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PROMOTING THE RAPID GERMINATION OF NEEDLE PALM SEED[1]

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Abstract. **Two procedures are reported for promoting high total germination percentages and the rapid and uniform seed ger-**

harvested seeds were mechanically scarified by removing with a scalpel 2 × 2 mm portions of the sclerotesta to: a) expose the endosperm in areas away from the embryo, b) show the embryo cap, or c) remove the cap covering the cavity containing the embryo (Fig. 1); a fourth treatment contained non-scarified seed. Each treatment consisted of four 15-seed replications. These four treatments were repeated later using seed stored 12 months at 100% relative humidity (RH) and 5°C. Both recently harvested and stored seeds were surface-sterilized before scarification by successive immersion in 50% (V/V) ethanol for 1 minute, and

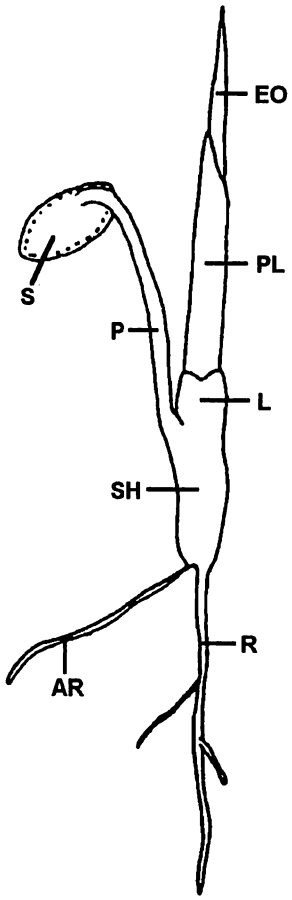

Figure 2. Structure of a recently germinated seedling of needle palm: EO = eophyll, PL = plumule, L = ligule, P = cotyledonary petiole, S = seed coat, SH = cotyledonary sheath, R = primary root, AR = adventitious root.

emergence through the sclerotesta. Total germination percentages (G) and days to 50% of final germination (T_{50}) were calculated, and data were analyzed using analysis of variance and treatment means were compared using Tukey's HSD procedure.

Results and Discussion

The stratification of needle palm seed for 12 months at 5°C and 100% RH increased total germination only when scarification allowed the sclerotesta or embryo cap to remain (Table 1). Stratification did not increase germination of non-scarified seeds nor of seed scarified by removing the cap covering the embryo and the sclerotesta above it, the latter having 98% and 96% germination for fresh and stored seed, respectively. The T_{50} values for seeds recently harvested or stratified were similar (Table 1). Non-scarified seed had larger T_{50} values than seeds scarified to expose the cap or to remove the cap covering the embryo. Removing the cap covering the embryo resulted in faster germination than leaving the cap intact (Table 1).

Alternating 12-hours at 40°C daily with 20°C or 25°C was found to increase needle palm seed total germination (Table 2). No differences in G occurred among alternating temperatures 20°/25°C, 20°/30°C, and 20°/35°C, or between 25°/30°C and 25°/35°C. Highest G (43%) resulted from 12-hour alternating 25°C with 40°C (Table 2). Trends for T_{50} were similar to G from 12-hour alternating temperatures. Fewer weeks were required to achieve T_{50} when 40°C was alternated with 20°C or 25°C, with the smallest T_{50} from 40°/25°C.

Seeds receiving 6-hours at 40°C daily alternated with 18-hours at 25°C promoted 80% total germination, while 12-hours 40°/25°C had 47% G (Table 3). Eighteen hours at 40°C daily reduced G to 10%, while constant 40°C prevented germination of the seeds. Alternating 6-hours at 40°C with 18-hours at 25°C stimulated more rapid germination, which resulted in the smallest T_{50} values (Table 3).

Table 1. Final germination percentage and weeks required to achieve 50% of final germination (T_{50}) of needle palm seeds stored 0 to 12 months at 5°C and 100% RH prior to several methods of mechanical scarification.

	Seed stratification (months)			
	0	12	0	12
	Germination		T_{50} values	
Treatment	(%)[z]	(%)[z]	(weeks)[z]	(weeks)[z]
Nonscarified	7.3 c[z,y]	12.3 d	11.3 a	9.0 a
Scarified to endosperm	10.5 c	56.0 c[x]	9.8 ab	6.3 ab
Scarified over embryo cap	23.2 b	79.5 b[x]	9.0 b	5.8 b
Scarified to remove cap	98.3 a	96.5 a	1.3 c	1.5 c

[z]Means in each column followed by the same letter are not different at the 0.01 level of significance as determined by Tukey's HSD procedure.
[y]Values represent the means of 60 seeds during a 20-week germination period.
[x]Denotes stored seeds had a significantly ($P < 0.01$) higher mean percent germination than nonstored seeds.

Table 2. Germination of needle palm seed under 12-hour alternating temperatures. Data are the means of 60 seeds during a 20 week germination period.

Alternating temp (°C)	Germination	
	G[z] (%)	T_{50}[y] (weeks)
20/25	5	8.6
20/30	7	8.0
20/35	10	7.2
20/40	25	5.3
25/30	12	7.3
25/35	15	5.9
25/40	43	3.8
Tukey's HSD, 5%	6	1.5

[z]Percent total germination.
[y]Days to 50% final germination.

Table 3. Germination of needle palm seed under 6, 12, or 18-hour alternating 25°C and 40°C temperatures. Data are the germination means of 160 seeds during 20 weeks.

Temperature		Germination	
25C (hours/day)	40C	G[z] (%)	T_{50}[y] (weeks)
24	0	13	8.0
18	6	80	2.4
12	12	47	3.5
6	18	10	4.8
0	24	0	—
Tukey's HSD, 5%		8	1.1

[z]Percent total germination.
[y]Days to 50% final germination.

Lengthening the daily period at 40°C to 12 or 18-hours delayed germination and increased T_{50} values.

Our research has identified two procedures for promoting high total germination of needle palm seeds rapidly and uniformly. Each procedure indicated a different probable cause for the poor germination of this seed. The scarification study indicated that needle palm seeds have a physical dormancy imposed by the thick-walled, tightly-packed sclereid cells of the sclerotesta. Removing the cap and sclerotesta covering the embryo cavity from seeds allowed the embryos to rapidly imbibe water and become fully hydrated. Embryo hydration promoted the emergence of the cotyledonary petiole from half the seeds (49%) within 1.3 weeks. The rapid germination of seeds without stratification at 5°C for 6 months indicated that at harvest seeds have mature embryos, and the embryos contain no chemical capable of inhibiting germination.

The results of our scarification study supported past reports that needle palm seeds have a physical dormancy permitting 7% to 14% total germination during 6-months to 2-years (Clancy and Sullivan, 1988; Popenoe, 1973; Shuey and Wunderlin, 1977). Constant warmth (30° to 35°C) after seed scarification was necessary to promote the emergence of the cotyledonary petiole. Carpenter (1988a) and Wagner (1982) have reported 30° to 35°C are required for germination and seedling growth of several palm species.

In our second study, seeds without scarification were soaked in DW for 7 days at 30°C; the water was changed daily to provide adequate aeration. After soaking, seeds were germinated in moist peatmoss at alternating 40°C for 6-hours and 25°C for 18-hours daily, and achieved 80% total germination. These results indicated that sufficient water penetrated the thick-walled, tightly-packed sclereid cells of the sclerotesta during 7 days of soaking at 30°C to fully hydrate the embryo. Although the cap covering the embryo cavity and the sclerotesta appear as physical barriers to embryo emergence, our results indicated that fully hydrated embryos emerge rather rapidly. The mean T_{50} was 1.3 weeks when seeds were scarified by removing the cap covering the embryo cavity and the sclerotesta above it, while hydrated non-scarified seeds germinated at alternating 40°C (6-hours) and 25°C (18-hours) had T_{50} of 2.4 weeks.

Our results cannot explain the rapid emergence of the cotyledonary petiole at constant 30°C after seed scarification, while 30°C failed to promote the germination of non-scarified seeds after hydration. Also, a few non-scarified seeds germinated at constant 35°C and none germinated at 40°C, but alternating 40°C for 6 or 12-hours daily with 25°C promoted high total germination. Possibly 40°C for short periods gives the promotive stimulus needed for the germination of needle palm seed. Carpenter (1988b) reported that imbibed *Butia capitata* (Mart.) Becc. palm seeds required constant 40°C for 3 weeks to terminate the dormancy of the seed, while 35°C under comparable conditions failed to promote germination.

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THE BLACK OLIVE (*BUCIDA BUCERAS* L.), A TROPICAL TIMBER TREE, HAS MANY FAULTS AS AN ORNAMENTAL

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Abstract. **The black olive (*Bucida buceras* L.) is native to the Yucatan peninsula and along the coast of Mexico, Central America and northern South America to the Guianas; the Bahamas, and the Greater and Lesser Antilles as far as Guadeloupe. Salt tolerant, the black olive grows in coastal swamps, wet inland woods, and on river banks, and tolerates dry limestone areas of South Florida. The tree is sturdily erect with tiered, whorled, often thorny branches, at first horizontal and later drooping. It is prone to producing suckers at the base. The elongated main branches bend downwards, making the tree top-heavy. Other drawbacks include the tree's need for regular pruning and its susceptibility to several pests and over two dozen diseases. *Philaphedra* scale causes the black olive to lose all its leaves; the mite *Eriophyes buceras* prevents normal fruit development, causing long, string beanlike galls. Both galls and leaves are high in tannin that stains sidewalks, vehicles, white roofs and cement decks. Black olives are best used for their excellent timber rather than as ornamentals.**

The black olive tree, *Bucida buceras* L. (syn. *Terminalia buceras* Wright) and the only other member of the genus, the Spiny Bucida, *B. spinosa* Jennings, belong to the family Combretaceae, which includes the familiar buttonwood (*Concocarpus erectus* L. and var. *sericea* Forst. ex D. C., Silver Buttonwood: also *Laguncularia racemosa* L., the white mangrove, and *Terminalia catappa* L., the tropical or Indian almond.