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Methods of Propagation for Some Important Samoan Timber Tree Species

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The US Territory of American Samoa (AS) is part of a volcanic archipelago located approximately 4100 km southwest of Hawaii at 14° S latitude and 170° W longitude. American Samoa consists of one main island, Tutuila, and several smaller islands including Aunu'u, Swain's Island, Rose Atoll and the Manua group of Ta'u, Ofu and Olosega. In total, the Territory is approximately 200 km^2. The climate is warm and wet with a mean temperature of 27°C and annual precipitation varying from 320 cm at sea level to more than 700 cm on Mt. Lata; at 1000 m the highest point in the Territory. Hurricanes are relatively common and have a major influence on vegetation.

The Samoan archipelago is the eastern-most extent in the Pacific of tall rainforest vegetation type, which originates in Southeast Asia. Tree species richness in AS is much lower than on the larger islands of Fiji, the Solomons, and New Caledonia or even the nearby independent state of Samoa due to the small size and isolation of the Territory's islands (Whistler 1994, 2002). Nevertheless, many tall trees, often fine timber species, occur in AS. Two of these are *Pometia pinnata* J.R. Forst & J.G. Forst.[1], the most important timber tree in Samoa, and the leguminous *Intsia bijuga* (Colebr.) O. Kuntze, that produces a heavy, dark, cabinet-quality wood favored for traditional kava bowls (Whistler 2001). Other prominent native timber trees include *Diospyros samoensis* A. Gray, *Syzygium inophylloides* (A. Gray) C. Muell., and *Terminalia richii* A. Gray (Whistler 2002). A recent introduction[2], *Flueggea flexuosa* Muell. Arg. is a fast-growing tree widely planted as boundary markers and harvested for *fale* (a traditional Samoan house) posts (Whistler 2001).

Seed germination percentage and germination rates vary widely among these species. *Diospyros* seed germination was 90% within 2 months when grown in the nursery (Foliga and Blaffart 1995). *Terminalia* trees, on the other hand, produce tens of thousands of seeds but less than 0.1% of them germinate in the field (Foliga and Blaffart 1995). Seeds sown in the nursery did not germinate after 4 months.

Vegetative propagation can be used as an alternative to collecting and germinating seeds. The use of cuttings for propagating *Terminalia* has been investigated in Samoa (Alatimu 1998). Sand as a rooting medium was preferable to either peat moss or peat moss:sand mixtures. In sand medium there was little difference in rooting success among cutting types (soft-tip, semi-hardwood, and hardwood), but rooting success was increased when cuttings were treated with indole butyric acid (IBA) powder.

The objective of this study was to test nursery propagation methods for important native Samoan timber trees. Performance of seed propagation, in terms of germination percentage and rate, was compared to vegetative propagation using cuttings. This work is important to determine the best means to provide adequate planting stock for reforestation of these trees in their native range.

Members of the Land Grant Forestry Program at the American Samoa Community College collected mature seeds and hardwood branch cuttings of *Diospyros*, *Flueggea, Intsia, Pometia, Syzygium*, and *Terminalia* from February to September, 1998 on the island of Tutuila, AS, using Trail (1994) as a guide for season of peak availability. The study was conducted at the greenhouse in Mapusaga, Tutuila, AS.

Seed processing for most of the species

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1. The nomenclature in this study follows Whistler (1994). After initial mention, study tree species will be identified by genus name only.

2. In contrast to a Polynesian introduction, which arrived before 1830 (Whistler 2002).

in this project was quite simple. *Diospyros*, *Intsia, Pometia, Syzygium,* and *Terminalia* seeds were gathered from the ground and planted in the greenhouse. *Flueggea* seeds required more processing due to their small size (Table 1). The fruits were collected from the tree, crushed by hand to remove the fleshy coat, and washed under running water in a sieve. The extracted seeds were placed in the sun to dry for 30 to 60 minutes. The seeds for all species were sown in 52 x 31 x 6 cm plastic germination trays filled with a 2:1 pasteurized top soil:perlite mixture. Seeds were placed just below the soil surface and watered daily.

Propagation by vegetative means was also attempted. Fifty hardwood branch cuttings from each species were collected. Twenty-five of these were treated with IBA rooting hormone prior to planting, while the controls (n=25) were untreated. Cuttings were planted in 2.3 L plastic bags filled with a 2:1 mixture of pasteurized top soil:perlite and allowed to grow with daily watering to keep the cuttings moist.

Data on seed weight, onset of germination, length of germination trial, percent germination, and cutting survival were recorded beginning immediately after planting. Germination rate (*R*), in $\% \cong \text{day}^{-1}$, was computed using the following equation:

$$R = P / (L - O) ,$$

where *P* is percent germination, *L* is the length of the trial and *O* is the onset of germination.

Relationships between seed weight and onset of germination, percent germination, and germination rate (Table 1) were tested using Pearson's correlation with Bonferroni probabilities. The same method was used to test for correlations of onset of germination with percent germination, and with germination rate.

Onset of germination varied widely among species (Table 1). *Pometia* germinated first, starting 7 days after planting. *Diospyros* and *Intsia* germinated at 14 and 15 days, respectively. *Flueggea* and *Syzygium* began germinating 20 and 35 days after planting, respectively. The slowest species, *Terminalia*, required 51 days to start germination.

Among the species tested, *Syzygium* had the highest germination (96%) followed by *Intsia*, (75%), *Pometia* (62%), *Diospyros* (50%), *Flueggea* (39%) and *Terminalia* (7%) (Table 1).

Three species, *Pometia, Diospyros,* and *Syzygium*, had rapid average germination rates, of 7.75, 6.25, and 3.43% $\cong \text{day}^{-1}$, respectively (Table 1). *Flueggea* and *Intsia* responded somewhat less rapidly with germination rates of 0.70 and 1.04% $\cong \text{day}^{-1}$. *Terminalia* germination rate of 0.06 % $\cong \text{day}^{-1}$ was the slowest of all the species tested.

There was no correlation between seed weight and onset of germination, percent germination, or germination rate. Similarly, there was no correlation between onset of germination and percent germination, or germination rate.

Data was not collected on seedling survival after germination. There was, however, sufficient survival that the seedlings were used as part of an old-field reforestation study.

None of the hardwood cuttings survived regardless of treatment. The greenhouse mix may have been too fine or too moist to promote root initiation. *Terminalia* cuttings propagated in Samoa performed best in the coarsest medium with the least water-holding capacity, sand (Alatimu 1998).

Propagation results from this project differed from those in Samoa (Foliga and Blaffart 1995). *Diospyros* and *Pometia* percent germination was lower (50% vs. 90%, and 62% vs. 70%, respectively). Percent germination of *Intsia*, *Syzygium*, and *Terminalia* was higher, (75% vs. 60%, 96% vs. 50%, and 7% vs. 0%, respectively) than in

Samoan nurseries.

Onset of germination was faster for *Intsia*, *Pometia*, and *Terminalia* (15 days vs. 21 days, 7 days vs. 14 days, and 51 days vs. 120 days, respectively) in this project. *Flueggea* and *Syzygium* initiated germination more slowly (20 days vs. 14 days, and 35 days vs. 21 days, respectively) than reported for Samoa.

The results of this project will be useful for nurseries in planning the propagation of their planting stock with regard to length of time required for germination and amount of seed required. The study should be repeated with both spatial and temporal replication while monitoring environmental conditions to increase the understanding of how the nursery environment and seasonality affect the species' germination.

Additional trials are needed to improve vegetative propagation methods for all species, particularly those that are difficult to reproduce by seed, *e.g.*, *Planchonella samoensis* H.J. Lam ex Christoph, for which it is difficult to collect seed, and *Termainalia*, which is difficult to germinate. Methods to be investigated include factors affecting rooting success of cuttings, assessing growth rates of cutting types, and out-planting survival. This assessment would be done through replicated studies using differing concentrations of IBA applied to various cutting types, e.g., soft-tip, semi-hardwood, and hardwood. Cutting survival, i.e., root initiation, growth rate and environmental conditions would be assessed periodically in the greenhouse. After the propagules reached a suitable size, they can be planted in the field and survival assessed there.

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Table 1. Seed weight and germination data for selected Samoan tree species.[3]

Species	Average seed weight (g)	No. Seeds	Germination onset (days)	Germination length (days)	Germination percent	Ave. germination rate (%/day)
Diospyros samoensis	0.43	341	14	22	50	6.25
Flueggea flexuosa	0.0024	800	20	76	39	0.7
Intsia bijuga	3.2	207	15	87	75	1.04
Pometia pinnata	5.2	210	7	15	62	7.75
Syzygium inophylloides	N/A	68	35	63	96	3.43
Terminalia richii	1.9	434	51	178	7	0.06

[3] Data collected from February to September, 1998, Tutuila, American Samoa. Average germination rate was computed as (*Percent Germination*)/(*Length of Trial - Onset of Germination*). N/A indicates data was not available.