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Growth and volume productivity of farm grown teak (*Tectona grandis* Linn. F) in cauvery delta zone of Tamil Nadu

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Abstract
A natural Teak resource is available only in few tropical and sub-tropical countries like India, Myanmar, Thailand etc. India is the leading exporter of teak resources in early decades, but presently the country is becoming the major net importer of teak resources in order to meet their requirements. Based on the constrains, the present study was conducted in farmlands under Cauvery delta zone (CDZ) of Tamil Nadu to analyze the available teak resources and their influence on growth and volume production. The growth biometrics and volume production of Teak among different block and boundary plantations of farm grown teak in different age class were recorded in cauvery delta agroclimatic zone of Tamil Nadu. On comparing both plantations, the present study revealed that growth biometrics is significant in boundary plantations of 15-20 years age class attaining maximum DBH (0.201 m), height (9.8 m) and volume (0.282 m^3). Hence, it is concluded that under farmland condition, Cauvery delta zone is more superior zone for teak boundary plantation due to the influence of optimum climatic and edaphic factors.

Keywords: Cauvery delta zone, farmland, growth, volume, teak, timber

Introduction
Teak (*Tectona grandis* Linn. f) is generally a light demanding species with maximum temperature of about 43 ℃ and minimum temperature of about 13 ℃. Teak is grown well in high light intensity of about 85 to 100% (Palanisamy *et al*. 2009) [8]. Teak shows promising growth under well drained alluvial soil with a neutral pH of about 6.5 to 7.5 (Pandey and Brown 2000) [9]. The mean annual rainfall for teak growth varies from 800 to 2500 mm with an altitude range of 1200 m above mean sea level (Chelliah *et al*. 2021) [3]. However, Teak shows poor growth on shallow or hard pan soil, laterite, black cotton, acidic, dry sandy soil and waterlogged soils.

Teak is considered as a premier wood species which is extensively utilized for furniture making all over the country (Shukla and Viswanath 2014) [14]. Tamil Nadu accounts various crop diversification is one of the resilience mechanism followed by farmers in different agroclimatic regions. Based on the influence of rainfall, irrigation and cropping pattern of Tamil Nadu has been classified into seven distinct agro-climatic zones (Kumar *et al*. 2021) [7]. In the seven agro climatic zones, fives zones are amenable for teak cultivation under farmlands which provides optimum climatic and edaphic conditions (Balasubramanian 2019) [1]. And interestingly among the different zones of Tamil Nadu, Cauvery delta zone is known as the hub of teak plantations for its extensive growth biometry.

Since Teak is a long rotation crop (50 to 80 years), however the rotation period may be reduced by suitable silvicultural practices (Buvaneswaran *et al*. 2006) [2]. The productivity of short rotation teak is high with a mean annual increment range of 10-20 m^3/ha/year (Sasidharan 2021) [13]. In the recent past decade, the country becomes the net importer of teak wood in order to meet its requirement (Kollert and Kleine 2017) [6]. In order to reduce the import duty of teak there is a great enthusiasm among farmers to grow teak outside the forest area which is also appropriately supported by different government programs. However, the status of teak growth in farmlands in terms of growth biometry has not been studied. In order to establish scientific evidences for teak performance in farm field, growth need to be studied extensively in relation to different diameter classes of teak grown in cauvery delta zone of Tamil Nadu. Thus, the present study focuses on evaluation of growth performances of farm

grown teak cultivated in selected zone of Tamil Nadu.

Materials and Methods

Farm grown teak plantations are surveyed in Cauvery delta zone (CDZ) of Tamil Nadu. The districts covered in Cauvery delta zone are Trichy, Thanjavur and Perambalur.

Field survey

Totally 12 blocks and 5 boundary plantations were estimated for growth biometry in Cauvery delta zone with 5% sampling intensity. In Cauvery delta zone with three age classes of teak namely 5-10, 10-15 and 15-20 years were estimated.

Estimation of DBH

DBH (Diameter at breast height) was measured at standard height 1.37 m using tree telescope (Laser distance meter) and the readings are expressed in meter (m) (Ravi *et al*. 2019, Raviperumal *et al*. 2018) [11, 12].

Estimation of Height

Height of the teak trees was measured from the ground level to the leading terminal tip using the advanced technology of Laser Distance Meter and results are expressed in meter (m) (Ravi *et al*. 2019) [11].

Estimation of volume

With the use of observed data the standing tree volume is estimated by using the formula given by Chaturvedi and Khanna (1982) and the results are expressed in cubic meter (m^3) (Raviperumal *et al*. 2018) [12].

$V = \pi r^2 h$

Where,
V = Volume
r = Radius
h = Top height

Result and Discussion

Farm grown Teak plantations of Cauvery delta zone of Tamil Nadu were recorded for its biometric attributes in 3 different age classes for both boundary and block plantation.

The biometric attributes viz., DBH, Height and Volume varies significantly among respective age class under Cauvery delta zone of Tamil Nadu. On comparing the first dataset consisting of growth parameters (Table 1), the maximum value of Diameter at breast height (DBH) is obtained for age class 15-20 years (0.201 m) and the minimum value is obtained for 5-10 years (0.078 m). With respect to height, the maximum value is recorded for age class 15-20 years (9.8 m) and the minimum value is recorded for age class 5-10 years (6.4 m). Relating to the volume, the maximum value is obtained for age class 15-20 years (0.282 m^3) and the minimum value is obtained for age class 5-10 years (0.030 m^3).

Table 1: Growth biometry of farm grown teak in block and boundary plantations

Zone	Plantation Type	Age class	Diameter at breast height (m)	Height (m)	Volume (m^3)
CDZ	Block	5-10	0.078	6.4	0.030
		10-15	0.128	6.9	0.089
		15-20	0.153	7.1	0.114
		Mean	0.120	6.8	0.078
		S.Ed	0.022	0.208	0.025
		CD	0.049	0.458	0.055
	Boundary	5-10	0.129	7.2	0.068
		10-15	0.176	8.9	0.237
		15-20	0.201	9.8	0.282
		Mean	0.169	8.6	0.196
		S.Ed	0.021	0.762	0.065
		CD	0.046	1.677	0.143

On comparing the biometric values of both boundary and block plantations in Cauvery delta zone, the boundary plantations with the age class 15-20 showed highest DBH (0.201 m), height (9.8 m) and volume (0.282 m^3) respectively. Based on comparison of growth biometrics between both plantations, boundary plantations performs better than block plantations owing to the difference in spacing and management practices for block and boundary plantations (Shukla and Viswanath 2021) [15].

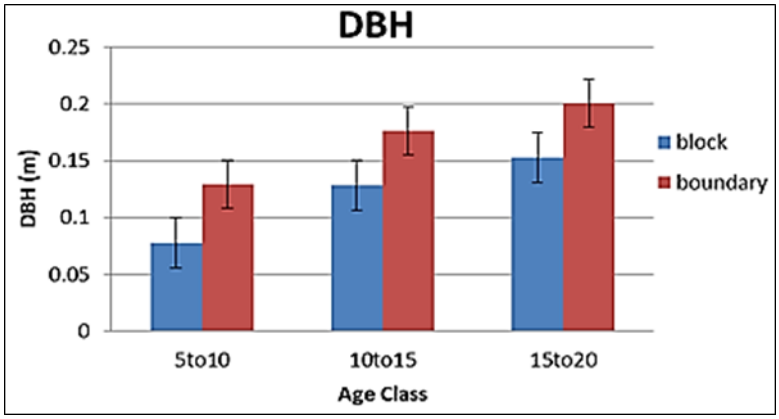

Fig 1: Comparison of DBH of block and boundary plantations of farm grown teak under cauvery delta zone

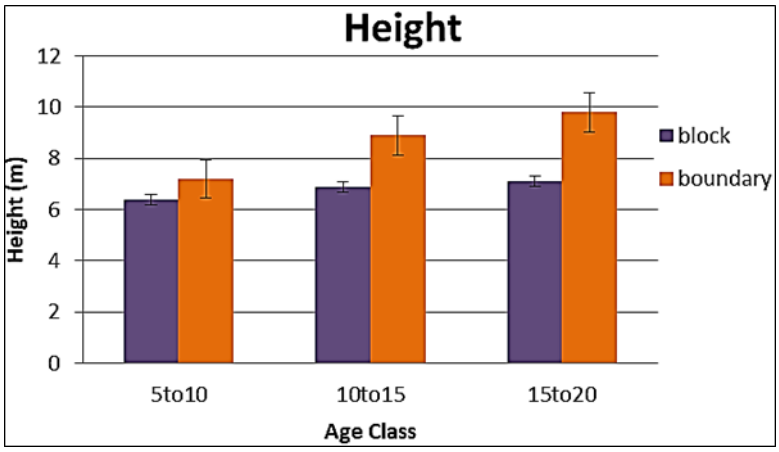

Fig 2: Comparison of Height of block and boundary plantations of farm grown teak under cauvery delta zone

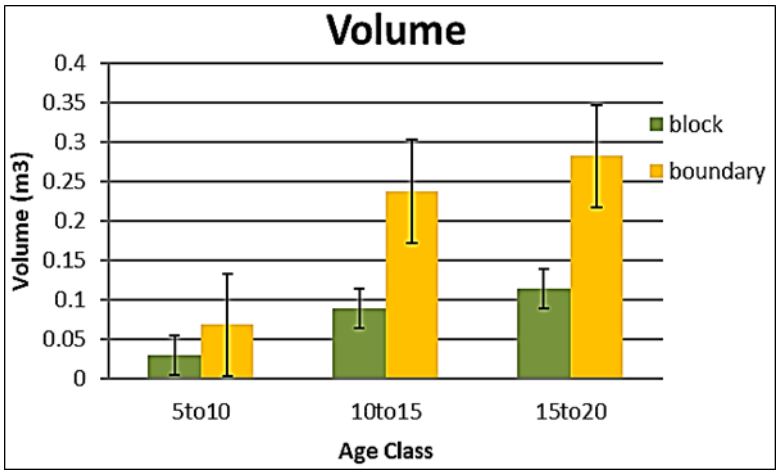

Fig 3: Comparison of Volume of block and boundary plantations of farm grown teak under cauvery delta zone

In the current study, the observed variations on growth biometrics were attributed to variations in edapho-climatic conditions under Cauvery delta agroclimatic zone. Average annual rainfall of 956 mm and good alluvial soil in cauvery delta zone contributed to the highest DBH and volume (Pavalan *et al*. 2015) [10]. This study also focused on the effect of spacing regime between teak grown in block and boundary type planting. Teak grows in boundary area shows highest girth and volume when compared to block planting area (Shukla and Viswanath 2014) [14]. This may be attributed to wider spacing adaptability for boundary planting (5m x 5m, 7m x 7m or 10m x 10m) compared to closer spacing (2m x 2m or 3m x 3m) of block planting. Zahabu *et al*. (2015) [16] also stated wider spacing favorability for teak grown in forest plantation of Tanzania. Enhanced volume production from teak boundaries are also attributed to low competition for growth resources such as light, water and nutrients from neighbouring trees and good management of the teak boundaries starting from establishment of seedling stage (Dotaniya *et al*. 2013) [4]. This is in accordance with Kidanu *et al*. (2005) [5] observed that volume production enhancement of eucalyptus under boundary plantation compared to block plantations.

Conclusion

The critical analysis on growth biometrics with respect to age class under Cauvery delta agroclimatic zone was carried out. The study concluded that 15-20 age class in both block and boundary plantations exhibited highest growth attributes. Thus, the age of the plantation and variation in average weather parameters of Cauvery delta zone can be used as a representative tool for growth biometrics, which helps the farmers to decide harvest period for teak that is economically viable and environmentally sustainable.

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