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SEED PROPAGATION OF PALMS

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Abstract. Interest in the production of palms in Hawaii has accelerated in recent years. This has resulted from greater use of palms in the landscape and the potential production of palms for the export market for interior landscape use on the mainland.

With this increased production has come a great awareness of some of the production problems with this crop. During the past year we have initiated a research project to study the culture and nutrition of palms. One of the objectives of the project is to determine the factors that influence the rate of palm seed germination and establishment. Two preliminary trials are reported here.

REVIEW OF LITERATURE

There are several different methods that have been used to improve the germination of palm seeds. *Copernicia* palm seeds were found to begin germination within 5 to 21 days after the pericarp was removed and the seeds were soaked in tap water which was changed daily. Mechanical scarification and soaking in 10% sulfuric acid for 15 minutes further hastened germination (10). Scarification by filing the hilum until the embryo was visible accelerated seed germination of *Gastrococos crispa* (Syn.: *Acrocomia crispa)* and *Arenga engleri* (8). Supplemental bottom heat (75 to 80°F) has been found to accelerate germination in many palm species (16,19,20) and soaking areca palm seeds briefly in sulfuric acid has also been recommended (2,15).

Most researchers agree that palm seeds germinate best when fresh, ripe seeds are used. Many palms lose their viability within a month as they have almost no ability to withstand desiccation (6). The fruit pulp or pericarp is usually removed and the seeds sown in a sterile, well drained medium such as vermiculite, which has good porosity and a high water holding capacity (19). However, Bunker (4) reported a germination rate of 83% after 30 days for *Chrysalidocarpus lutescens* seeds with the fruit pulp still attached when treated with 75° to 85°F bottom heat.

Nagao and Sakai in 1979 (13) demonstrated that presoaking Alexandra palm seeds (*Archontophoenix alexandrae*) in water for 24 to 72 hours enhanced germination and was further increased by soaking in 100 and 1,000 ppm GA. The following year, Nagao *et al* (14) found that scarification and presoaking with water or 1,000 ppm GA were the most effective methods of accelerating seed germination in Alexandra and Macarthur (*Ptychosperma macarthurii*) palms, and that the use of bottom heat (27°C) further reduced the germination time of Macarthur palm seeds.

Palm seeds are often planted in flats or beds and transplanted to container for growing on. Vegetable transplanting studies have found that yield, size, overall growth, and health are greatly influenced by the time of transplanting due to the physiological recovery of the young plants (1,11,21). The general rule is to transplant seedlings with the appearance of the first true leaves (3,17,18). Failure to remove plants from the flat at this stage can result in extensive root damage of the over-developed root system which results in slower establishment and poor growth (3). It is suggested that palm seedlings should be transplanted when one to two mature leaves have developed (5,9,12,19).

MATERIALS AND METHODS

Areca palm or golden-fruited palm (*Chrysalidocarpus lutescens* H. Wendl.), an important ornamental foliage plant from Madagascar, was used in these trials. Although their seeds germinate more readily than those of many other palm species, accelerating the germination rate and increasing total germination are still matters of concern to commercial nurseries.

Experiment I.

The purpose of this study was to determine if presoaking Areca palm seeds in water or aqueous solutions of gibberellic acid (GA) would shorten the time to, and increase the percentage of germination. Mature Areca palm seeds were obtained locally in January, 1982. After the exocarps were removed, the seeds were treated as follows: a) presoaked in distilled water for 24 to 72 hours; b) presoaked in aqueous solutions of GA at 10, 100 or 1,000 ppm for 72 hours; and c) untreated. The 6 treatments were replicated 6 times, with 150 seeds per treatment in a randomized block design.

The seeds were planted in No. 2 vermiculite and placed in a 73% shade Saran house, with a medium temperature range of 68 to 72°F. Germination was determined by shoot visibility 30, 40, 50 and 60 days after planting.

Experiment II

This study was initiated to determine the best stage and method for transplanting areca palm seedlings for optimum growth and development. It has also been observed that recently transplanted seedlings exhibit unexplained leaf spotting and plant losses. This study was also designed to evaluate the influence of handling during transplanting on seedling establishment and growth.

Emerging seedlings were taken from community seedling flats at three stages: (1) when the first leaf was elongated but not unfolded; (2) when the first leaf was fully matured; and (3) when the second leaf was fully unfolded. Seven treatments were installed in a completely randomized design with 8 replications for each of the three stages. The treatments consisted of: (1) seedlings carefully removed, leaving roots and the medium intact; (2) seedlings separated and planted immediately; (3) seedlings separated then allowed to sit on top of the flat exposed for 30 minutes then planted; (4) seedlings separated then planted but not watered until the next day; (5) seedlings separated then placed under intermittent mist for 30 minutes, then planted; (6) seedlings separated, planted, placed under inermittent mist for one day; and (7) seedlings separated then planted immediately and placed under 30% Saran shading.

Seedlings of all stages were planted into 10.2 cm black plastic pots with 5 uniform seedlings per pot. The medium consisted of a 1:1 (v:v) peat:perlite mix, with Micromax and dolomite lime added at the rate of 1.5 and 8 lbs per cu. yd., respectively. A soluble 20-20-20 fertilizer was applied every 10 days.

Treatments, with the exception of No. 7, were placed under 80% Saran shade at the Magoon Research Facility on the University of Hawaii at Manoa campus. Plants were watered immediately unless treatments dictated otherwise. Temperature in this area during the experiment ranged from 20° to 30°C.

Observations were made at 10-day intervals consisting of 1) increase in height and 2) seedling mortality. Measurements were concluded at the 50th day from the start of the transplanting. Analysis of variance and mean separation were conducted on the data.

RESULTS AND DISCUSSION

Experiment I

Seed germination was higher than the control for each treatment at the 40 day interval, with the highest germination at 1,000 ppm GA (Table 1). At the 50 day interval, only GA at 100 and 1,000 ppm significantly enhanced the germination over the other treatment. However, the final germination percentage at 60 days after planting was not significantly influenced by any of the treatments. Thus, while the treatments did accelerate the germination rate, the final germination percentage was not significantly greater than the control. Future research should determine if presoaking seeds in GA shortens the time of germination to an amount significant to justify the additional material and labor expense.

Table 1. The effect of seed treatment on germination percentage of areca palm (*Chrysalidocarpus lutescens*) seeds.

Treatment	Rate	Days following treatment			
		30	40	50	60
Control	—	0	8.0[x]	52.0c	73.3ab
Water presoak	24 hrs	1.3	26.7b	51.3c	64.0b
Water presoak	72 hrs	0.7	27.3b	56.0bc	70.7ab
GA	10 ppm	0	35.3b	67.3ab	81.3a
GA	100 ppm	0.7	39.3b	71.3ab	78.7a
GA	1,000 ppm	2.7	66.0a	76.0a	82.0a

[x] Mean separation within columns by Duncan's multiple range test, 5% level.

The slow germination of palm seed has been attributed to the possibility of chemical inhibitors within the seed as well as the hard seed coat surrounding the endosperm (7,14). Nagao *et al.* believed the effectiveness of GA was related to its ability to penetrate the seed coat of the palms, since scarification and GA at 1,000 ppm increased the germination rate (14). While no chemical inhibitors have been found in palm seeds to date, they may contribute to their slow germination rate. Thus, it is possible that GA, as a germination promoter, might counteract many of the inhibitory effects of these endogeneous substance. This work demonstrates that presoaking in water and GA accelerate areca palm seed germination.

Experiment II

Areca palm seedlings transplanted at the spike leaf stage showed little growth reduction due to handling methods (Table 2). Exposing the seedling roots to the air for 30 minutes prior to planting resulted in a slight set-back in height 20 days after planting. However, after 30 days these plants had recovered and were comparable in size to the other treatments.

When the seedlings were transplanted after the first leaf was fully expanded (Table 3), those that had their roots exposed to the air for 30 minutes were permanently stunted, showing no indication of recovery 50 days after transplanting.

Again, the other treatments had no adverse effect on seedling growth.

Table 2. The effect of transplant treatment on growth[x] of areca palm (*Chrysalidocarpus lutescens*) seedlings transplanted at "spike leaf" stage.

Treatment	Days After Transplanting				
	10	20	30	40	50
1. Minimum disturbance	1.2a[y]	5.0ab	6.2a	8.6ab	9.4a
2. Normally planted	1.1a	4.1bc	6.2a	8.8ab	9.7a
3. Seedlings exposed to air	1.4a	3.7c	6.5a	8.4ab	9.9a
4. Planted; water withheld	1.2a	4.1bc	6.2a	7.3b	9.6a
5. Seedlings exposed to mist	1.4a	4.8ab	6.4a	8.2ab	9.9a
6. Planted; exposed to mist	1.4a	4.9ab	6.9a	9.0	10.4a
7. Planted; 30% shade	1.5a	5.4a	6.0a	8.4ab	9.2a

[x] Average growth increase after transplanting (cm).
[y] Means followed by the same letter are not significant at the 0.05 level.

Table 3. The effect of transplant treatment on growth[x] of areca palm (*Chrysalidocarpus lutescens*) seedlings transplanted at first stage.

Treatment	Days After Transplanting				
	10	20	30	40	50
1. Minimum disturbance	2.2a[y]	4.3a	6.5a	7.8a	8.5a
2. Normally planted	1.5ab	3.4ab	5.8a	7.6ab	8.4a
3. Seedlings exposed to air	0.9b	1.5b	2.3b	3.7b	5.3b
4. Planted; water withheld	1.7ab	3.6a	5.8a	7.5a	8.7a
5. Seedlings exposed to mist	1.5ab	3.5a	5.8a	7.4ab	7.9a
6. Planted; exposed to mist	1.6ab	3.1a	5.3a	7.0a	7.9a
7. Planted; 30% shade	1.4ab	2.9ab	5.7a	6.8a	8.1a

[x] Average growth increase after transplanting (cm).
[y] Means followed by the same letter are not significant at the 0.5 level.

Transplanting at the two-leaf stage resulted in greater growth reduction on seedlings with their roots exposed for 30 minutes (Table 4). These plants were 64% shorter than seedlings that were bare-rooted but planted immediately, when measured 50 days after transplanting. This compares to a 37% growth reduction for seedlings transplanted at the one-leaf stage. Also, seedlings transplanted at this stage and placed under mist for 24 hrs following potting were significantly reduced in growth for the first month, but appear to recover as indicated by the measurements 50 days after transplanting.

The number of seedlings which died were again highest where the seedling roots were left exposed for 30 minutes prior to potting (Table 5). The mortality increased as the age of the seedling increased with losses of 63 percent for seedling transplanted at the 2-leaf stage compared to only 8 percent when transplanted at the spike stage.

The results of this trial would suggest that areca palm seedlings can be successfully transplanted from the community seedling flat when reasonable care is exercised but plant losses can result if the seedling roots are allowed to dry. Best results were obtained when the roots received minimum disturbance or were removed from the germination medium, potted, and water immediately. It is also suggested that plant losses can be minimized by transplanting at an early stage, at the spike leaf or 1st leaf stages.

Table 4. The effect of transplant treatment on growth[x] of areca palm (*Chrysalidocarpus lutescens*) seedlings transplanted at two-leaf stage.

	Days After Transplanting				
Treatment	10	20	30	40	50
1. Minimum disturbance	2.2a[y]	3.0a	3.6ab	7.1a	10.1a
2. Normally planted	1.6ab	2.9a	4.0a	6.5a	9.4a
3. Seedlings exposed to air	1.1b	1.4b	1.6c	2.4c	3.4b
4. Planted; water withheld	1.8ab	2.8a	4.1a	6.0ab	8.3a
5. Seedlings exposed to mist	1.4ab	2.9a	3.9a	5.8ab	8.6a
6. Planted; exposed to mist	0.9b	1.7b	2.5bc	4.7b	7.9a
7. Planted; 30% shade	1.9ab	3.1a	3.9a	5.9ab	9.2a

[x] Average growth increase after transplanting (cm).
[y] Means followed by the same letter are not significant at the 0.05 level.

Table 5. Mortality[x] of areca palm (*Chrysalidocarpus lutescens*) seedlings due to treatment.

	Development Stage of Palm Seedlings		
Treatment	Spike leaf	1 leaf	2nd leaf
1. Minimum disturbance	0%	0%	0%
2. Normally planted	0	0	0
3. Seedlings exposed to air	7.5	35.0	62.8
4. Planted; water withheld	0	7.5	7.5
5. Seedlings exposed to mist	0	2.5	5.7
6. Planted; exposed to mist	0	2.5	0
7. Planted; 30% shade	5	2.5	0
TOTAL	1.8	7.1	11.0

[x] Percent that died of all seedlings in treatment.

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ROOTING OF STEM CUTTINGS OF BREADFRUIT (*ARTOCARPUS ALTILIS* [PARKINS.] FOSB.) UNDER INTERMITTENT MIST

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Abstract. Mature, woody, leafless cuttings of 'Ma opu' and 'Maafala' breadfruit rooted with 95% success under intermittent mist in about 10 weeks after treatment with rooting hormones. Some cuttings rooted and/or sent out shoots more rapidly than others and additional time under mist might have produced stronger root systems. There is also a preliminary indication that leafless stem cuttings can be rooted in a shaded transparent plastic tent, used as a humidity chamber. This would be a particularly