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NOTE

VARIATION OF SEEDLING VIGOUR AMONG HALF-SIB FAMILIES OF TEAK (*TECTONA GRANDIS*)

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Selecting phenotypically superior trees from various provenances and employing them in a breeding orchard have been an important strategy adopted in the improvement of teak (Vasudeva *et al.* 2001). However, selection of individual trees on the basis of phenotype alone is often incomplete since genetic worthiness of the selected trees is not assessed. Evaluation of progenies of selected clones as to their early growth and vigour traits at the seedling stage is important for seedling selection. Since there is hardly any information on the degree and extent of variation of early vigour at seedling stage among teak clones of Karnataka (Vasudeva *et al.* 2001), the present study was conducted on half-sib families of teak derived from a 20-year-old clonal seed orchard (CSO) in Karnataka, South India.

Seeds were collected directly from three individual trees (i.e. three ramets) each from seven clones of teak originating from diverse provenances (Table 1) and were sown on standard raised nursery beds in completely randomized design (CRD), during May 2000 at the College of Forestry, Sirsi, Karnataka (14° 36' N, 75° 53' E; 619 m asl). The mean annual rainfall is 2657 mm, most of which is received between June and October. Three-month-old seedlings (60 per ramet) were transplanted to polythene bags from the nursery bed and monthly data were recorded on plant height and collar diameter for a period of one year. At the end of the experiment, measurements of shoot length, root length, number of leaves, leaf area and dry weight of stem, leaf and root were taken on five randomly selected seedlings from each ramet. Leaf area was worked out based on dry weight basis. Leaf area was measured on 30 randomly selected fully expanded leaves from all ramets using a Leaf Area Meter and then leaves were completely dried to get the dry weight of each leaf recorded separately. A regression line fitting leaf area and dry weight was computed:

$$y = 7.981 + 137.704\,x$$

where,

y = leaf area in cm^2
x = dry weight of leaf in g

Using this relation, leaf area on individual seedling basis was worked out. The data were analysed as per completely randomized design (CRD).

Among the morphometric characteristics, plant height, collar diameter, and number of leaves per plant did not significantly differ at family level at the end of the study (data not shown). However, families differed significantly with respect to most of the root characteristics such as maximum diameter of tap root, length of longest lateral root and

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number of lateral roots as well as leaf area per plant (Table 1). The family of clone 24, which recorded the highest overall value, was significantly superior to all others tested, while that of clone 9, which recorded the least overall value, was significantly inferior to all others (Table 1). Jayashankar *et al.* (1999) have also reported differences among different teak provenances of Kerala for the number of lateral roots and length of largest roots.

Progenies of different clones differed significantly in biomass characteristics (on dry weight basis) and the differences were very large (Table 2). The family of clone 24 also had the highest total biomass (39.99 g) and that of clone 32 had the least (12.31 g), which was far below the clonal average. Since plants with high root growth establish easily and perform well because of their ability to produce new roots promptly after planting in the field (Wakeley 1959), progenies of the clone 24 may be considered superior. However, families did not show statistically significant differences for shoot–root ratio. This suggests that although the total biomass varies among families, the distribution of biomass into above- and below-ground parts is similar. With respect to all biomass characteristics, families of clones 24, 19 and 7 registered higher values. Biomass of clone 24, which obtained the highest value, was found to be many times larger than the family of the poorest performer, the family of clone 32. Biomass production is a function of the photosynthetically active radiation received by the leaves (Hazara & Tripathi 1986). As optimal leaf mass levels increase, biomass production would substantially increase. Families of clones 24, 19 and 7 may have higher potential for photosynthetic carbon fixation as they possess higher leaf area per plant. This was reflected by the larger amount of dry matter production (total biomass, shoot and root biomass) by seedlings from these families in comparison with other half-sib families.

In general, families from the southern provenance of Karnataka were superior with respect to biomass traits; however, families of the northern provenance (which is relatively drier) were better with respect to tap-root and lateral-root lengths. This may reflect a response of genotypes to adapt to the drier conditions.

The quality and genetic potential of the seedlings that are converted into stumps have a strong influence on their future performance (Tewari 1994). Early assessment of the seedling vigour is also useful in eliminating poor progenies from field testing, which will go a long way in reducing the cost associated with carrying out the test and also effect the

Table 1 Variation in root characteristics among different families of teak clones at the end of the study. Values are means ± S.D.

Family (clone) I.D.	Origin of the clone (forest range, provenance)	Tap-root length (cm)	Max. diameter of tap root (mm)	Length of longest lateral root (cm)	No. of lateral roots
MyHuT8 (24)	Vijarpet, South	23.2 ± 2.8	17.32 ± 1.6	17.1 ± 0.6	12.30 ± 2.7
MyHuT3 (19)	Vijarpet, South	23.3 ± 6.0	16.51 ± 1.5	16.8 ± 0.3	10.65 ± 0.5
MyMK3 (37)	Kakanakote, South	20.4 ± 4.8	19.11 ± 0.4	14.6 ± 0.4	9.13 ± 2.0
MySA1 (13)	Arasake, South	23.4 ± 2.8	13.54 ± 1.6	15.8 ± 1.4	6.30 ± 0.1
MyHaK1 (32)	Haliyal, North	22.8 ± 5.4	13.32 ± 2.4	17.4 ± 0.1	5.90 ± 0.4
MyHaV3 (7)	Haliyal, North	23.2 ± 2.7	14.56 ± 0.7	18.6 ± 0.7	7.73 ± 1.8
MyHaV5 (9)	Haliyal, North	21.5 ± 0.9	12.87 ± 0.7	18.4 ± 1.4	8.03 ± 1.2
F test		ns	*	*	*
cd		–	2.25	1.58	2.85
sem (±)		0.78	0.44	0.39	0.57
cv (%)		17.02	8.51	5.10	18.36

ns = not significant; * = significant at 0.05 p level; cd = critical difference at 0.05 p level; sem = standard error of mean; cv = coefficient of variation (%).

Table 2 Variation in leaf area and biomass traits (per plant in g) among families of different teak clones on dry weight basis. Values are means ± S.D.

Family (clone) I.D.	Leaf area per plant (cm^2)	Root biomass	Shoot biomass	Total biomass	Shoot/root ratio
MyHuT8 (24)	1521.3 ± 465.4	22.0 ± 9.6	17.99 ± 5.19	39.99 ± 14.7	0.84 ± 0.13
MyHuT3 (19)	1167.4 ± 479.1	13.4 ± 2.8	13.10 ± 4.86	26.44 ± 7.67	0.97 ± 0.16
MyMK3 (37)	814.0 ± 44.2	9.69 ± 3.5	8.51 ± 0.85	18.21 ± 4.30	0.93 ± 0.23
MySA1 (13)	730.9 ± 75.9	7.48 ± 1.8	7.41 ± 0.52	14.89 ± 2.36	1.02±0.20
MyHaK1 (32)	562.9 ± 149.9	5.96 ± 0.3	6.35 ± 2.50	12.31 ± 2.79	1.04 ± 0.38
MyHaV3 (7)	995.8 ± 103.6	11.9 ± 3.3	10.88 ± 2.03	22.78 ± 5.28	0.93 ± 0.07
MyHaV5 (9)	608.4 ± 132.1	8.81 ± 3.5	6.41 ± 1.72	15.21 ± 4.88	0.78 ± 0.02
F	*	*	*	*	ns
cd	441.23	7.56	4.91	11.96	–
sem (±)	86.58	1.39	1.06	2.4	0.04
cv (%)	25.83	37.38	27.44	31.36	20.24

ns = not significant; * = significant at 0.05 p level; cd = critical difference at 0.05 p level; sem = standard error of mean; cv = coefficient of variation (%).

genetic improvement at a relatively faster rate. In fact, Jayashankar *et al.* (1999) have shown that height and collar diameter at seedling stage had a positive association with growth and vigour of teak stumps. Hence the data of the present study may help in future improvement of teak. Further, progeny evaluation at seedling stage also aims to generate preliminary information for developing juvenile–mature correlation of important traits. However, conclusive juvenile–mature correlation for economic traits in teak is lacking, hence a thorough investigation is highly necessary to accelerate teak improvement programme.

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