Australian Government
AusAID

SPRIG News

Optimising spacing regimes for whitewood plantations in Vanuatu

Introduction

Whitewood (*Endospermum medullosum* L.S Smith) is a tropical tree that grows to about 40 metres tall. The combination of high quality timber with fast growth on good quality soils makes it a valuable tree in Vanuatu. Its distribution ranges from Indonesia through Papua New Guinea, Solomon and Santa Cruz Islands to Vanuatu, occurring predominantly in lowland, humid tropical climates with high rainfall. In Vanuatu, it occurs from the north to the central part of the archipelago: Banks, Espiritu Santo, Maewo, Ambae, Pentecost, Malekula, Paama, Epi, Shepherd Islands, Efate and Erromango (Thomson 1998). Unsustainable logging in the past has threatened the continued viability of the native forest utilisation on Espiritu Santo (the largest island of Vanuatu). There is a high demand for Vanuatu Whitewood in the Asian market (about 1500m^3/annum), and in the Vanuatu domestic market for light construction, furniture, interior joinery works. It has potential for veneer and plywood production. The apparent wind-firmness and disease resistance of the species and the high value of its light coloured timber make it a promising candidate for wider establishment in commercial plantations and reforestation (Haines and Walker 1995).

With perspective and foresight, Mr Neil Croucher (Manager of Melcoffee Sawmill) established a 300 ha planting of whitewood in 1994. The site was an area of regrowth bush that had been degraded and covered by invasive plants.

This report summarises a trial that was set up to ascertain the optimal spacing for *Endospermum medullosum*. One of the key silvicultural requirements to producing good quality wood is developing appropriate spacing and thinning regimes. Without the correct plantation spacing, the use of good genetic stock will be wasted.

In Vanuatu, when determining spacing, there are two important factors that have to be taken into account. The first is the high probability that several cyclones of varying intensity will pass close to the plantation and cause damage in the form of leaf loss and branch breakage, broken tops, stem breakage and windthrow. The second factor is the need to remove smaller and or, poorly formed trees, to leave a final crop of well-formed trees of sawlog quality.

Methods and materials

In order to determine the optimal spacing regimes for plantation grown whitewood, a trial was established in 1995 at Lorum-Loro plantation, northeastern Espiritu Santo. Gross plots were 10 rows x 10 trees, with net internal measure plots 8 rows x 6 trees. There are 12 spacing treatments, 4 between-row spacing intervals (4, 6, 8 and 10 m), with 3 within-row or between-tree spacing intervals (2, 4 and 6 m), which are replicated across two sites at Lorum-Loro.

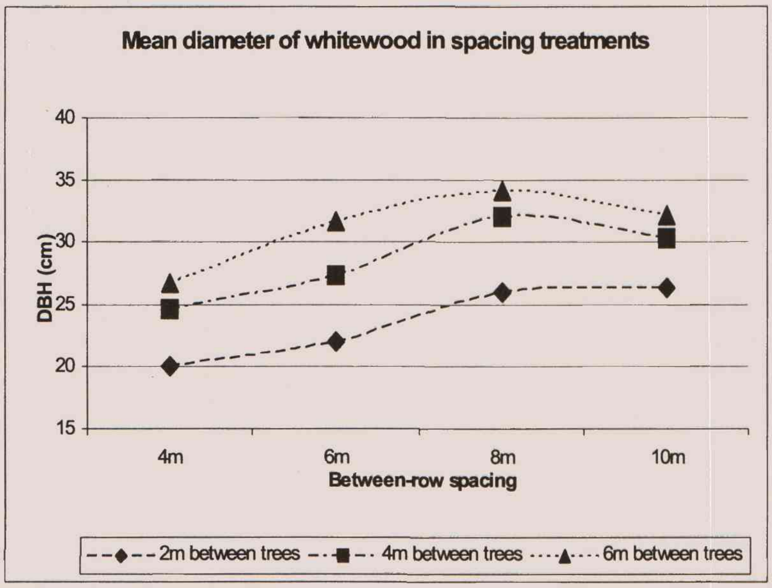
Results

The survival rate is generally good across all treatments, with a range from 63% to 94% of all trees alive. Location appears to be a determining factor, as we observed a significant difference between replicates for the same spacing. Although the site has not experienced a devastating cyclone in the past 9 years, there have been a few occurrences of strong gales across the sites (including cyclone Zuman which passed 25 km north in April 1998, Cyclone Sose in April 2001 and Cyclone Paula in March 2001). No detailed information can be collected on the relationship between spacing and wind resistance.

An assessment at 9 years observed significant difference between spacing (see Table 1).

Table 1: Mean of DBH and height on spacing treatment established with whitewood at Lorum-Loro plantation, Espiritu Santo

	Spacing between rows							
Spacing between trees	4m		6m		8m		10m	
	DBH(cm)	Height(m)	DBH(cm)	Height(m)	DBH(cm)	Height(m)	DBH(cm)	Height(m)
2m	20.0	14.6	22.0	15.4	26.0	15.4	26.3	14.8
4m	24.6	15.5	27.3	15.3	32.0	15.5	30.3	13.6
6m	26.7	15.4	31.6	14.6	34.1	14.6	32.1	13.0



Graph 1: Mean diameters at breast height at age 9 for whitewood trees grown under various spacing treatments.

Height and stem diameter

The trend for stem diameter at breast height (DBH) is that as between-tree spacing interval increases so does the mean diameter, with the largest mean diameters in the wider 6-m between-tree spacing interval and the smallest in the 2-m between-tree spacing interval (Graph 1).

This was not the case with mean heights (Graph 2). The tallest trees in the entire experiment were in the intermediate 4-m between-tree spacing interval (mean height 15.5 m), although the mean height for the 6-m between-tree spacing interval was not much shorter (15.4 m).

Volumes

Using volume equations developed for whitewood (Ioan Viji MSc thesis), underbark volume estimates (based on overbark measurements) show that mean tree volume increases as distance between trees increases and reaches a peak at the 8-m between-row interval, after which mean tree volume begins to decrease (Graph 3).

Discussion and conclusion

The largest stem diameters occurred in the between-row spacing of 6, 8 and 10 metres with 6 metres between-tree spacing. All of these treatments producing diameter means well above 30 cm DBH. The spacing of 8 m x 4 m also grew trees over 30 cm DBH (Graph 1).

For the between-row interval of 6 m we obtained an increase of 44% with increased between-tree spacing, from 22 cm DBH for 6 m x 2 m to 31.6 cm DBH for 6 m x 6 m spacing. For other between-row intervals the increases ranged from 25% to 31%.

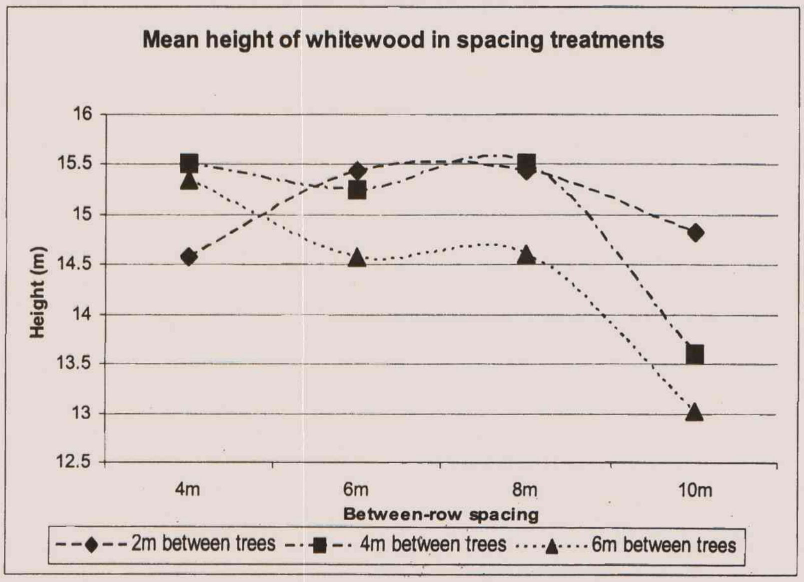
The tallest trees (15.5 m) were found at spacings 4 m x 4 m and 8 m x 4m, closely followed by trees grown at 6 m x 2 m and 8 m x 2 m (both 15.4 m). The shortest trees were found at the widest spacing 10 m x 6 m (13.0 m).

The plotted individual tree volumes shown in Graph 3 clearly indicate all of the tree spacings at **8 m between rows** produced the best volumes irrespective of distance between trees. However, this is also true for **6 m between trees,** which produced the best volumes irrespective of distance between rows.

Why plant at a closer spacing when the widely spaced trees are growing as well? Closer spacing between trees assists with vine control when the trees are small. It also gives an opportunity to remove poorly performing individuals when it comes time to thin.

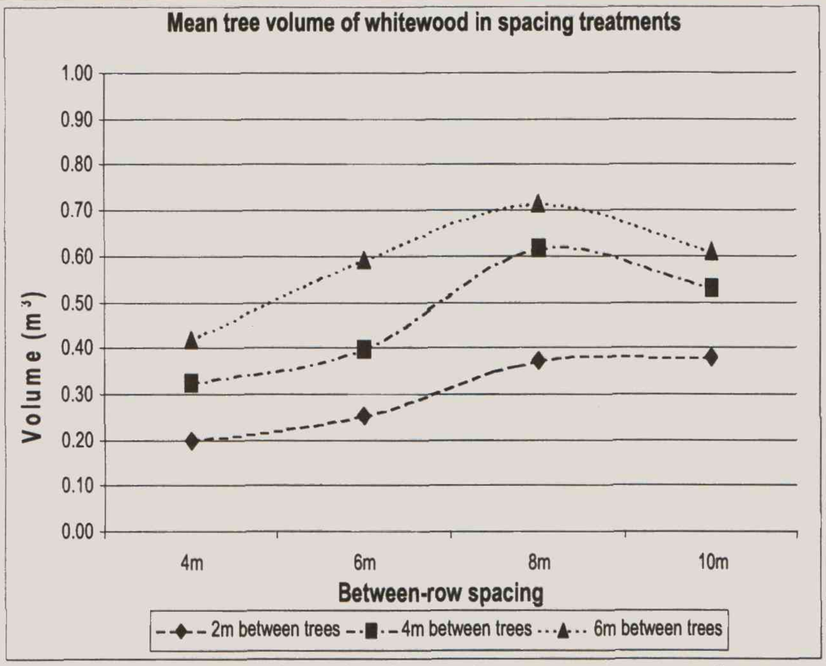
At 9 years the closer spacing treatments produce trees 20% taller than in the widest spacing. The competition for light is possibly the main determining factor in the growth rates observed.

Graph 2: Mean heights for whitewood trees at age 9 grown under various spacing treatments.



However, a limit is reached for the closest spacing, where growth is possibly hindered by roots interaction. We also observed in this case a larger dispersion of height (15.6%), due to a number of trees having been prematurely shadowed and dwarfed by their neighbours. Although closer spaced trees produce lower individual tree volumes, the numbers of stems per hectare mean that stand volumes are higher. Graph 4 shows individual tree volumes plotted against stand volumes. To produce the largest trees with maximum volume per hectare, the optimal spacing appears to be 8 m x 4 m (312 stems/ha).

The results from this trial indicate that a final spacing of around 6 m x 6 m (278 stems/ha) or 8 m x 4 m (312 stems/ha) would be optimal. To obtain these final stockings, an initial spacing of 6 m x 3 m or 8 m x 2 m should be used. This would give the grower the option to thin any unsuitable stems. The choice between 6-m or 8-m between-row spacing will depend on harvesting equipment used: the 8-m spacing is more adapted to heavy machinery utilised by large logging companies while a 6-m spacing will accommodate portable sawmill operations.

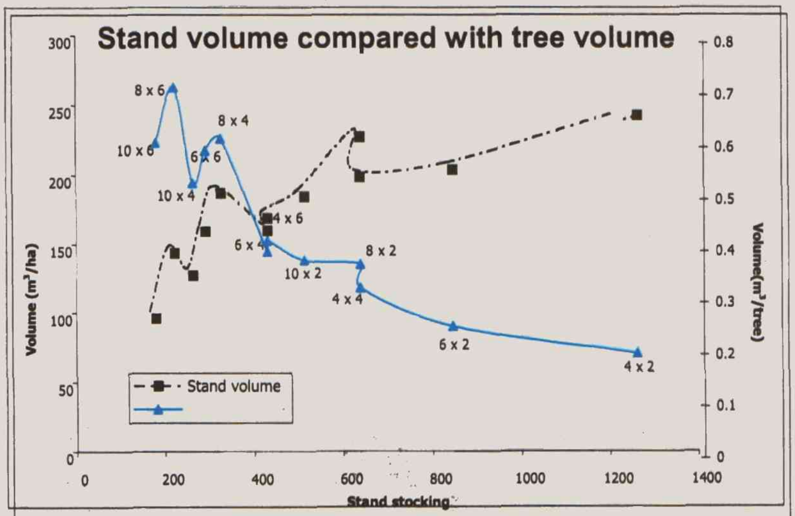


Graph 3: Individual tree volumes for whitewood trees at age 9 grown under various spacing treatments.

Acknowledgements

Thanks to Mr Neil Croucher, Managing Director of Melcoffee Sawmill Ltd, for initiating Loro Whitewood Trials and allowing us to access and collect data. Recognition is given to Mr Steven Walker and Russell Haines of Queensland Department of Primary Industry Forestry, who set up the trials and conducted a feasibility study on whitewood plantation. Thanks to Forestry Officers Atchinson Smith and Tarere Garae for assisting us in collecting data.

Graph 4: Individual tree volumes plotted against stand volumes. An optimal spacing to produce largest trees with maximum volume per hectare is 8 m x 4 m or 6 m x 6 m. Note that spacing labels for stand volume correspond with the spacing labels for tree volumes.



References

Haines, R.J. and Walker, S.M. 1995. Whitewood tree improvement and silviculture. Consultancy project for Melcoffee Sawmill Ltd., Vanuatu. Queensland Forest Research Institute, Gympie, Queensland – Melcoffee Plantation Project Technical Report No. 1 (June 1995).

Thomson, L.A.J. 1998. *Endospermum medullosum* L.S. Smith: notes on taxonomy and nomenclature. Pacific Islands Forest and Trees Newsletter 2/98.

Viji, I. 2004. Inheritance studies on Whitewood (*Endospermum medullosum* L.S. Smith) characteristics of economic importance in Vanuatu. University of the South Pacific Masters Thesis (in review).

Submitted by:

Rufino Pineda[1], Rodney Aru[2] and Ken Robson[3]

[1] Learn Project Manager, Department of Forestry, PMB 004 Luganville, Santo, Vanuatu

[2] Forest Manager, Melcoffee Sawmill, PO Box 224 Luganville, Santo Vanuatu

[3] Principal Technical Officer, Horticulture and Forestry Sciences, Department of Primary Industries and Fisheries, Walkamin, Queensland, Australia