

Growth Performance and Physical Properties of 15-year old Teak Clones from Kerala, India



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Background

- Teak being one among the most important high quality timber species India, an area of more than 1.67 million ha is at present under teak and on an average 50,000 ha is planted annually.
- In spite of these extensive plantations, the yield (MAI) of teak in forest plantations is comparatively low as 2.85 m³/ ha/yr on a 55-60 year rotation period.
- The use of poor germplasm of seeds of unknown origin is a major handicap for low productivity of the plantations.
- Intensive short -rotation teak plantation is now being practiced the world over in 70 tropical countries.

Teak clonal forestry

Recently, teak clonal forestry has been viewed as the most efficient strategy for generating uniform planting material of superior quality for enhanced yield, high wood quality and commercial volume in the shortest possible time overcoming other genetic improvement methods

(Goh et al., 2007, 2016)

Superior clonal planting material of teak is now available commercially with known genetic origin revealed to the growers/end-users.



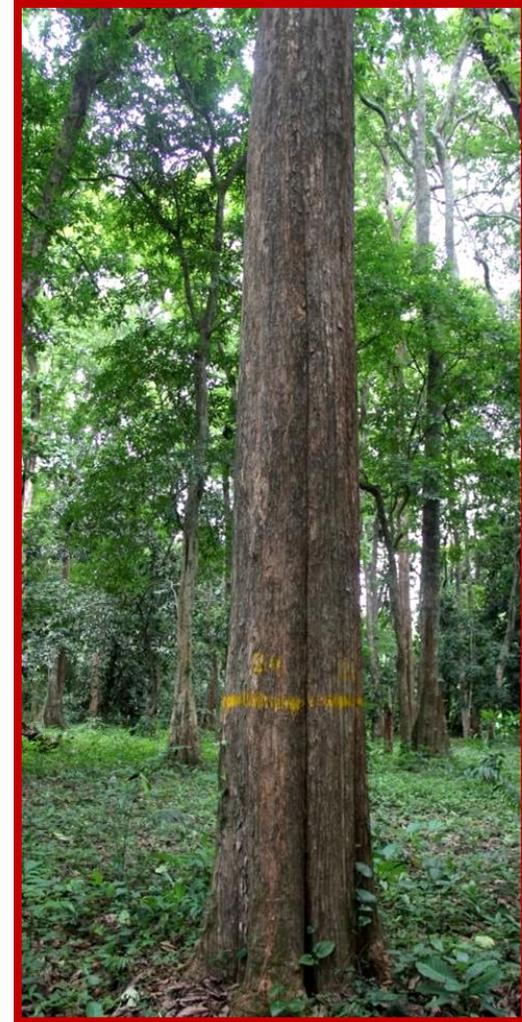
Teak clonal plantations

In this context, KFRI in early 2000 established a pilot scale true – to- type clones of superior plus trees of teak in different locations in Kerala (Surendran et al, 2006, Surendran, 2014)

Their parent plus trees originated from Nilambur, Konni and Arienkavu forest Divisions of Kerala, India.

The cloned teak is expected to exhibit superior traits as seen in the parent plus trees.

In teak, heartwood formation starts at the age of 4-5 years. Hence it was decided to evaluate the growth performance and wood properties of these selected clones.



Plus tree of teak

Objectives

To assess the growth performance of teak clonal plantation established at different locations in Kerala, India.

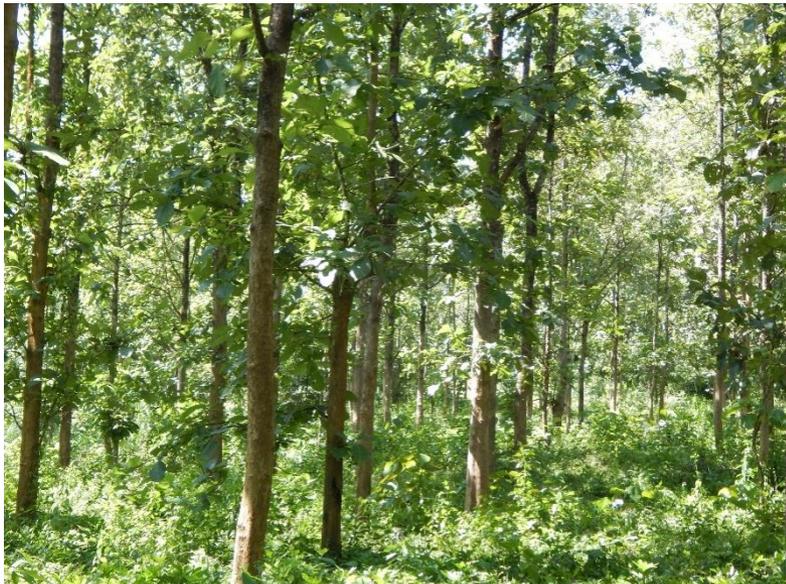
To link the basic wood properties like DBH, HW-SW ratio, density, growth rate (ring width), colour and anatomical characteristics among the different clones and selection of best clones showing faster growth rate, high proportion of heartwood with desirable wood qualities for future tree improvement.

Sampling strategy

About the Teak clones

Year of planting	Total Area (ha)	Clone code	Plus tree origin	Spacing	Total No. of standing trees
2000	1.70 ha	T1, T3, T4, T5, T6, T10	Nilambur	5 x 5 m	551
		T11, T16	Konni		
		T24, T46	Arienkavu		

Altogether 10 clones selected



*From each clones
3 defect free-
dominant trees
selected for
increment core
sampling (2 cores
per tree)*

*Total 60 core
samples*

Properties studied and Results

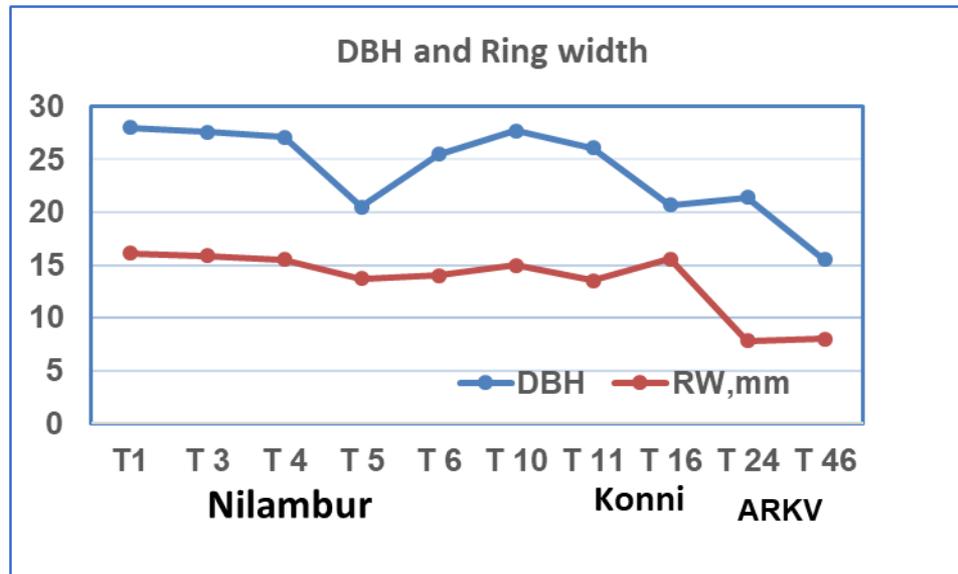
DBH, Ring width (growth rate), heartwood/sapwood percentage, density, colour

Tree dimensions and percentage of heartwood and sapwood at breast height (BH) level of the selected clones at 15 years

Clone origin	Clone No.	Tree height (m)	Heartwood		Sapwood	
			DBH (cm)	HW%	Thickness	Percentage
Nilambur	T1	18.0	28.0	69.9	1.6	30.1
	T3	19.3	27.6	68.3	2.0	31.3
	T4	19.0	27.1	62.6	2.4	37.4
	T5	20.7	20.5	52.2*	2.6	47.8
	T6	20.0	25.5	55.2*	2.7	44.8
	T10	19.0	27.7	68.6	2.4	31.4
Mean		19.3 ^{ns}	26.1*	62.8*	2.3	37.1*
Konni	T11	19.0	26.1	65.1	1.8	34.9
	T16	20.0	20.7	54.1	2.2	45.9
Mean		19.5 ^{ns}	23.4*	59.6*	2.0	40.4*
Aryankavu	T24	20.0	21.4	50.0	2.5	50.0
	T46	16.0	15.5	44.5	2.2	55.5
Mean		18.0 ^{ns}	18.4*	47.5*	2.4	52.6*

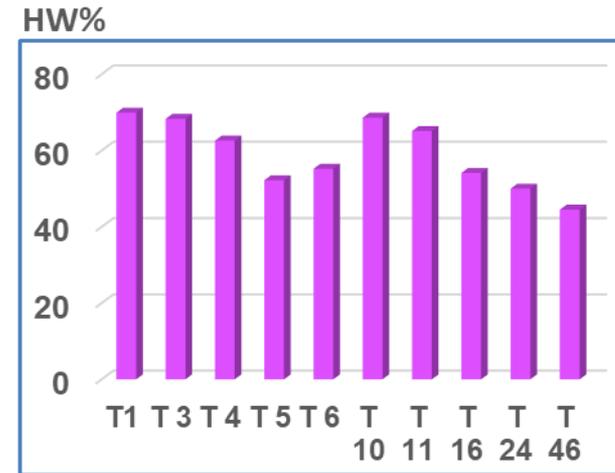
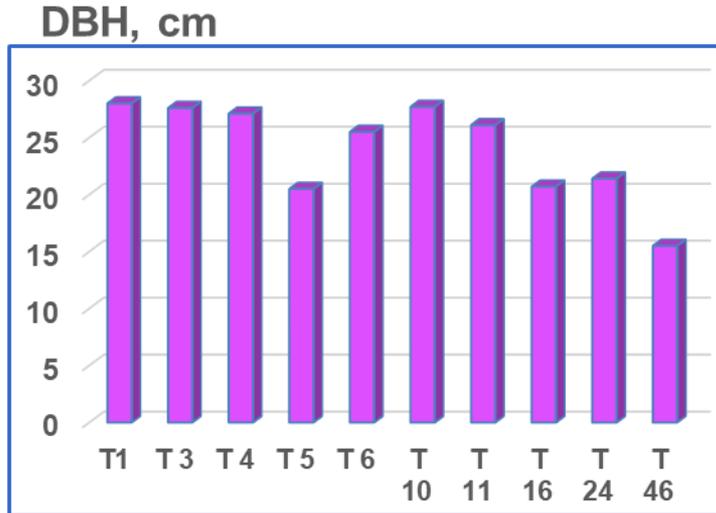
ns – non significant (p=0.5); * significant at p≤ 0.05

DBH and Ring width



Nilambur clones (T1, T3, T4 & T10) showed significant difference ($P \leq 0.05$) in terms of DBH. However maximum growth rate (ring width) was observed in Nilambur clones (16.1 mm)

DBH and Heartwood %



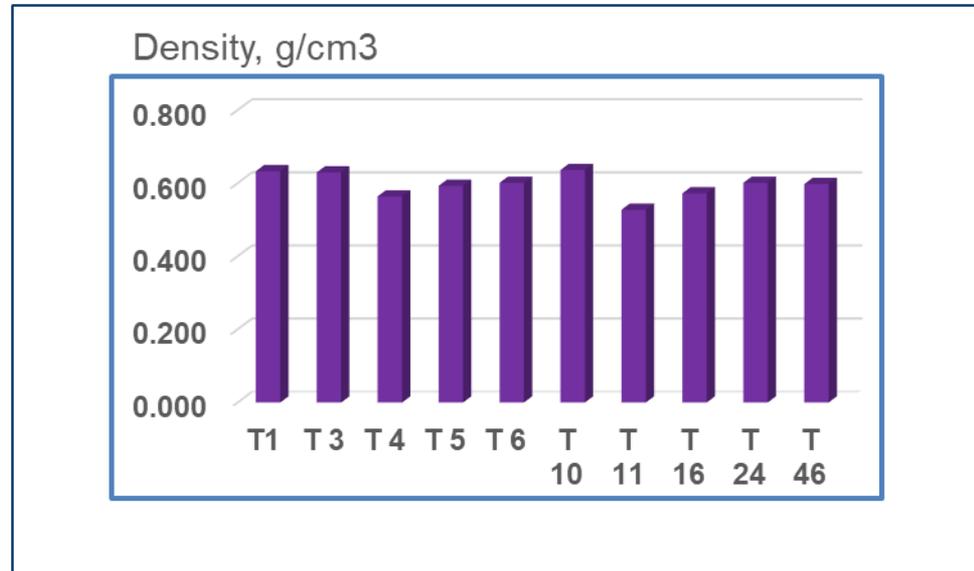
Nilambur clones (T1, T3, T4 and T10 stand superior showing high DBH and high amount of HW% with Konni clone of T11.

Maximum heartwood content (69.9%) was recorded in T1. Growth rate (ring width) was consistently increased with increasing DBH.

Sapwood percentage decreased with increase of heartwood and at maturity sapwood percentage get stabilised.

Density of wood

Density being a heritable trait did not vary with tree size or with age and is independent of growth rate.



Density of clone T11 and T16 (Konni) are significantly less (0.550 g/cm³) compared to Nilambur (0.630 g/cm³). This may be due to higher amount of earlywood with thin walled fibres.

Nilambur clone showed superiority in terms of density. The result indicate that at the age of 15 years, the teak clones reached density of mature trees.

Wood Colour

Colour is one of the quality criteria of wood to assess its suitability for certain end-uses such as furniture and decorative veneers.

Wood colour influences prices and even slight difference in heartwood colour would yield the product a different value.



Uniform golden brown colour of Nilambur teak

Wood colour was measured with CIE $L^*a^*b^*$ system, where three variables are estimated: L^* for lightness, coordinate a^* defines redness and coordinate b^* defines yellowness.

In mature teak trees of Nilambur plantations, Kerala, these three coordinates are highly saturated that impart a golden brown colour.

Wood Colour

Colour parameters of teak clones (N=60) with CIE L*a*b* system

Clone	L* (lightness)	a* (redness)	b* (yellowness)	dE
T1	56.75 ±2.9	7.66 ±0.5	21.11 ±0.7	0.34
T3	55.97±1.1	7.41 ±0.2	20.55 ±0.6	0.26
T4	59.99 ± 2.8	7.02 ±0.4	19.83 ±0.4	0.27
T5	59.39 ±2.6	7.33 ± 0.7	20.63 ±0.4	0.40
T6	59.11 ±1.6	7.06 ±0.5	21.71 ±0.6	0.23
T10	57.41 ±1.2	7.46 ± 0.1	20.45 ± 0.6	0.21
T11	58.93 ±3.5	8.89 ±0.5*	21.37 ±0.8	0.29
T16	57.53 ±1.2	8.23 ±0.0*	20.42 ±0.6	0.39
T24	58.50 ±2.3	7.11 ±0.7	20.24 ±0.8	0.29
T46	57.47 ±0.3	8.17 ±0.7*	20.62 ±2.0	0.49

No significant colour difference (dE) between the clones. However, redness index (a*) of Clone T11, T16 and T 46 are lighter ($p \leq 0.05$) than other clones having deeper colour.

Conclusions

Tree diameter at breast height (BH Level) showed a positive correlation with faster growth rate (ring width) and higher heartwood percentage.

Teak clonal plantations established at Kerala from superior plus trees shows promising results in terms of faster growth and achieved maximum heartwood percentage at the age of 15 years (69%).

The density of selected clones of Nilambur reached the maturity value of 630 kg/m³ in 15 years of growth.

Conclusions

The wood colour (L*a*b* values) of 15- year old teak clones is similar to the previous reports of Teak from Nilambur.

The study revealed that the judicious selection of teak clones of superior plus trees offer avenues for establishing teak plantations with enhanced wood quality traits like straight bole, increased DBH, faster growth rate and higher heartwood volume.

Teak clonal forestry overcomes the limitations of traditional breeding programmes and ensures uniform distribution of outstanding genotypes with enhanced yield within a short period which is advantages to the investors in wood industry.



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