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EVALUATING *EUCALYPTUS UROPHYLLA* PROVENANCES FOR SHORT ROTATION FORESTRY

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SUMMARY

Sugarcane production has ceased on the island of Hawaii and eucalyptus plantings are proposed to replace much of the former cane land. Eucalyptus species have high biomass yield potential and are widely planted in tropical and subtropical locations for the production of timber, paper pulp, and charcoal. Other proposed uses for eucalyptus fiber are medium density fiber board, oriented strand board, and laminated board. There are about 500 species of eucalyptus of which 100 of these were introduced to Hawaii for evaluation and for use in watershed conservation programs. Eucalyptus species identified as having high yield potential in Hawaii are *E. grandis*, *E. saligna*, *and E. urophylla.*

This test demonstrated the potential for the improvement of *E. urophylla* by the introduction of provenances from the native range of the species and by the selection of elite individual trees within the provenance in field trials. The gain in yield is captured through vegetative propagation of the selected trees.

INTRODUCTION

Eucalyptus urophylla was identified in Hawaii Agriculture Research Center (HARC) trials as having high yield potential, making it a candidate for short rotation forestry in Hawaii. *E. urophylla* growth and yield compared favorably with the previously established Hawaii standards, *E. grandis and E. saligna*, for biomass. *E. urophylla* produced an annual dry matter increment of 11.6 t/a (28.7 mt/ha) in two replicated trials on Hawaii (Osgood and Dudley, 1993). Several elite *E. urophylla* trees were selected from the trials and one of these, designated URO4, was vegetatively increased and is currently being evaluated in a field trial at Pepeekeo, Hawaii.

Owing to the promising initial results in Hawaii with *E. urophylla*, several provenances (regionally collected seed from the native range of the species) of *E. urophylla* were introduced from Indonesia. The seed was provided by the Australian Tree Seed Centre in Brisbane and was planted at Pepeekeo in 1990. This procedure increases the probability of the selection of a seed source better adapted to specific sites and provides the opportunity for the selection of individual elite trees within the provenance. The objectives were to measure the variation in growth between *E. urophylla* provenances, to select elite individuals within the best provenances, and to propagate the elite individuals for field evaluation as clones.

PEPEEKO SITE CONDITIONS

Elevation:	1000 feet
Annual rainfall	200 inches (Avg.)
Soil type	Kaiwiki silty clay loam (Hydrandepts)
Soil pH:	4.9 to 5.1

MATERIALS AND METHODS

Provenances of *E. urophylla*, several additional eucalyptus species and interspecific hybrids of *E. grandis* by *E. urophylla* were obtained as seed from the Australian Tree Seed Centre, the Queensland Department of Forestry and the Hawaii Division of Forestry and Wildlife (Table 1). Seed was sown at the BioEnergy Development Co. greenhouse at Wainaku and the trees were field planted in 1990 at Pepeekeo. A completely randomized design was used with four trees transplanted per plot in a single row. Each provenance was replicated four times. Diameter and height of individual trees were measured periodically for four years; then, selected elite trees within the plots were felled and weighed. Juvenile stem regrowth from the elite trees was collected and placed in sterile culture for micropropagation.

RESULTS

Significant differences for stem diameter and height were found between provenances of *E. urophylla*, the interspecific hybrids and other species of eucalyptus (Tables 2 and 3). Weights of the individual selected trees at four years from planting ranged from 96 kg/tree to 170 kg/tree. The volumes of the selected trees varied from about 2 to 8 times the average volume of the provenance (Table 4).

CONCLUSIONS AND DISCUSSION

The test demonstrated a high degree of variability among provenances of *E. urophylla* and demonstrated the opportunity for the selection of elite trees within the provenance. Thus, there is considerable opportunity for improvement of eucalyptus yield through the selection of the best adapted provenance of a species for a specific planting site, and by selecting elite trees for vegetative propagation within a given provenance. Further gains in yield potential and wood quality can be made by crossing elite trees both within and between species, then selecting elite progeny. Genetic gain can be captured by vegetative propagation following the model used for sugarcane and other vegetatively propagated crops. Additional gain in yield, disease and insect resistance, and wood quality could be accomplished by the introduction of additional species and provenances and initiation of a well designed breeding program.

REFERENCES

Osgood, R. V. and N. S. Dudley (1993). Comparative study of biomass yields for tree and grass crops grown for conversion to energy. State of Hawaii contracts 18817, 20033, 22823, 27626, and 32116. Final Report to State of Hawaii Department of Business Economic Development and Tourism.

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Table 1. Eucalyptus Provenance and Species Description and Origin

HARC No.	CSIRO No.	Selected Tree No.	Species	Seed Origin
1	14534	U2	*E. urophylla*	Mt. Egon, Indonesia
2	14534	U42	*E. urophylla*	Mt. Egon, Indonesia
3	14534	U41	*E. urophylla*	Mt. Egon, Indonesia
4	12895	U47	*E. urophylla*	Mt. Mandiri, Indon.
5	14533	U41	*E. alba*	Mt. Lewotobi, Indon.
6	14534	U2	*E. urophylla*	Mt. Egon, Indonesia
7	14534	U52	*E. urophylla*	Mt. Egon, Indonesia
8	14534	U77	*E. urophylla*	Mt. Egon, Indonesia
9	None	T. C.	*E. camaldulensis*	Bangkok, Thailand
10	None	AGxU	*E. grandis* x	
			E. urophylla	Aracruz, Brazil
11	None	Tree 2	*E. grandis* x	
		A2277	*E. urophylla*	Aracruz, Brazil
12	14534	U18	*E. urophylla*	Mt. Egon, Indonesia.
13	14534	U44	*E. urophylla*	Mt. Egon, Indonesia.
14	14534	U45	*E. urophylla*	Mt. Egon, Indonesia
15	12895	U31	*E. urophylla*	Mt. Mandiri, Indon.
16	14534	U48	*E. urophylla*	Mt. Egon, Indonesia
17	None	none	*E. microcorys*	Unknown
18	None	Tree 1	*E. grandis* x	Hawaii
		A2277	*E. urophylla*	(Aracruz, Brazil)
19	None	156-2	*E. grandis*	Atherton, Qdl., Aus.

Table 2. Ranked Mean Diameter of Provenances of Eucalyptus at 48 Months after Planting in the Field at Pepeekeo, HI

HARC No.	Eucalyptus Species	Diameter (cm)	Group
13	*urophylla*	15.26	A
10	*urophylla* x *grandis*	15.23	A
19	*grandis*	14.55	AB
14	*urophylla*	14.53	AB
8	*urophylla*	14.05	AB
4	*urophylla*	13.94	AB
15	*urophylla*	12.65	ABC
12	*urophylla*	12.13	BCD
2	*urophylla*	12.05	BCD
3	*urophylla*	12.00	BCD
16	*urophylla*	11.78	BCD
5	*alba*	11.05	CD
11	*urophylla* x *grandis*	10.98	CD
7	*urophylla*	10.94	CD
6	*urophylla*	10.48	CD
1	*urophylla*	9.41	DE
18	*urophylla* x *grandis*	9.27	DE
17	*microcorys*	7.39	E
9	*camaldulensis*	7.24	E

Means with same letter are not significantly different at the 5% level.

Table 3. Ranked Mean Height of Provenances of Eucalyptus at 48 Months.

HARC No.	Eucalyptus	Ht. (m)	Group
10	*urophylla* x *grandis*	18.75	A
13	*urophylla*	16.68	AB
4	*urophylla*	15.93	BC
19	*grandis*	15.85	BC
11	*urophylla* x *grandis*	15.62	BC
14	*urophylla*	15.38	BC
8	*urophylla*	15.15	BC
15	*urophylla*	14.62	BCD
	alba	14.62	BCD
2	*urophylla*	14.10	BCD
12	urophylla	13.79	BCD
7	*urophylla*	13.77	CD
16	*urophylla*	13.31	CD
18	*urophylla* x *grandis*	13.27	CD
1	*urophylla*	12.41	DE
6	*urophylla*	12.25	DE
17	*microcorys*	10.40	E
9	*camaldulensis*	10.39	E

Table 4. Stem Weights for Selected Trees and Selected Tree Volume Relative to Average Tree Volume for the Provenance at Four Years after Planting.

HARC No.	Dry Weight (kg/Stem)	Selected Tree Volume (% of Average for Provenance)
4	80	210
19	96	250
11	116	500
8	121	300
8	127	350
	133	230
7	141	650
7	162	840
10	170	290
12	171	610

Note: Two elite trees were selected for HARC Nos. 7, 8 and 10. Other provenances had only one selected tree or no selected tree. Refer to Table 1 to determine the provenance, species or hybrid designation and origin.