

PACIFIC SOUTHWEST Forest and Range Experiment Station

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P.O. BOX 245, BERKELEY, CALIFORNIA 94701

A SPACING TRIAL IN AUSTRALIAN TOON...

an interim report

Herbert L. Wick

Robert E. Burgan

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At what spacing should Australian toon (*Toona australis*) be planted? A recent survey of young Australian toon plantations in the Waiakea-Olaa reforestation area, island of Hawaii, showed that much of the area planted at a 10- by 10-foot spacing is now not adequately stocked. Would a closer spacing have resulted in more acceptable and desirable trees per acre?

In 1961, when the first Australian toons were planted in the Waiakea-Olaa reforestation area, a spacing study was started to help answer this question.¹ The objective of the study was to determine the optimum spacing interval to plant Australian toon with sawtimber as the intended crop.

Measurements of the study plots in 1969 suggest that . . .

- Spacing had not affected diameter or height growth, or survival of 8-year-old trees.
- Basal area per acre decreased as spacing increased.
- The number of acceptable and desirable trees *per acre* decreased as spacing increased, but individual tree quality was not affected.

THE STUDY

The study was set up on typical aa rockland that had been cleared by bulldozer of the native ohia rain-forest type. Areas of compacted aa, from tree-fern harvesting skidroads, are common to much of the land in the Waiakea-Olaa reforestation area and were found in the site.

The study site is typical of the land on which more than 6,000 acres of Australian toon has been planted since the early 1960's. An annual planting program of some 2,000 acres is planned for this land.

The spacing trial was installed in a Latin-square design with four replications of four spacing intervals:

ABSTRACT: Australian toon (*Toona australis*) was planted at four spacing intervals—6, 8, 10, and 12 feet—in a trial on the island of Hawaii. Measurement of 8-year-old trees showed that spacing interval did not affect diameter or height growth or survival; but basal area per acre decreased as spacing increased. A goal of 400 acceptable and desirable pole-sized trees per acre can be reached by using good planting technique and an initial spacing of slightly less than 9 by 9 feet, and by weeding the first year.

OXFORD: 176.1 *Toona australis*:(969):232.11.

RETRIEVAL TERMS: *Toona australis*; species trials; planting density; Hawaii.

6, 8, 10, and 12 feet. Twenty-five trees were planted in each spacing replication, with a buffer of at least two rows of trees between it and the next spacing. The trees used in the trial were smaller and less vigorous than normal.¹

The plots were cleaned in May 1962–9 months after establishment—to release the trees from competing vegetation, primarily liliko'i (*Passiflora edulis*). No further cleanings were performed. In January 1962, 14 trees of the same age were selected from adjacent planting units to replace dead trees in the plots. Two months later, two additional trees were replaced. After the first year, dead trees were not replaced.

In July 1966, the plots were measured for growth. In October 1969, they were measured for growth, including d.b.h. and height; and for tree quality, including cull factors, clear panel, log length, sweep or crook, defects, crown class, and vigor.

The data from the plot measurements were analyzed by an analysis of variance for Latin-square sample design.

In the first year, the following replanting was needed to assure 100 percent stocking of the 16 plots (each with 25 trees) at the end of the year; 6-foot plots—three trees; 8-foot plots—five trees; 10-foot plots—seven trees; and 12-foot plots—one tree.

Planting spacing per se, did not affect diameter or height growth, but did affect basal area per acre. Basal area decreased as spacing interval increased, from a high of 158 square feet per acre on 6- by 6-foot spacing to a low of 45 on the 12- by 12-foot spacing (*table 1*).

Tree quality did not differ significantly among trial spacings, but when expanded to a per acre basis, the effect of spacing on tree quality did become significant. There were 411 trees per acre rated

Table 1 — Average diameter, height, and basal area of Australian toon plantings by four spacing intervals, at 5 years and 8 years, Waiakea-Olaa reforestation area, island of Hawaii

Spacing (feet)	Average diameter		Average height		Average basal area
	Age 5	Age 8	Age 5	Age 8	Age 8
	— Inch —		— Feet —		Sq. ft./acre
6	3.0	4.5	24	36	158
8	2.6	3.9	18	26	67
10	3.0	5.2	20	34	77
12	2.5	4.7	17	30	45

desirable in the 6-foot spacing; 82 in the 8-foot spacing; 78 in the 10-foot spacing; and only 36 per acre in the 12-foot spacing (*table 2*; *fig. 1*).

We defined tree quality classes as follows . . .

- *Desirable tree*: growing stock tree of commercial species with no serious defects or serious pathogens, and of good vigor; must have now or potentially a sawlog length of more than 32 feet; less than 4 inches of sweep or crook in the 16-foot butt; no scale-reducing seams, rots, or cracks; and a clear panel at least 8-feet long in the poorest of the best three faces in the butt log.

- *Acceptable tree*: growing stock tree that does not meet the specifications for a desirable tree, but has now or potentially a butt sawlog length of at least 12 feet and is not culled because of forking, sweep, crook, or some other cull factor.

- *Cull*: tree with one or more characteristics that prevent it from being classified as desirable or acceptable, such as lodged or arched over; stem lean of more than 8 degrees; forked below 12 feet; heavy branching below 12 feet, thereby having the effect of forking or excessive taper; overtopped and of low vigor.

Table 2 — Number of trees by spacing and quality class in 8-year-old Australian toon spacing trials, Waiakea-Olaa reforestation area, island of Hawaii

Quality class ¹	Trees per plot ¹ at spacing (feet) of . . .				Trees per acre at spacing (feet) of . . .			
	6	8	10	12	6	8	10	12
	Number							
Desirable	8.50	3.00	4.50	3.00	411	82	78	36
Acceptable	12.25	14.25	15.25	14.50	593	388	266	176
Total	20.75	17.25	19.75	17.50	1,004	470	344	212
Cull	3.50	6.25	4.25	5.75	169	170	74	70
Total	24.25	23.50	24.00	23.25	1,173	640	418	282

¹Average of four plots — each initially had 25 trees.



Figure 1—*Eight-year-old Australian toon plantation at 6- by 6-foot spacing.*

Early inspections showed that trees on the skid-road areas were less vigorous than trees elsewhere. It was thought that the lag in growth would be overcome rapidly when the tree roots reached beyond the zone of the compacted aa.¹ Eight years after planting, however, trees on the skidroad areas were found to have a significantly slower growth rate, lower quality, and lower survival rate than the other trees—regardless of initial spacing.

RECOMMENDATIONS

In this spacing trial, with careful planting, weeding, and replanting to assure 100 percent stocking at the end of the first year, the survival rate 7 years later

was 95 percent. Of all trees planted, 72 percent grew to be acceptable or desirable. Similar techniques should yield the same kind of results in administrative plantings. If the stocking goal for pole stands is 400 desirable and acceptable trees per acre, for example, it should be attainable by planting 560 trees per acre at slightly closer than 9- by 9-foot spacing.

NOTES

¹Pickford, G. D. *Establishment report for Australian toon spacing study in the Waiakea Forest Reserve*. 1962. (Unpublished rep. on file at Pacific SW. Forest & Range Exp. Sta., Honolulu, Hawaii.)

The Authors

HERBERT L. WICK was formerly on the staff of the Station's Institute of Pacific Islands Forestry, headquartered in Honolulu, Hawaii. He is now supervisory forester, Burns Ranger District, Malheur National Forest, Oregon. ROBERT E. BURGAN joined the research staff of the Station's Institute of Pacific Islands Forestry, Honolulu, Hawaii, in 1969. He received bachelor's (1963) and master's (1966) degrees in forestry at the University of Montana.

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