]. Identifying the correct stage of harvesting in this species is imperative for tree growers to get better returns for the farm wood harvested by the tree growers.
Yield model is a form of equation used to predict the yield of tree with respect to age, volume, climatic, edaphic, topographical so on for even aged and uneven aged plantation. Yield model construction is one of the measures for deriving the volume of trees. Generally the yield models are constructed for fast growing tree species (Pulp wood species, Match wood, Ply wood) with straight bole and with minimum rotation period. Yield model is used to predict the changes in tree and stand values for periods between successive inventories, for predicting the productivity and profitability of the plantation (Raviperumal, 2018) [9].
The age of stand and the average height of trees are essential to estimate the actual volume and the annual increment of a stand. The preparation of yield table results in the present productivity of the plantation and derives the yield model by using the field data (Sureshkrishnan, 2017) [12]. Studies on yield estimation and prediction for trees planted in the farmer's field are very minimum. These farm grown tree species form the raw material base for the wood based industries of the country. Therefore it is important to assess the productivity and predict the yield of tree species grown by the tree growers. Based on the above need, the yield model for *Ailanthus excelsa* was constructed for Cauvery delta agro climatic zone of Tamil Nadu for the benefit of tree growing farmers to get a fair price for their produce.

Materials and Methods
The field data for yield model construction of *Ailanthus excelsa viz.*, tree height, bole height, diameter of 2 meter segments were collected in the farmer's field of Cauvery delta zone of Tamil Nadu. The instrument laser distance meter was used to measure the height, diameter at breast height and diameter at 2 m intervals up to bole height with simple random sampling

method in age classes of 1- 10 years. The diameter was taken at every two meter interval of tree height, hence form factor ignored for the volume estimation.
Volume of the trees were estimated by using the formula,

$V = \pi r^2 h.$

Where,
r - Radius of tree
h - Height of tree

Based on the age class, diameter and estimated volume, the yield model for *Ailanthus excelsa* was constructed. Among the yield parameters, age and average diameter were used as independent variables and volume as dependent variable. The multiple linear regression equation used for construct the yield model was

$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + \ldots\ldots\ldots + b_nx_n$

Where,
Y - Yield (m^3)
a - Intercept
X_1 - Age of the tree in years
X_2 - Average Diameter
b_1, b_2 - Coefficients of b_1 and b_2

Result and Discussion
Yield model is the tool for assessing and predicting the yield of farm grown trees, which helps the tree grower in assessing the yield. The yield model for *Ailanthus excelsa* in Cauvery delta agro climatic zone was constructed based on the growth parameters observed in trees grown in farmlands in age classes of 1-10 years.
In bole height, the maximum value was recorded in the age class of 9-10 years with 7.56 m followed by 6.73 m (Age class of 8-9 years), 6.40 m (Age class of 7-8 years) and the minimum in the age class of 0-1 years (1.45 m). The diameter at breast height was maximum (0.180 m) in age class of 9-10 years and minimum (0.047 m) in age class of 0-1 years. The result of the present study is in line with the findings of, Jat *et al.* (2010) [2] that the tree height growth ranged from 0.88 m to 2.53 m in 2 years old *Ailanthus excelsa* plantations. (Sureshkrishnan, 2017) [12] also reported that the tree height growth ranged from 8.32 m to 11.52 m in 8-9 years old *Ailanthus excelsa* plantations in Cauvery delta agro climatic zone of Tamil Nadu. The height and diameter profile of every tree species varied from site to site (Piotto, 2007) [7].
In the present study, the volume of the trees was calculated by non-destructive sampling. The volume was ranked in the order of 0.192 m^3 (Age class of 9-10 years) > 0.147 m^3 (Age class of 8-9 years) > 0.113 m^3 (Age class of 7-8 years) > 0.092 m^3 (Age class of 6-7 years) > 0.074 m^3 (Age class of 5-6 years) > 0.046 m^3 (Age class of 4-5 years) > 0.038 m^3 (Age class of 3-4 years) > 0.018 m^3 (Age class of 2-3 years) > 0.011 m^3 (Age class of 1-2 years) > 0.003 m^3 (Age class of 0-1 years). The finding of Bermejo *et al*., (2009) [1] in teak with age class of 10 years supports the results of the present study, whereas the sampling was done by destructive method. Similar trend of volume increment in five age classes of *Ailanthus excelsa* grown in farmer's field of Cauvery delta zone in Tamil Nadu (Sureshkrishnan, 2017) [12].

Table 1: Volume of *Ailanthus excelsa* trees grown in Cauvery delta agro climatic zone of Tamil Nadu

S. No	Age class (Years)	Bole height (m)	Average Diameter (m)	Average Volume (m^3/tree)
1	0-1	1.45	0.047	0.003
2	1-2	2.62	0.075	0.011
3	2-3	3.18	0.084	0.018
4	3-4	5.26	0.096	0.038
5	4-5	5.50	0.103	0.046
6	5-6	5.65	0.129	0.074
7	6-7	6.23	0.137	0.092
8	7-8	6.40	0.150	0.113
9	8-9	6.73	0.167	0.147
10	9-10	7.56	0.180	0.192

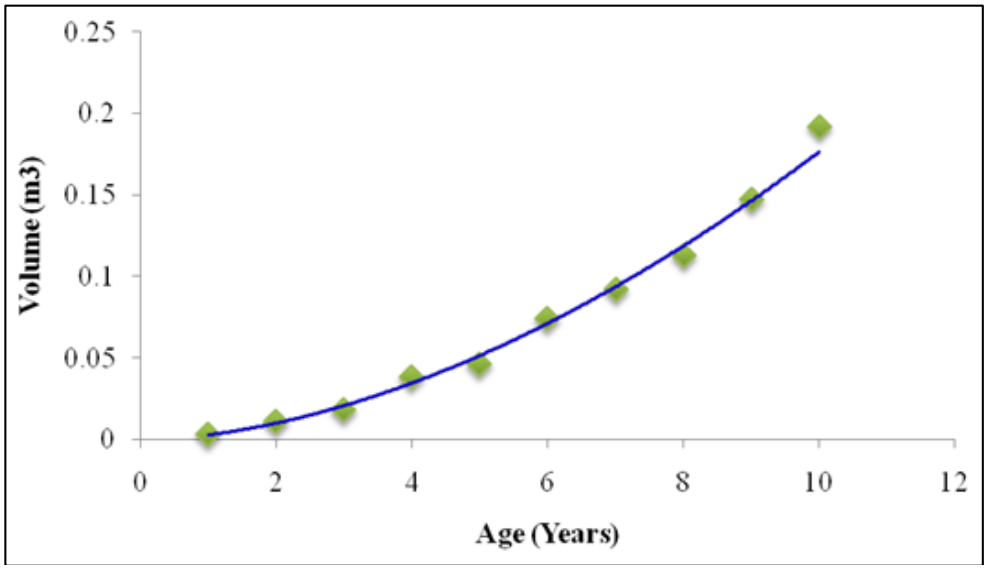

Fig 1: Volume curve between age (years) and total volume (m^3) in *Ailanthus excelsa*

The yield model provides information about the yield of the trees at various stages of growth; this will enable the tree growers to harvest trees at an optimum age to ensure good economic returns from the tree crops grown by them. Yield table for *Ailanthus excelsa* was developed using the multiple linear regression model technique. The similar technique was used by Mohammad *et al*. (2011) [4] to estimate the forest stand volume and tree density. The yield model for *Ailanthus excelsa trees* grown in farmlands of Cauvery delta agro climatic zone of Tamil Nadu, India was constructed using the age class, diameter and volume of trees.

Y= -0.041 + (0.019*Age) + (0.083*Diameter)

Islam *et al*., (2012) reported on two models of In(V) = 8.3023 + 2.1746 In(D) and In(V) = –9.1864 + 1.85502 In(D) + 0.8234 In(H) were found to be the suitable models to estimate volume of Rain trees. The yield prediction for *Eucalyptus* species fit with age was found to be the best model in most *Eucalyptus* plantations due to its reliability and sigmoid growth curve (Latifah *et al*. 2014) [11]. The current yield model predicted in *Ailanthus excelsa* were in line with the yield model predicted in neem and albizia (Raviperumal *et al*, 2018) [9], teak (Vindhya Prasad *et al*, 2013) [13], teak and Gmelina (Morataya *et al*, 1999) [5], teak and ailanthus (Sureshkrishnan, 2017) [12].

Conclusion

The result of this study inferred that the yield model for *Ailanthus excelsa* was Y= -0.041 + (0.019*Age) + (0.083* Diameter) for Cauvery delta agro climatic zone of Tamil Nadu. The yield model will be instrumental in deriving to device the volume of trees by the tree growers to know the dimension and value of their produce by substituting the age and diameter of trees directly in the yield model.

Acknowledgement

The authors acknowledge the support of Tamil Nadu Forest Department for funding the research project on “Developing growth yield table for stand and seed orchard of *Ailanthus excelsa* in Tamil Nadu”.

References

1. Bermejo, Ivan, Isabel C, Alfonso San Miguel. Growth and yield models for Teak plantations in Costa Rica. Forest Ecology and Management. 2003; 189:97-110.
2. Jat HS, Mann JS, Sharma SC, Rupachand. Identification of best performing Ardu (*Ailanthus excelsa*) genotypes in semi-arid ecosystems of Rajasthan. Indian Journal of Agricultural Sciences. 2010; 80(3):227-230.
3. Lavhale MS, Mishra SH. Nutritional and therapeutic potential of *Ailanthus excelsa*: A review. Pharmacognosy Rev. 2007; 1:105-113.
4. Mohammad, Jahangir, Shaban Shataee, Manoocher Babanezhad. Estimation of forest stand volume, tree density and biodiversity using Landsat ETM+ Data, comparison of linear and regression tree analysis. Procedia environmental Sciences. 2011; 7:299-304.
5. Morataya R, Galloway G, Berninger F, Kanninen M. Foliage biomass-sapwood (Area and volume) relationships of *Tectona grandis* LF and *Gmelina arborea* Roxb.: silvi cultural implications. Forest Ecology and Management. 1999; 113(2-3):231-239.
6. Pérez-Cordero LD, Kanninen M. Heartwood, sapwood and bark content, and wood dry density of young and mature teak (*Tectona grandis*) trees grown in Costa Rica. Contenido de duramen, albura y corteza, y densidad de la madera seca de árboles de teca jóvenes y maduros (*Tectona grandis*) cultivados en Costa Rica. Silva Fennica. 2003; 37(1):45-54.
7. Piotto DD. Growth of native species planted in open pasture, young secondary forest and mature forest in humid tropical coasa rica. Journal of tropical forest science. 2007; 19:92-102
8. Rajasugunasekar D. Cultivation techniques for Ailanthus. In: Transfers of tree cultivation technologies.Eds Buvaneswaran *et al*. Institute of Forest Genetics and Tree Breeding Prdag print Coimbatore, 2014, 19-22
9. Raviperumal A, Balasubramanian A, Manivasakan S, Hari Prasath CN, Suresh Krishnan M. Yield Model Construction in Neem (*Azadirachta indica*) Under Western Agro Climatic Zone of Tamil Nadu, Southern India. Trends in Biosciences. 2018; 11(24):3237-3239. Print: ISSN 0974-8431.
10. Sheikh Sirajul Islam, Jonaed Kabir, Abdul Kadar Muhammad Masum. Volume Table of Raintree (*Saman ea saman*) in Bangladesh by Regression Technique. Open Journal of Statistics. 2012; 2:115-119
11. Siti Latifah, Teodoro Reyes Villanueva, Myrna Gregorio Carandang, Nathaniel Cena Bantayan, Leonardo M. Florece Predicting growth and yield models for *Eucalyptus* species in Aek Nauli, North Sumatera, Indonesia : Journal of Agriculture, Forestry and Fisheries 2014; 3(4):209-216
12. Sureshkrishnan M. Developing yield table for few tree species grown in western agro climatic zone of Tamil Nadu, M. Sc Thesis, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, 2017.
13. Vindhya Prasad, Tewari K, Mariswamy M, Arunkumar AN. Total and Merchantable Volume Equations for *Tectona grandis* Linn. f. Plantations in Karnataka, India Journal of Sustainable Forestry. 2017; 32:213-229.