

## NOTES

### FIELD PERFORMANCE OF TISSUE CULTURE-DERIVED TEAK (*TECTONA GRANDIS*)

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Teak (*Tectona grandis*) is a plantation species popular for its valuable hardwood. It is a deciduous tree, which can attain a height of 25 to 35 m and a diameter at breast height (dbh) of 100 cm or more (Lapongan 1998). It is the most extensively planted tree species throughout Asia (Lamprecht 1989, Appanah & Weinland 1993). In Sabah, Malaysia, teak is valued as a plantation species. It has been introduced to Sabah back in 1920's but to date only a small hectareage has been planted (Lapongan 1998).

Limited planting stock is the major constraint faced by local planting agencies. Seed source from the existing teak plantations in Sabah is very limited and the quantity is not sufficient for large-scale planting. Due to this, planting agencies in Sabah are still relying on planting materials imported from other countries such as Thailand and Indonesia (Lapongan 1998).

The applicability of tissue culture method for clonal propagation of elite teak has been widely published in the past (Sunitabala *et al.* 1994, Goh & Galiana 1998, Monteuuis *et al.* 1998). The axillary bud of mature (more than 15 years old) elite tree is normally used as explant for these studies. In clonal propagation, it is assumed that clones produced via tissue culture method will replicate in totality the structures and growth form of the tree which they are derived from. However, this assumption is incorrect for tree species (Ng 1999). The author reported that plantlets derived from different parts of the same tree looked and behaved differently from each other. This statement concurred with the report stating that propagules taken from plagiotropic growth will continue to grow laterally, sometimes for an indeterminate length of time and tissue culture-produced plants are not truly juvenile unless the initiating tissue is juvenile (Swartz 1991). Hormonal changes induced by tissue culture rejuvenation may continue to cause reorientation of plant habit for long periods of *ex vitro*. Ng (1999) reported that clones from buds taken from crowns of plus trees over 80 years old with tall, straight, cylindrical bole produced plantlets that grew into crowns with large limbs. With these points in mind, this study was carried out to assess the growth performance and characteristics of tissue culture-derived teak.

Clonal propagation was carried out using axillary buds of selected superior trees from teak plots located at Bandau in Kota Marudu and Apas in Tawau, Sabah. The seed origins of the Bandau and Apas plots are from Indonesia and Trinidad respectively. Plus trees from each plot (six from Bandau and four from Apas) were chosen based on their growth and form. The axillary buds were collected from the candidate plus trees (CPTs) as explants. Tissue culture propagation method was used to propagate the respective CPT. The trees were between 30 and 70 years old at the time of experiment. The height and dbh of Bandau plot ranged from 22.4 to 42.4 m and 46.7 to 75.0 cm respectively. Dbh for Apas plot ranged from 62.0 to 151.0 cm. Clear bole length for Bandau and Apas plot ranged from 11.4 to 20.4 m and 20.0 to 25.0 m respectively.

A total of 138 tissue culture-derived teak, comprising 10 genotypes, were hardened at the nursery for two months before being planted out in the field using line planting at a distance of 4 × 4 m. Assessment was carried out twice a year for two years. Parameters measured were height, dbh, number of branches produced and number of trees producing flowers. In another study, a comparison of growth (dbh and height) was made between the tissue culture-derived teak from Bandau and seedling derived teak, also from Bandau that was already existing at the plot in Segaliud Lokan. The plantlets and the seedling-derived teak were two and four years old respectively when the comparison was made. Analysis of growth performance was carried out using *t*-test.

Mean height and dbh recorded for the tissue culture-derived plants ranged from 6.15 to 10.79 m and 4.65 to 10.00 cm respectively (Table 1). There were significant differences in height ( $p < 0.0001$ ) and dbh ( $p < 0.0001$ ) between all superior trees tested. The results indicate that the growth performance of tissue culture-derived teak was comparable to their clones as reported by Lapongan (1998). The author found that the mean annual increments (MAI) for height and dbh of the Bandau plot were 0.41 m and 0.80 cm respectively while those for the Apas plot were 0.58 m and 0.77 cm.

**Table 1** Mean height, MAI, dbh and forking percentage for teak after two years of growth at plot 99/1(A) and 99/1(B), Segaliud Lokan, Sabah, Malaysia

CPT	Source	No. of plants	Mean height (m)	MAI height (m/year)	Mean dbh (cm)	MAI dbh (cm/year)	Forking (%)
1000	Bandau	10	7.16	3.58	5.45	2.73	10
1003	Bandau	9	8.54	4.27	6.93	3.47	67
1005	Bandau	19	10.52	5.26	8.51	4.26	26
1006	Bandau	14	10.29	5.15	7.04	3.52	24
1008	Bandau	1	9.37	4.69	6.3	3.15	0
test	Bandau	51	10.79	5.40	6.53	3.27	26
3000	Apas	17	6.88	3.44	6.45	3.23	24
3004	Apas	10	6.15	3.08	4.65	2.33	20
3007	Apas	1	10.37	5.19	10.00	5.00	0
3011	Apas	6	7.16	3.58	6.00	3.00	67

Assessment of growth form revealed that about 27% of the plants, regardless of their origin, produced branches (Table 1) while 73% grew straight with one single trunk. It was observed that some of the plants with branches produced crowns with large limbs or multiple leaders. This concurs with the suggestion by Ng (1999) who reported that trees do not replicate in totality the organisms from which they are derived from. However, the low percentage of branching indicates that mature tissue still can be used for clonal propagation of selected plus tree. Nevertheless, plantlets produced from tissue culture initiated from adult tissue should be considered as adult and, conversely, plantlets are not truly juvenile unless the initiating tissue is juvenile (Swartz 1991). Thus, tissue culture using juvenile buds are more practical for production forestry as the cells differentiate better and thus, better growth of plantlets can be expected. Since none of the plants in this study flowered, it is concluded that rejuvenation process occurred in these plants.

Results from Segaliud Lokan plot comparing teaks derived from seedling and tissue culture, both originating from Bandau, are given in Table 2. There was no significant difference in height ( $t = 1.06$ ,  $p > 0.29$ ) between plants derived from tissue culture and

seedling. However, there was significant dbh difference between these trials ( $t = -11.23$ ,  $p < 0.0001$ ). Although the comparison was between two- and four-year old plants derived from tissue culture and seedling respectively, the results indicate that growth performance of the former is comparable with the latter. It has been reported that teak displayed faster growth rate at earlier ages but slower at age 30 years old and above (Roberto *et al.* 1998). Therefore, age of tree also determines its growth rate. The fast growing rate observed in this study is evidence that rejuvenation phase has occurred within the plantlets.

**Table 2** Growth performance of teak derived from tissue culture and seedlings

Source (Bandau)	Location	Age (year)	No. of plants	Mean dbh (cm)	MAI dbh (cm/year)	Mean height (m)	MAI height
Tissue culture	Segaliud Lokan	2	98	6.79	3.40	9.45	4.73
Seedling	Segaliud Lokan	4	128	10.97	2.74	9.78	2.45

### Conclusion

The success of propagating mature tissues from mature superior trees and their impressive field performance indicate that true-to-type cloning is possible for the existing plus trees. However, more research needs to be carried out to overcome the problem of juvenility of plantlets produced by mature tissues.

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