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DIRECT SEEDING of lemon-gum eucalyptus, redwood, and brushbox in Hawaii

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ABSTRACT: Direct seeding has economic and silvicultural advantages over planted seedlings. To see if three selected timber species could be direct-seeded, trials were held at Kulani Camp, island of Hawaii. After 1 year, lemon-gum eucalyptus had fair stocking and height growth, but redwood and brushbox had not progressed satisfactorily. Mulch had no real effect on either stocking or height growth of any species.

OXFORD: 232.33:(969)[+ 176.1 *Eucalyptus citriodora* + 174.7 *Sequoia sempervirens* + 176.1 *Tristania conferta*].
RETRIEVAL TERMS: Hawaii; artificial stand establishment; direct seeding; *Eucalyptus citriodora; Sequoia sempervirens; Tristania conferta.*

Direct seeding may be a practical method of establishing forests in Hawaii. The method has silvicultural and economic advantage over planted seedlings. Seedlings that grow in place generally have better developed and distributed root systems than planted stock. And a successful direct seeding usually produces more seedlings per acre, allowing for greater natural selection and pruning. When successful, direct seeding should also be cheaper than planting. Before large-scale seedings can be made, species adaptability to specific sites and the limiting factors present must be determined.

Three timber species–lemon-gum eucalyptus *(Eucalyptus citriodora* Hook.*)*, redwood *(Sequoia sempervirens* Endl.*)*, and brushbox *(Tristania conferta* Br.*)*–were direct seeded in experimental plots at the Kulani Camp on the island of Hawaii in 1968. This was a first look at the feasibility of direct seeding these species on this site and the effects of a mulch on success. If a species shows some success (at least 60 percent stocking and early height growth), additional tests to determine if species performance can be improved by adding fertilizers and other mulches are in order. So far only lemon-gum eucalyptus shows any promise.

STUDY SITE

The study site is on the east slope of Mauna Loa at an elevation of 4,900 feet *(fig. 1)*. The site is nearly level. The soil, Kahaluu extremely rocky muck, is about 10 inches deep over pahoehoe lava. It dries out quickly during the short (5 to 7 days) but frequent dry periods that occur. Rainfall averages about 95 inches annually. During the 1-year study period which began January 19, 1968, 96.7 inches of rain fell. The mean annual temperature is 56.5°F. September is the warmest month, with daily highs averaging 69.4°F.; January is the coolest month, with daily lows averaging 43.1°F.

Figure 1—*Three timber species were direct-seeded in trials at Kulani Camp on the island of Hawaii.*

METHODS

The native ohia *(Metrosideros collina* [Forst.] Gray*)* -treefern *(cibotium* sp.*)* forest was removed by bulldozers. Five blocks, each with six rows, were laid out. Each row contained 10 seed spots. Seeds of each test species were sown in prepared spots in two adjacent rows in each block. After seeds were sown, one of the two rows was mulched with about ¼-inch layer of bagasse (sugarcane extraction residue). Seed spots averaged about 15 inches in diameter. The number of seeds sown per spot was based on germination tests. Enough seed was used so that at least five viable seeds were sown in each spot. Seeds were covered with a thin layer of soil. All seed spots were kept free of overtopping weeds.

The seed spots were examined for seedlings every 2 weeks for the first 2 months, then monthly thereafter. A seed spot was considered stocked if it held at least one seedling. Height of the tallest seedling in each spot was measured to the nearest inch during the final examination.

RESULTS AND DISCUSSION

Lemon-Gum Eucalyptus

Stocking.—The first lemon-gum eucalyptus seed germinated in both the mulched and unmulched spots after 4 weeks. Maximum stocking of 64 percent for the unmulched spots occurred 2 months after sowing. Maximum stocking for the mulched spots was also 64 percent, but did not occur until 2 months later. While conserving moisture in the soil the mulch also probably lowered the temperature of the soil underneath it. This condition could explain the slower germination in the mulched spots. After 1 year, stocking in the unmulched spots declined to 50 percent and in the mulched spots to 62 percent *(table 1).* Short dry periods apparently were responsible for higher mortality of seedlings in the unmulched spots. There was a large variation in the number of stocked spots per row in both the mulched and unmulched rows, so the stocking difference was not statistically significant.

Table 1 —*Stocking and seedling heights after 1 year in direct seeded plots of lemon-gum eucalyptus, brushbox, and redwood, by treatment*

Tree species	Treatment	Stocked spots	Seedlings per stocked spot range	Height	
				Average	Range
		Percent	*No.*	*— Inch —*	
Lemon-gum eucalyptus	mulch	62	1 - 5	22	2 - 53
	no mulch	50	1 - 4	20	1 - 55
Redwood	mulch	38	1 - 4	5	2 - 12
	no mulch	16	1 - 1	6	2 - 19
Brushbox	mulch	0	–	–	–
	no mulch	4	1 - 2	1	1 - 1

Height growth.–Seedlings in the mulched spots grew, on the average, 22 inches in a year; those in the unmulched spots grew 20 inches. There was no significant difference between treatments.

Lemon-gum eucalyptus appears to be a fair prospect for direct seeding on this and similar sites. Stocking on mulched spots was acceptable, and seedlings made adequate height growth *(fig. 2)*.

Redwood

Stocking.–The redwood seeds first germinated after 4 weeks in both the mulched and unmulched spots. Maximum stocking of 24 percent in the unmulched spots was recorded at that time. Maximum stocking of 56 percent in the mulched spots was recorded after 6 weeks. Thereafter stocking in both the mulched and unmulched spots gradually decreased. This decline appeared to be caused by short dry periods, as no evidence of bird, animal, or insect damage was observed. Stocking after 1 year was 38 percent in the mulched spots and 16 percent in the unmulched spots–a statistically significant difference (5 percent level) *(table 1)*.

Height growth.–Redwood seedlings grew only slightly in the year, averaging 5 inches in the mulched spots and 6 inches in the unmulched spots.

The poor stocking and the slow growth probably makes it impractical to establish redwood forests on this and similar sites by direct seeding. Mulching increased stocking significantly, but not practically, because stocking was still far below the minimum for acceptable stocking.

Brushbox

Stocking.–The first brushbox seed germinated in the mulched and unmulched spots 9 months after being sown. Maximum stocking was also recorded at that time in both the mulched and unmulched spots. Stocking in the mulched spots declined from the maximum of 4 to 0 percent by the end of the year, and stocking in the unmulched spots declined from 8 to 4 percent *(table 1)*.

Figure 2–*After 1 year, this lemon-gum eucalyptus growing in a mulched seed spot, was 53 inches tall.*

Height growth.–Only two seedlings were alive at the end of the study period and both were only about 1 inch tall.

Poor stocking and height growth indicate that brushbox forests must be established on this site by methods other than direct seeding. Mulching had no effect.

The Author

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