Seven-year performance of eucalyptus species in Napa County

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Eucalyptus was promoted in the early 1900s as the "miracle tree" that would solve wood fiber supply problems in California. Early plantings were intended to be a primary source of lumber, railroad ties, and mining timbers. People began to sour on the purported "miracle tree" when it became evident that eucalyptus grown in California is subject to excessive shrinkage and warping that prevent it from being used as planned.

The energy crisis of the mid-1970s brought renewed interest in eucalyptus in California, mostly from people hoping to reduce their heating bills with wood energy. In this use, eucalyptus excels. Its heating value rivals or surpasses that of California native hardwood species, and it grows considerably faster. In addition, eucalyptus is being accepted as a raw material for paper, especially high-quality printing and photocopier papers.

A common problem in early eucalyptus plantings was the lack of information, and the wealth of misinformation, about which species to plant, field spacing, crop management practices, and expected yield.

In April 1979, a test planting was established in Napa County to obtain data for predicting yields of eucalyptus under intensive management. At the time, most yield data available pertained to *Eucalyptus globulus* (blue gum), the species most commonly planted in California. Other species and selected individuals of certain species showed promise for increased frost tolerance, greater growth rates, and more desirable wood properties for use as fuel and paper pulp.

Eucalyptus camaldulensis (river red gum) and *E. dalrympleana* (mountain gum) were selected for the Napa trials from the best available seed source. Both species are relatively frost tolerant, have a rapid growth rate, and can survive in the wide range of soil and rainfall conditions found in California.

This article summarizes the final results of that seven-year study with *E. camaldulensis* and *E. dalrympleana*. Intermediate results were reported in *California Agriculture* in May-June 1982 and March-April 1984.

Methods

Eucalyptus seedlings of the two species were planted in April 1979 near Calistoga, at the northern end of the Napa Valley. The seedlings were planted on a 5- by 5-foot spacing at a density of 1,742 stems per acre. They were grown in a clay loam soil and were sprinkler-irrigated throughout the seven-year trial to prevent moisture stress. For the first three years, chemical weed control (Surflan [oryzalin] at 3 pounds active ingredient per acre) was applied annually. The trees were fertilized with 200 pounds of actual nitrogen per acre per year.

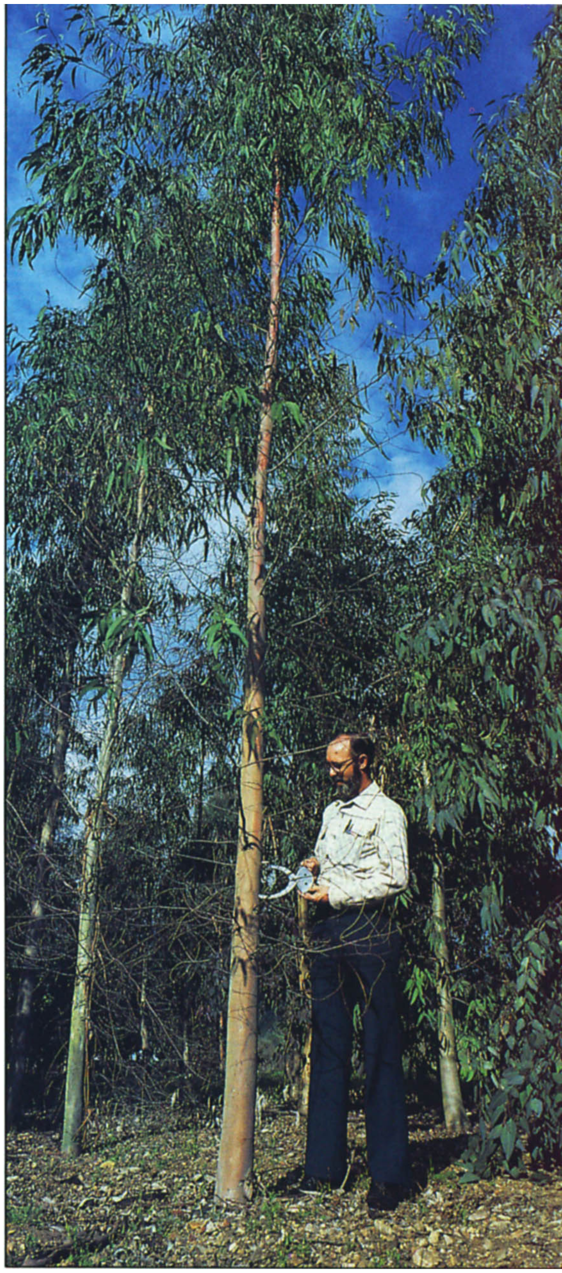
All surviving trees were measured every two years from planting and again at the final harvest in July 1986. Diameter at breast height (a point 4.5 feet above the ground) and total height were measured. Diameter was also measured along the stem in the second year and at harvest to calculate stem taper and volume. Measured trees were selected from interior blocks of the test plots to avoid an edge effect.

Ten percent of the harvested trees were selected at random for additional measurements. Stem taper fresh weights with and without branches and wood samples were recorded. Wood disk samples of the stem were taken at 2, 25, and 40 feet for wood moisture content and specific gravity determination. Using these data, we developed tree volume and weight equations and used them to calculate yields per acre .

TABLE 1. Tree characteristics at various ages

Age	Avg. DBH	CV*	Avg. height†	CV
months	*inches*	*%*	*feet*	*%*
Eucalyptus camaldulensis:				
27	1.82	47	16.49	30
51	3.30	41	32.06	30
75	4.24	47	44.93	34
86	4.56	45	44.63	39
E. dalrympleana:				
27	1.33	45	11.93	30
51	2.72	54	24.99	41
75	3.60	58	34.39	48
86	3.70	62	36.94	50

* CV = coefficient of variation = standard deviation/mean.
† The slight reduction in average height of *E. camaldulensis* is due to measurement error.



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One eucalyptus species, grown under intensive management in the Napa Valley, in 7 years produced an average of 10 cords of usable wood per acre per year. Author Dean Donaldson measured the DBH (diameter at breast height) halfway through the project.

Results

Of the surviving trees, *E. camaldulensis* showed significantly greater growth than *E. dalrympleana* (table 1). At 75 months, the standing trees were measured with a clinometer. At 86 months, the harvested trees were measured with a steel tape along the stem. The trees gained little height overall between the two periods.

Eucalyptus camaldulensis also had greater survival and larger yields per acre than *E. dalrympleana* (table 2). All mortality occurred within the first two years.

The growth rate for the *E. camaldulensis* trees, calculated as the average amount of wood produced per acre per year, appeared to level off near 850 cubic feet. This

Clones of 20 trees showing superior growth characteristics during the Napa trials have been planted at Davis for evaluation.

TABLE 2. Stand characteristics at various ages

Age	Survival	Volume	MAI*	CV†	Dry weight‡	CV
months	%	.... *cu ft/ac/yr*	....	%	*tons/ac*	%
E. camaldulensis:						
27	88	223.74	99.44	53	5.02	43
51	88	1973.63	464.38	44	30.15	36
75	88	5316.81	850.69	24	78.71	26
86	88	5883.21	820.91	23	87.59	24
E. dalrympleana:						
27	65	95.48	42.44	11	.99	14
51	65	852.73	200.64	16	10.96	18
75	65	2379.03	380.64	33	30.65	33
86	65	3103.21	433.01	31	40.38	32

* Mean Annual Increment = average annual growth.
† CV for volume and MAI are equal.
‡ Calculated from weight data from harvested trees (86 months). Predicted dry weights for younger trees (27-75 months) are probably overestimated because younger trees have a higher proportion of less dense, juvenile wood.

represents about 10 cords of usable wood per acre per year. At harvest, the growth rate of *E. dalrympleana* was still increasing, and this species was producing around 6 cords per acre per year. Its lower growth rate compared with that of *E. camaldulensis* was due in part to poor seedling survival.

The high coefficient of variation for both species illustrates the extreme variability in seedling plantations. As a further indication of this variability, 25 percent of the yield was contained in only 10 percent of the trees.

Tree taper measurements were used to develop volume equations after 27 months and 86 months. Tree weight measurements collected at 86 months were used to develop weight equations. Our results indicate that merchantable volume can be accurately predicted from diameter and total height — characteristics easily measured in the field.

In the early growth stages, the two species produced very little volume while they developed root systems and foliage (fig. 1). Trees then entered a period of rapid growth, when most of the merchantable volume was produced. Finally, they reached a plateau, where growth increased at a slower rate. From an economic standpoint, harvest should occur at the point where growth just begins to level off. At harvest, *E. camaldulensis* had just passed this point; *E. dalrympleana* had not yet reached it (fig. 1).

TABLE 3. Moisture content and specific gravity

Species	Moisture*	Specific gravity† Wood	Bark
E. camaldulensis	53.1	.57	.52
No. obser.	24	29	27
CV (%)	3	5	13
E. dalrympleana	57.6	.50	.40
No. obser.	45	48	48
CV (%)	4	9	8

* Moisture content wood and bark (% green weight).
† Calculated on a green volume-oven dry weight basis.

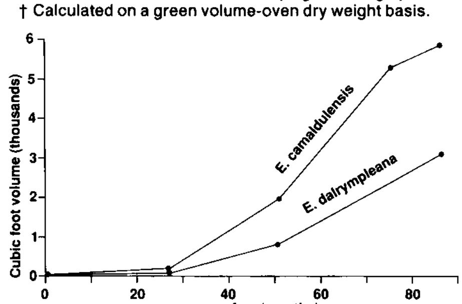

Fig. 1. The two species produced little volume for the first two years, then began to grow rapidly, but at different rates.

Wood density analyses showed uniform specific gravity for trees of a particular age regardless of diameter (table 3). *Eucalyptus dalrympleana* had a higher moisture content and lower specific gravity than *E. camaldulensis*. The specific gravity for both species in this trial was lower than that reported in Australia, but this may be explained by the youth of the trees in the Napa study. Younger trees have a higher proportion of less dense, juvenile wood relative to total volume than do older, mature trees.

At harvest, foliage, branches, and unmerchantable above-ground material represented only 16 percent of the fresh weight of *E. camaldulensis* and 15 percent of *E. dalrympleana*. In native oaks of about the same diameter and height, 25 to 30 percent of the fresh weight is unmerchantable material.

Conclusions

Eucalyptus camaldulensis and *E. dalrympleana* grown under intensive management produce a merchantable volume of fuelwood or pulpwood on a relatively short rotation. In seven years, the average production was 10 cords per acre per year for *E. camaldulensis* and 6 cords per acre per year for *E. dalrympleana* in the Napa Valley.

The wood specific gravity values reported here are comparable to those of native hardwoods commonly used for firewood. Because of the high moisture content at harvest, it may be advisable to field-dry the wood to reduce shipping costs.

Eucalyptus dalrympleana is somewhat more difficult to establish than *E. camaldulensis*, but it is more frost tolerant. The tolerated minimum temperature reported for *E. camaldulensis* is about 20°F, while *E. dalrympleana* may tolerate temperatures as low as 10°F.

The high variability in this planting indicates that selection of the best trees could lead to more uniform stands with higher volumes, desirable wood properties, and improved form. Superior growth characteristics were identified in 20 trees (about 5 percent) at the time of harvest. Sprouts from these selected trees have been cloned and will be tested in future trials.

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