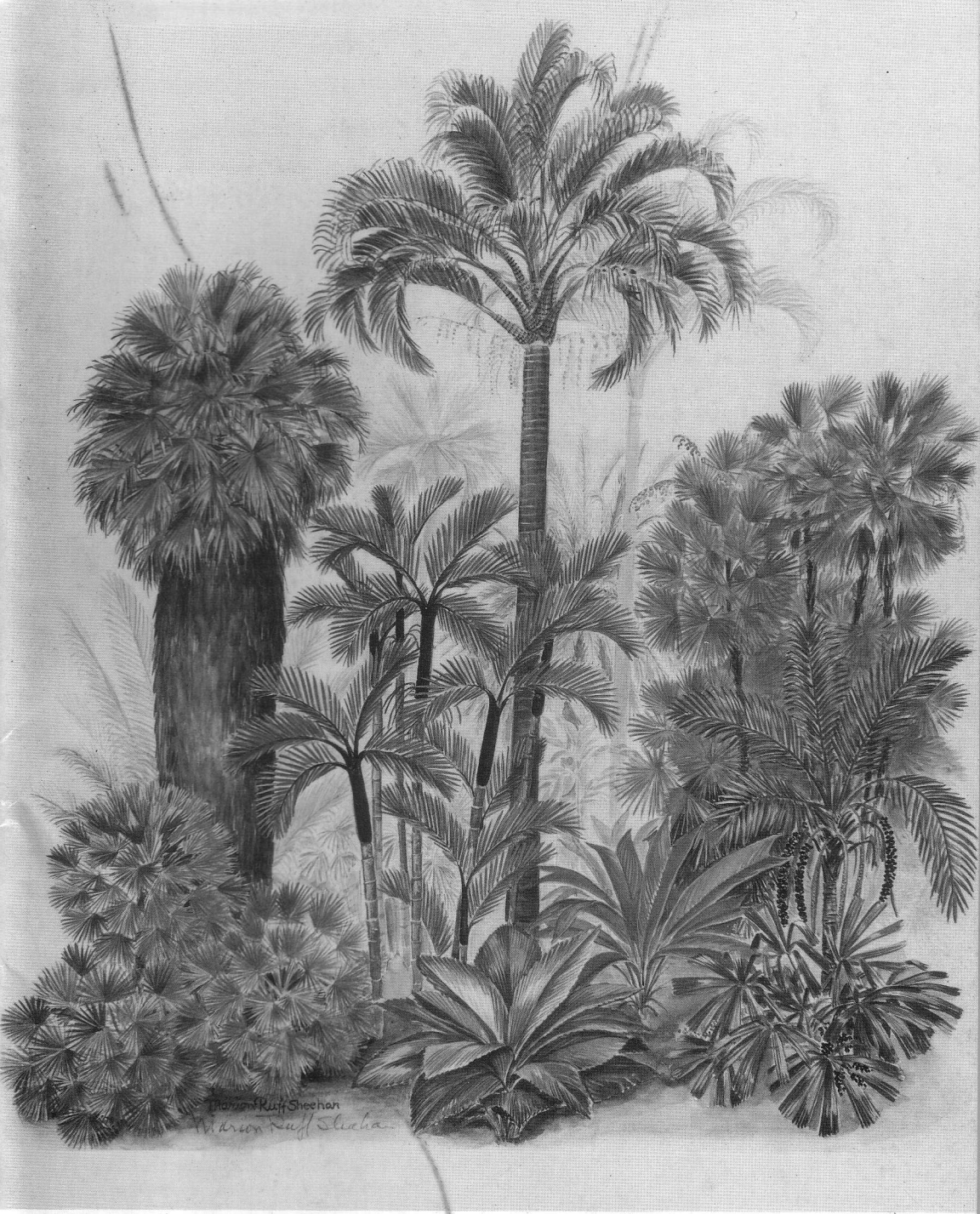


PRINCIPES

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October 1987
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Palm Habits. Reproduction of water color by Marion R. Sheehan for the front of the dust jacket of "Genera Palmarum." See enclosure with this issue.

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Nutritional Value of Desert Fan Palm Fruits

JAMES W. CORNETT

Palm Springs Desert Museum, 101 Museum Drive, Palm Springs, CA 92263

The Cahuilla Indians of the Southern California deserts were known to utilize fruits and seeds of the desert fan palm, *Washingtonia filifera*, as a food resource (Parry 1881, Chase 1919). The fruits ripened in late summer through early fall with healthy trees producing up to 15 infructescenes per palm and up to 18 kg of fruit per infructescence (Cornett 1985). In wet years, the total harvest could reach 600,000 fruits and a total of 270 kg per tree. Cahuilla women usually sun-dried the fruits and stored them in clay jars. Later, the entire fruits would be soaked in water and then ground into flour in bedrock mortars (Cornett 1987). The relative importance of this food resource has not been determined although Indian villages and campsites are frequently associated with desert fan palm oases (Cultural Systems Research 1983, Cornett 1987). Information on the nutritional value of *W. filifera* fruits could shed light on their value as a food resource.

Fruits, including seeds, were analyzed for their nutritional content by Shankman Laboratories in Los Angeles, CA. The results are listed in Table 1 along with data on the nutritional value of singleleaf pinyon (*Pinus monophylla*), honey mesquite (*Prosopis juliflora*), and black oak (*Quercus kelloggii*), other food plants of the Cahuilla (Bean and Saubel 1972). Of special interest is the comparison between fruits of the desert fan palm and mesquite. Mesquite is a common oasis plant whose importance as a food resource is often touted by anthropologists (Bean and Saubel 1972, Heizer and Elsasser 1980). Nutritional information on two other palm genera has been included as they are known to occur within oases containing *W. filifera*.

Based on a content of 384 calories per 100 g of fruit and a 3,000 calorie daily requirement, the fruit harvest from a single desert fan palm would provide a human with enough food for up to 200 days. In addition, as shown in Table 1, the carbohydrate percentage of desert fan palm fruits is considerably higher than other Indian food plants including the mesquite. However, desert fan palm fruits have significantly less protein; less than half that of mesquite. This information compliments the early literature regarding palm fruit usage by suggesting that *W. filifera* fruits had the potential of being an important dietary mainstay. The situation could have been similar to the role of the date palm, *Phoenix* spp., in the old world.

Acknowledgments

I thank Jule Ann Huffnagle for her assistance in securing palm fruits. This study was made possible through a grant from the Richard King Mellon Foundation.

LITERATURE CITED

ATCHLY, A. A. 1984. Nutrional value of palms. Principes 28: 138–143.

BEAN, L. J. AND K. S. SAUBEL. 1972. Temalpakh. Malki Museum Press, Banning. 255 pp.

CHASE, J. S. 1919. California desert trails. Houghton Mifflin Company, Boston. 387 pp.

CORNETT, J. W. AND J. M. STEWART. 1986. Palm burning and increased spadix production. Southwestern Naturalist 31:552–553.

CORNETT, J. W. 1985. Unpublished Notes. Located at: The Palm Springs Desert Museum, Palm Springs, CA.

*Table 1. Nutritional analysis of desert fan palm (*Washingtonia filifera*) fruits including seeds. Nutritional analysis of analagous parts of other Indian and non-Indian food plants are provided for comparison. Calories (Cal) are per 100 g. Protein (Pro) thru ash are % by weight. Calcium (Ca) thru riboflavin (Ribo) are mg/100 g.*

Species of Fruit	Cal	Pro	Fat	Carbo	Fib	Ash	Ca	Ph	Ir	A	Th	C	Ni	Ribo
Washingtonia filifera[1] (desert fan palm)	348	3.1	2.8	77.7	10.4	5.4	110	89	7.8	180	0.06	5.0	1.0	0.13
Pinus monophylla[2] (singleleaf pinyon)	—	10	23	54	—	—	—	—	—	—	—	—	—	—
Prosopis juliflora[3] (honey mesquite)	—	8.3	2.4	52.0	—	—	—	—	—	—	—	—	—	—
Quercus kelloggii[3] (black oak)	—	4.6	18.0	55.5	11.4	1.6	—	—	—	—	—	—	—	—
Brahea sp.[4] (blue palm)	—	5.6	9.2	—	—	—	—	—	—	—	—	—	—	—
Phoenix dactylifera[4] (date palm)	354	2.8	0.6	94.1	3.0	2.5	76.1	81.3	3.9	38.7	0.12	0.0	2.84	0.13
Barley[5]	—	8.7	1.9	71.0	5.7	—	—	—	—	—	—	—	—	—
Wheat[5]	—	11.4	1.0	75.4	0.2	—	—	—	—	—	—	—	—	—
Corn[5]	—	9.2	1.9	74.4	1.0	—	—	—	—	—	—	—	—	—

Notes: Cal, calories; Pro, protein; Carbo, carbohydrates; Fib, fiber, Ca, calcium; Ph, phosphorus; Ir, iron; A, carotene (as Vitamin A); Th, thiamine; C, vitamin C; Ni, niacin; Ribo, riboflavin.

Reference codes: 1, Shankman Laboratories; 2, Lanner 1981; 3, Bean and Saubel 1972; 4, Atchley 1984; 5, Heizer and Elsasser 1980.



1. Fruits of *Washingtonia filifera.*

———. 1987. Indians and desert fan palms. Masterkey 60(4): 12–17.

CULTURAL SYSTEMS RESEARCH, INC. 1983. Paniktum hemki. Prepared for the Andreas Cove Country Club, City of Palm Springs, CA. 335 pp.

HEIZER, R. F. AND A. B. ELSASSER. 1980. The natural world of the California Indians. University of California Press, Berkeley.

LANNER, R. M. 1981. The pinyon pine: a natural and cultural history. University of Nevada Press, Reno.

PARRY, C. C. 1881. The desert palm. San Francisco Evening Bulletin, March 24, 1881, p. 4, col. 1.

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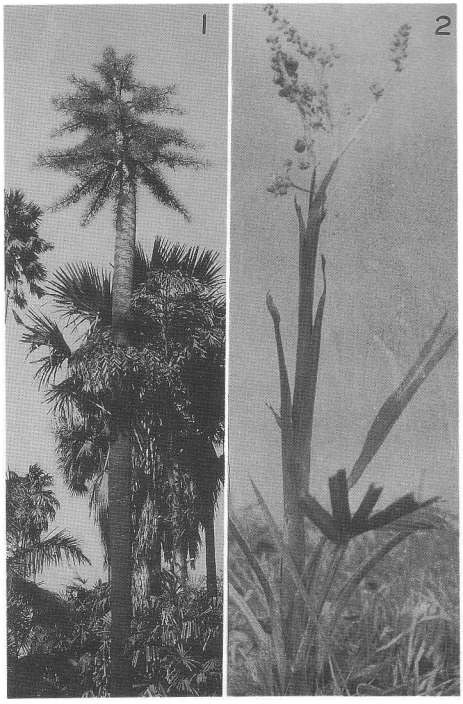
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Principes, 31(4), 1987, pp. 162–164

Dwarf Corypha utan

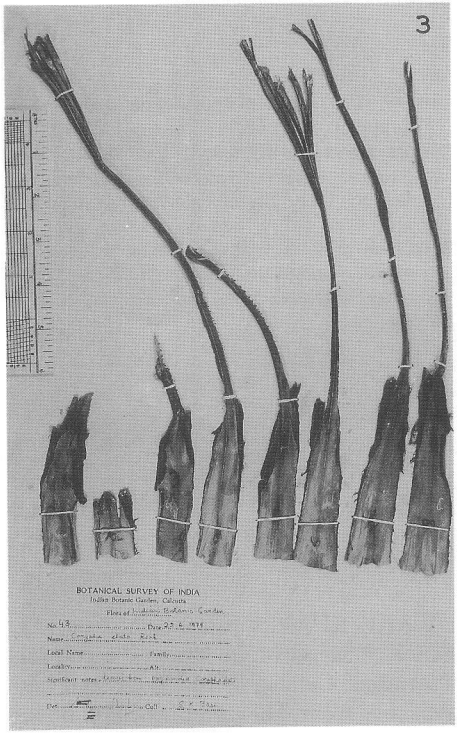
SHYAMAL K. BASU
Indian Botanic Garden, Howrah 3, India

Corypha utan Lam, (syn. *C. elata* Roxb.) is a distinct species, displaying on its stem conspicuous foliar spiral markings and having a long petiole with stout, black to deep brown teeth on the margins. The tree, after completion of 50 to 60 years of its vegetative phase, bears a massive terminal inflorescence (Fig. 1) about 15 m above the ground. A full-grown tree takes about 15 to 20 months from the emergence of the terminal inflorescence to the development of mature fruits. A very curious looking dwarf palm (Fig. 2) was seen in the Indian Botanic Garden, Howrah, in May, 1979. The palm had some sparsely segmented leaves appearing from ground level, a prominent scapelike terminal inflorescence stalk bearing thinly ramified branches. Without the terminal inflorescence the plant appeared like a normal *C.*

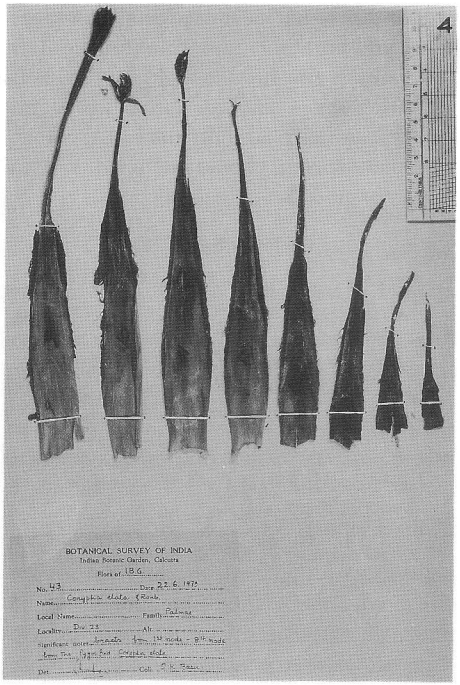


1. *Corypha utan* with a massive terminal inflorescence. Note distinct spiral markings on the upper part of the stem.

2. Dwarf *Corypha utan* with delicate scapelike terminal inflorescence.



3. Successive leaves showing prominent petioles and sheaths.



4. Transformation of leaves into bracts by reduction of the petiole and blade.



5. A terminal infloresence in a young *Arenga pinnata*.

utan seedling and to some extent like *Sabal minor* and *Nannorrhops naudeniana*, the latter now believed to be a dwarf form of *N. ritchiana* (Moore 1980). This dwarf palm was kept undisturbed until all its flowers had opened, within a period of 10 to 15 days. Though most of the flowers dropped after anthesis, a few persisted and developed into buckshotlike immature fruits which dried and dropped without further development. The upper part of the plant soon withered after all the immature fruits had fallen.

Morphology

Plant with the subterranean stem 75 cm long. Rhizome conical, 25 cm long, 14 cm broad at the widest part, 2.5 cm diameter at the uppermost part; anchoring roots conspicuous, each 20–30 cm long, 7–8 mm wide; lateral roots twisted, horizontal, 35 in number; each 20–45 cm long, 7–9 mm wide. Leaves about nine in number, juvenile in appearance, arising from compressed nodes, gradually transformed into bracts by supression of the blade and petiole and expansion of the sheath (Fig. 3, 4); sheath coriaceous, 9–13 cm long, 2–3.5 cm broad at middle, biligulate; petiole slender, minutely dentate at the margins, 4.5–16 cm long, 8–9 cm broad at the middle; leaf blade with 2 to 3 segments, 8–10 cm long; internodes variously elongated in aerial part of the stem; bracts 5–19 cm long, acuminate. Inflorescence scapelike with flowering branches (spikes) of the first to second orders (Tomlinson and Soderholm 1975) bracteate at the base; lowermost first order branch longest. Flowers in clusters of 3–5, about 7 mm long, sessile, pale yellow at anthesis; calyx 3.5 mm long, 2 mm broad at the middle, solid, pedicelliform at base, prominently

3-toothed; petals 3, oblong, slightly reflexed, 4.5 mm long, hyaline, shorter than the stamens; stamens six, filaments subulate, anthers ovate; stigma prominently 3-lobed.

The emergence of a terminal inflorescence at a very young age was also noticed in *Arenga pinnata* (Fig. 5) and *Caryota mitis*. In both cases the terminal inflorescences bore male flowers only, instead of flower clusters (triads) of two lateral male flowers and a central female flower. The above phenomenon is rare and occurs probably due to the reasons suggested by Essig (1971) for *Chrysalidocarpus lutescens*. There are similar instances of hapaxanthy in seedlings of *Cocos nucifera* (Davis and Menon 1953, Menon and Pandalai 1958), which normally produces only axillary inflorescences. It was also reported that these dwarf coconut plants were short-lived and bore only abnormal female flowers. This is the first record of precocious flowering in *Corypha utan*. It is not understood why an individual of this massive palm species should change its normal behavior and flower neotenically.

LITERATURE CITED

DAVIS, T. A. AND K. P. V. MENON. 1953. A midget coconut palm. Indian Coconut J. 6: 139–144.

ESSIG, F. B. 1971. Terminal flowering in *Chrysalidocarpus lutescens*. Principles 15(3): 106.

MENON, K. P. V. AND K. M. PANDALAI. 1958. The coconut palm, a monograph. I. C. A. R. New Delhi.

MOORE, H. E., JR. 1980. Palmae. *In*: K. H. Rechinger (ed.). Flora Iranica 146. Academische Druck, Austria, Pages 1–6.

TOMLINSON, P. B. AND P. K. SODERHOLM. 1975. Flowering and fruiting in *Corypa elata* in South Florida. Principes 19: 83–99.

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Principes, 31(4), 1987, pp. 165–168

Rhopalostylis sapida on Great Barrier Island, New Zealand

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New Zealand native forests give an immediate impression of being like tropical rainforest, yet the New Zealand climate, can only be classified as warm temperate at best. This impression is no doubt enhanced by the frequent and luxurient presence of New Zealand's only palm referred to by the Maori people as "*nikau*," *Rhopalostylis sapida*. The "*nikau*" palm occurs throughout the North Island and extends into the South Island as far south as the Banks peninsula; a notable presence of the *nikau* is on the Chatham Islands about 600 miles east off the South Island. This southernmost limit is halfway between the Equator and the South Pole near the northern limits of the drift ice of the Antarctic continent, surely the most southern limit of any palm species. The closely related species, *Rhopalostylis cheesemanii* occurs on the Kermadec Islands. *Rhopalostylis baueri* is native to Norfolk Island. These last two species show close resemblance to the New Zealand *R. sapida*.

Nikau is commonly known as the "feather duster palm," because of the rigid upright leaves which form its characteristic crown. Although the *nikau* palm of New Zealand is recognized as one species there is considerable variation in form in different parts of the country. Generally, those growing in the more southern regions are more robust and taller in stature. Those growing in the northern part of the North Island are less tall, finer leaved, and more upright in form. In contrast those growing on the offshore Islands of the North Island are very different. They grow more vigorously, have thicker trunks and generally have a more open crown. They seem to be more allied to the Kermadec Island *nikau*, *R. cheesemanii*.

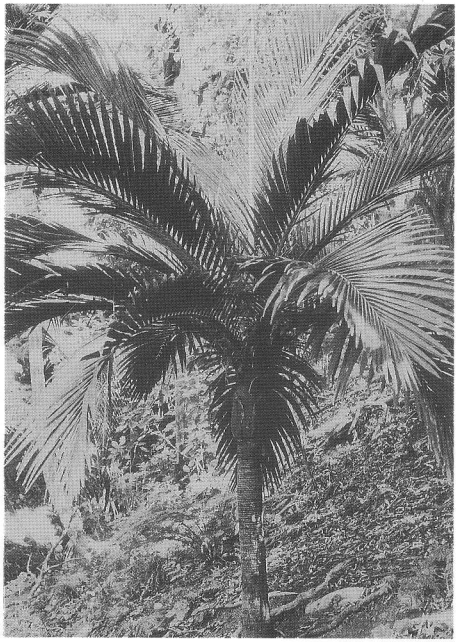
In order to collect the best form of *Rhopalostylis sapida* I decided to visit Great Barrier Island in search of seed most suited for growing in nursery and for distribution to the International Palm Society.

My visit to Great Barrier Island was planned to coincide with the ripening of seed which normally commences during the month of August. The only regular means of reaching the Island is to fly from Auckland City in a small single engined aircraft which takes only 40 minutes to reach one of the airstrips on the "Barrier." The flight itself is a delight as one crosses the island studded Hauraki Gulf until the well named Great Barrier Island is reached. This rugged mountainous island is approximately 30 miles long by about 8 miles wide and shelters the entrance of the Hauraki Gulf from the fierce gales which periodically sweep in from the northeast. Most of the island is clad in dense forest, much of it secondary bush, cut over during the last century to extract its valuable Kauri timber. Flying over the island forest canopy one can see the many star shaped heads of the *nikau* palms which have reached the upper canopy of the forest, the color of the leaves being a lighter green in contrast to the generally somber hues of the general vegetation. The Island is sparsely populated, hence a trip needs to be well planned to allow for an extended



1. *Nikau* palms, *Rhopalostylis sapida* (Great Barrier Island form): group of *Nikaus* at the outlet of a stream at Wreck Bay, Great Barrier Island. Note the upright growth of the leaf canopy in this exposed site.

stay in case the weather closes in, effectively blocking all communication with the mainland. My object was to hike to Wreck Bay, so named after a schooner wrecked there last century. This secluded inlet is situated along the northeastern part of the Island in a totally uninhabited region, forest covered to the water's edge. It is here that



2. Splendid form of *nikau*, *Rhopalostylis sapida*, growing in the shade of the forest, Great Barrier Island.



3. *Nikau* palms, *Rhopalostylis sapida*, lend a tropical appearance of the New Zealand bush on Great Barrier Island.

some magnificent stands of *nikau* occur. From the airfield the road leads north for about six miles until the last farmhouse is reached. From here we proceeded to walk along the beach until a suitable track was found which turned inland, up a steep ridge reaching an altitude of about 1,000 feet.

All along the ridge *nikaus* were present scattered here and there, never in solid stands. Most palms exposed to the open hillside were windlashed and tattered on the outer leaves. In spite of these severe conditions the palms survived and grew. Observing the leaf structure and the manner in which they are held on the trunk it is perhaps easy to understand why the *nikau* succeeds where other palms would fail. The crown is shaped like an inverted cone, the old outer leaves held in place on the trunk by a sturdy bulbous crownshaft attached to the trunk. The upright leaves in turn protect the inner leaves hence enabling the palm to function. The *nikau* palm is generally recognized by this peculiar feather duster appearance.

These same palms growing in the protected environment of the bush display a totally different growth pattern. Here the leaves grow much larger, arch out and appear much less upright. Very often palms growing under shady conditions fail to flower and seed.

Following a series of high ridges and peaks one reaches Wreck Bay after a three hour hike; here one steeply descends into a narrow inlet or cove headed by a stoney beach through which a stream emerges. Generally, the *nikau* does not grow in pure stands, the only exception perhaps being along damp gullies and streams. Around the stream running into the Bay there is a large area of *nikau* growing in swamp conditions. Here the *nikaus* have the more upright growth pattern as the palms are in full light. It was here also that most of my seed collection took place.

In order to compare the various forms of the *nikau* we have planted the different forms on our farm. The extra vigor displayed by the Great Barrier Island form is showing in our climatic conditions, hence the differences are genetic rather than environmental. Seed of the Great Barrier Island form was sent to the Seed Bank of the International Palm Society.

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Principes, 31(4), 1987, pp. 169–171

Components of Fermenting Palm Sap and Bottled Palm Wine

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ABSTRACT

The length of preservation and bacteria associated with the variation in the components of palm sap during fermentation were investigated at room temperature. The fermenting palm sap at room temperature deteriorated after two days of storage; while its counterpart treated at 75° C for 30 minutes stored well at room temperature for 12 months. There was a sequence in the bacteria genera (*Micrococcus*, *Streptococcus*, *Leuconostoc*, *Lactobacillus* and *Acetobacter*) isolated during the palm sap fermentation. The activities of these microorganisms result to changes in the composition of the chemical constituents of palm sap and palm wine. Whereas, NIFOR fabricated general purpose waterbath at 75° C for 30 minutes inhibited the proliferation of bacteria.

The incorporation of bottled palm wine (fermented palm sap) into the local beverage market is currently gaining wide acceptability in Nigeria. Palm wine is a popular traditional African beverage which is obtained by tapping *Raphia* palm (*Raphia hookeri* G. Mann and H. A. Wendl.) and oil palm (*Elaeis guineensis* Jacq.) trees. Palm sap ferments easily, and becomes sour within a few hours of collection. When fresh it is sweet, refreshing, nourishing and a nutritious drink containing sugar, vitamins and minerals. *Raphia* palm wine has a sugar content of about 6–8%, an acidity (calculated as acetic acid) of about 0.4% and protein (% w/v) of about 0.05% (Eapen 1982, Okiy and Ojomo 1985). Within 24 hours of fermentation, sugar content reduces to 0.5–1% while acidity increases to 0.5–0.6% (Eapen 1982). Present in the wine are various microorganisms (mainly bacteria and yeasts) which originate from the indigenous flora of the palm trees and from equipment used in collecting the sap (Okafor 1975, Ojomo et al. 1984).

The Nigerian Institute for Oil Palm Research (NIFOR) has successfully designed and made its own General Purpose Waterbath for bottling palm wine. The need has arisen to investigate the efficiency of the waterbath to ensure that the bottled palm wine can be preserved for up to twelve months without appreciable deterioration of quality. I report here the changes in bacteria composition and the major chemical constituents of fresh and bottled palm wine due to the activities of microorganisms.

Materials and Methods

Aliquots of 630 mL of freshly collected *Raphia* palm wine were crowncorked and then pasteurized by treating in NIFOR waterbath at 75° C for 30 minutes and stored for periods ranging 2–12 months at 28° C. The unbottled palm sap was allowed to ferment in the air at room temperature for 5 days. During the fermentation and at 3 months interval (bottled palm wine), 1 mL samples were used for chemical analyses; pH was determined using pH meter; alcohol was determined by gas liquid chromatography according to the procedure of Sharma et al. (1984); the total sugar content was determined by the anthrone method of Yemm and Willis (1954) and the acidity by titration against 0.1 N sodium hydroxide. Media and meth-

Table 1. Bacterial variability during fresh palm sap fermentation.

	Bacterial Genera
Day 1	*Micrococcus, Streptococcus, Leuconostoc.*
2	*Micrococcus, Streptococcus, Leuconostoc, Lactobacillus.*
3	*Micrococcus, Streptococcus, Lactobacillus, Acetobacter.*
4	*Micrococcus, Streptococcus, Lactobacillus, Acetobacter.*
5	*Micrococcus, Streptococcus, Acetobacter.*

Table 2. Bacteria associated with bottled palm wine.

		Bacterial Genera
Months	1	—
	3	—
	6	*Lactobacillus*
	9	*Lactobacillus*
	12	*Lactobacillus*

Table 3. Chemical components of fresh palm sap during fermentation.

		pH	Sugar (%)	Alcohol (%)	Acidity (%)
Day (fresh)	1	3.83	7.5	2.0	.35
	2	3.64	5.2	3.8	.42
	3	3.53	2.8	4.5	.47
	4	3.5	2.2	3.6	.5
	5	3.37	1.2	3.2	.57

Table 4. Chemical components of bottled palm wine.

		pH	Sugar (%)	Alcohol (%)	Acidity (%)
Months	1	3.83	7.5	2.0	.35
	3	3.85	7.3	2.05	.36
	6	3.9	7.28	2.1	.36
	9	3.95	7.27	2.15	.37
	12	3.85	7.2	2.1	.375

ods for bacteria isolation procedure were of Ojomo et al. (1984). Bacteria identification was in accordance with the method described by Buchanan et al. (1975).

Results and Discussion

Due to microbial variability changes in the components of fresh palm sap during fermentation were observed. At atmospheric temperature, the sugar concentration of the palm sap started to fall after a few hours and fermentation was completed within four days. As from the second day (Table 3), sugar decreased in concentration; the concentration fell from 7.5% to 5.2% on the first day, and less than half of the first day value after a period of three days. This fall was accompanied by a progressive increase in acidity and a sharp rise in the level of alcohol concentration. At this stage, the palm wine contained 1–2% alcohol after 24 hours fermentation and its value never rose beyond 4.5% after 72 hours. A fresh sap contains no alcohol, but after a few hours the production of alcohol usually begins, with rapid evolution of CO_2 (Faparusi and Bassir, 1972).

At pH 3.5 to 4.0, the palm wine is considered suitable for drinking. Within 24 hours of tapping, the pH of the fermenting sap fell rapidly from 7.0 to 3.83. At this stage of the palm sap fermentation, the degree of infection is high. The lowering pH and rising alcohol content are both factors resulting from the metabolic activities of the bacteria which get into the sap as it drips out of the tree (Table 1). Bacteria which are always present in the palm wing during the five days' analyses are *Micrococcus* and *Streptococcus*. The lactic acid bacteria isolated include certain species in the genera *Streptococcus*, *Leuconostoc* and *Lactobacillus*. Fermentation

was started by the bacterial genera *Streptococcus* and *Leuconostoc* (Tables 1 and 3). The sugar was converted to lactic acid, alcohol, acetic acid and other products. As the acids accumulate, *Leuconostoc* was inhibited after day 2, but the fermentation continues with *Lactobacillus*. A slight fall of alcohol level after the third day is due to oxidation of alcohol by a newly invading species of *Acetobacter*. Its appearance decreased the alcohol percentage from 4.5% to 3.6% and there was an increase in acidity. Okiy and Ojomo (1985) reported that a good quality fresh or bottled palm wine should possess the following characteristics: Sugar level not less than 6%, alcohol concentration of about 2% and acidity level not more than 0.5%. Using the ahove criteria, the fermenting palm sap at room temperature deteriorated after two days of storage. Whereas, the major chemical constituents of the bottled palm wine remained normal after 12 months of storage at room temperature. The activities of the microorganisms using NIFOR All Purpose Waterbath at 75° C for 30 minutes were inhibited. So far, attempts to preserve palm wine by use of NIFOR waterbath have produced acceptable results.

Acknowledgments

The author is grateful to the Director, NIFOR and members of the Plant Pathology Division.

Literature Cited

Buchanan et al. 1975. Bergey's manual of determinative bacteriology, 8th ed. Williams and Wilkins Company, Baltimore, MD, U.S.A., p. 1268.

Eapen, P. I. 1982. Some studies on the preservation and bottling of Palm Wine. J. Nig. Inst. for Oil Palm Res. 6: 217–221.

Faparusi, S. I. and Bassir, O. 1972. Factors affecting the quality of palm wine 2. Period of Storage. West Afric. Jour. Biol. and Appl. Chem. 15: 24–28.

Ojomo, E. E., Aderungboye, F.O. and Nwosu, S. O. 1984. Studies on the microbiology of NIFOR Raphia and Oil Palm Wine. Canadian Institute of Food Science and Technology Journal 17: 172–174.

Okafor, N. 1975. Microbiology of Nigerian Palm Wine with particular reference to bacteria. Journal of Appiied Bacteriology 38: 81–88.

Okiy, D. A. and Ojomo, E. E. 1985. A sampling of the quality of some brands of Palm Wine bottled in Nigeria. J. Nig. Inst. for Oil Palm Res. 7.

Sharma et al. 1984. Maximisation of fuel ethanol from Pawpaw fermentation. Energy 9: 15–20.

Yemm, E. W. and Willis, A. J. 1954. The estimation carbohydrates in plant extracts by anthrone. Biochem. J. 57: 508.

THE 1988 BIENNIAL MEETING

The next Biennial Meeting of The International Palm Society will be held in Queensland, Australia in the latter part of September 1988, with two tentative Post Biennial optional tours, (1) Australia or (2) New Guinea. Details concerning itineraries, accommodations, and costs will be included in a forthcoming issue of *Principes*. Meanwhile save your pennies and join fellow members in 1988 down under.

Edward M. McGehee, President
The International Palm Society

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Parajubaea—An Unsurpassed Palm for Cool, Mild Areas

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In the San Francisco area our winters are sufficiently mild that we can have plants as tender as bananas and flowering gingers permanently in the ground where they normally suffer no cold damge, so that an interest in other tropicals and subtropicals naturally develops in the adventurous gardener. But our summer temperatures generally remain below 80° F. (below 70° F near the coast!) and nights are nearly always below 60° F. This can be a challenge to much of the plant life our winter mildness allows. The slowly emerging answers to our quests for adaptable plant material other than some very good native species seem to lie in the tropical highlands. There is no other area of our planet at sea level outside of a few islands or similar coastal strips such as areas of New Zealand, Chile, or South Africa where winters are so mild and summers so cool. Although tropical highland regions often do not have our dry summer season, temperatures throughout the year in such locations as the lower Himalayas, the mountains of New Guinea, or the northern Andes are very much like those of coastal central and northern California. Perhaps a few other areas such as Darjeeling, Kandy, Kenya, Tasmania, and highland areas in New Zealand also have similar climates.

What good fortune for us that these regions provide the habitat for some of the most beautiful and spectacular palm species known! Because most of the palm growing regions of the earth are warm to hot, at least in summer, most of these highland species have either not been tried or have failed to survive outside their habitat. But now with a growing number of palm enthusiasts in our cool climate a concerted effort has been made to establish highland species with notable successes. Several species of *Ceroxylon* have been cultivated for nearly a decade now in the San Francisco area and all have shown an excellent response to our climate in the form of vigorous and healthy growth into extremely attractive young palms. This is wonderful for large areas such as parks, but who besides the palm collector wants a 300 ft tall palm next to his house? Without question the one highland palm which answers the home gardener's need for a long-lived, elegant, vigorous, and tough palm in our cool climate is *Parajubaea cocoides*. I first fell for this beautiful species upon seeing the photograph in *Palms of the World* simply labelled as *Parajubaea* sp. This was years ago when the biology library of my graduate school obtained its copy of the book. In 1976 I saw the actual trees in the photo in one of the city squares in Quito, and the love was not lessened. Warren Dolby was at that time cultivating a young specimen of *P. cocoides* in his Oakland garden with good result. With this encouragement the first large collection of seeds for Northern California was made there in Quito in 1976.

The results of this collection of seed will be discussed shortly, but first some description of the palm is in order. Among the terms used in *Hortus Third* to describe *Parajubaea cocoides* are the following: solitary, unarmed, monoecious, leaves pin-



1. The crown of Warren Dolby's *Parajubaea cocoides* emerging from his Oakland garden. Photo by G. Fullington.

nate, no crownshaft, leaves long petioled, pinnae regularly arranged. A mention is made of 20 ft height, but many trees in Quito are closer to 30–40 ft. These terms depict a palm filling a gap in our material for northern California. Other than *Syagrus romanzoffiana* we have no slender-trunked pinnate palms which perform well in the cool areas. Even Arecastrum looks best only in areas with some summer heat, and although *Archontophoenix* specimens are occasionally seen in good form, they must be protected from wind in the coastal regions and from frost further inland. Our experience to date with *Parajubaea* is that it tolerates these conditions admirably, but that story will now be told from its beginning.

The first *Parajubaea* to be grown in our area, that belonging to Warren Dolby, was grown from a seed of the old tree at the Gillespie estate in Santa Barbara. The Santa Barbara tree is quite old and has been producing some seed for many years. It has survived years at a time with no water other than winter rains, and although sickly looking through these times of stress it survived. Another notable specimen is in Ed Moore's garden in San Diego. Both of these palms are in areas a little too warm for their best development, but they fruit and continue to grow. But when Warren Dolby's palm is examined, the true beauty and vigor of *Parajubaea cocoides* in a cool climate begins to be appreciated. Warren's plant after only fourteen years from seed has now almost ten feet of trunk topped by a magnificent crown of perhaps thirty healthy fronds covering a spread of over fifteen feet! It is now already in full flower and seed production.

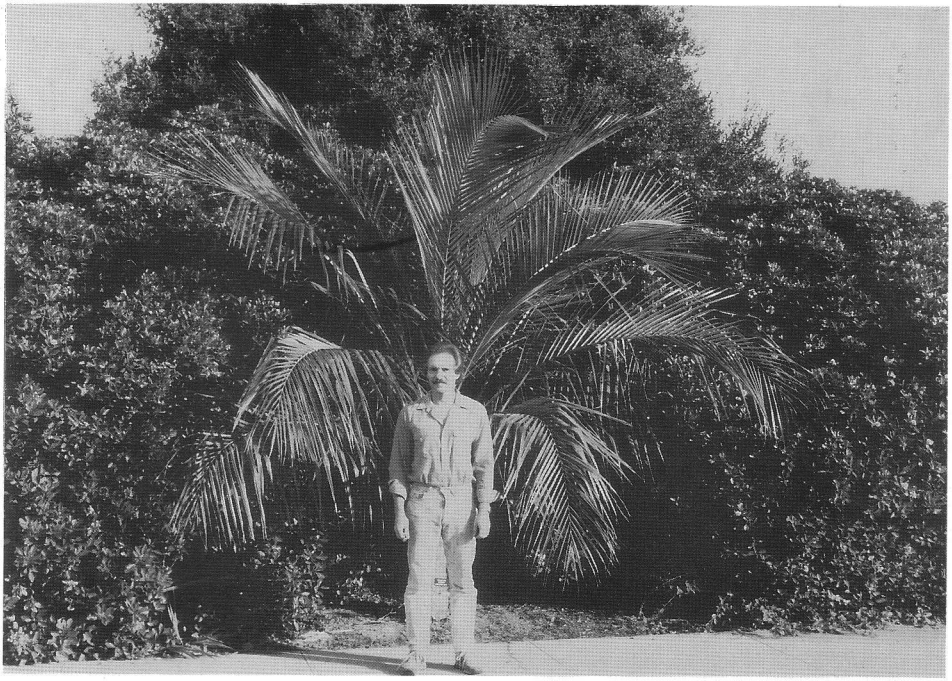
The seeds from the 1976 collecting trip were gathered mostly along the streets in Quito. It was necessary to do this early in



2. *Parajubaea cocoides* in Oakland's Lakeside Palmetum. Photo by G. Fullington.

the morning before the local people got to them to crack and eat the coconut-like seed kernels. Some seeds were gathered on private properties (with permission). One notable source was the grounds of the Hotel Quito Intercontinental which the locals seem to avoid. The seeds need to be thoroughly dried before germination is attempted. The Ecuadoreans gave instruction to leave them in the fruit in a dry warm place for two months. Germination was carried out in a loose, airy planting mix with the seeds resting on the surface of the mix beneath a thin layer of damp sphagnum moss. They were placed in an area with warm days (80° F) and cool nights (55–60° F) Sprouts began to appear within two months and continued sporadically for several years from the same batch of seeds. About 90% of them grew within the first several months, but one seed germinated after lying on the ground in leaf litter under a plum tree for eight years! Upon germination the seed puts out a long root before any top growth commences. When a sprout appears (sometimes two come from one seed) the seed should be lifted and placed in the surface soil of a container at least one gallon in capacity. The first leaf will emerge within about two months.

Parajubaea cocoides is not a palm for container growing. Even in a 15 gallon container growth soon stops at which time a three foot plant will decide to remain that size for years or until put into the open ground. One reason for this is that *Parajubaea* roots tend to grow straight down unless stopped by rock or hardpan, and they are even fairly good at penetrating that. Once the bottom of the container is reached the roots make a circle or two, then stop. This also means that you do not transplant this palm once it is in the ground. Small specimens have been lost in moves even by professional tree



3. *Parajubaea cocoides* at the USDA Western Regional Research Center in Albany, CA, with the author for scale. Photo by E. Adalsteins.

movers with large equipment. Ideally a one to five gallon size plant should be put into its permanent site in the ground and never again disturbed. With ample water and *cool nights* growth will soon be rapid and vigorous. Cool night requirement for this palm cannot be over-emphasized. In its habitat 10,000 feet high in the Andes nights are in the range of 40–50° F. In areas where nights are consistently over 55–60° F *Parajubaea cocoides* loses its vigor and health and even if it survives it will not look as good as more suitable species. Temperatures of 25° F have been experienced where *P. cocoides* grows in Ecuador. Small specimens have had some leaf damage at about that temperature in our inland areas of California, but cold tolerance seems quite adequate for most of the San Francisco region. Plants from the 1976 seed collection which went into the ground as small specimens and have been well watered are now almost fifteen feet in height. Some which have remained in containers are still eighteen inches tall! There are specimens at all sizes in between in the San Francisco area from this batch of seeds, depending on how long they have been in the ground and the exposure to sun. This is a sun loving palm and should always be planted in full sun. Its habitat does have a short (one or two month) drier season, but the palm seems to thrive on ample water.

Notable specimens can now be seen in the Palm Society chapter's Lakeside Palmetum in Oakland, at the University of California Berkeley botanic garden, at the USDA Western Regional Research Center in Albany, CA, and in many of our members' own gardens. And don't miss the outstanding *Parajubaea cocoides* in Warren Dolby's garden—it looks far better even than similar size plants in their native

Ecuadorean Andes. Another large collection of *Parajubaea* seeds was made by your author along with Dale and Cindy Motiska in 1983. Plants from this second collection are now almost ready for permanent planting. And now with the first local tree to begin fruiting we are well on the way to establishing *Parajubaea cocoides* as a new landscape feature in Northern and Central California. We cannot grow coconuts, but we can grow a palm remarkably similar which has no hope of ever growing outside our cool summer climate zones. Thus we shall forever be blessed with a unique and beautiful palm which collectors throughout the rest of the world will have to see in the Andes or in coastal California.

Garden Club of America and World Wildlife Fund Scholarships in Tropical Botany

The tropics contain roughly 60 percent of the world's plant species, yet we have relatively little information on the biology and ecology of many of these plants. Since 1982 the Garden Club of America and World Wildlife Fund-U.S. have awarded at least two, $5,000 scholarships each year for work in tropical botany. The purpose of the scholarships is to encourage students to work on the systematics, reproductive biology, ecology and ultimately, the conservation of tropical plants and ecosystems. Available to all students enrolled in a U.S. university and working on their doctoral dissertation, the scholarship is intended to fund field research expenses. An indication of a long-term commitment by the student to conservation of tropical ecosystems is a deciding factor in awarding the scholarship.

Three of the thirteen recipients have been working on questions of palm taxonomy, ecology and conservation. In 1983, Andrew Henderson of the New York Botanical Garden received an award for his work on the systematic relationships and reproductive biology of three Iriarteoid genera, *Iriartea*, *Socratea* and *Dictyocaryum*. The grant enabled him to conduct collecting trips to Costa Rica, Panama and Colombia. In 1986, Bill Hahn of Cornell University was awarded a scholarship for his study of the Asian genus *Caryota*, which allowed him collecting trips in southeast Asia. In 1987, the Garden Club of America awarded a special third scholarship to Stephen Siebert of Cornell University for his work on the ecology and ethnobotany of wild rattans in forest preserves of Sumatra, Indonesia.

These scholarships will be offered again this year and it is hoped that they will become a permanent program of the Garden Club of America and World Wildlife Fund.

To apply for the scholarships students should submit the following information: 1) a curriculum vitae, including graduate and undergraduate transcripts; 2) evidence of foreign language capability; 3) a two-page outline of the proposed research; 4) a letter stating his or her plans for the future, with a statement on their commitment to conservation; and 5) a letter of recommendation from the advisor, which should include an evaluation of the student's progress to date. U.S. citizenship is not a requirement, however, students must be enrolled in a U.S. university. The awards will be made on a one-time basis, and applications are due by December 31, 1987. Recipients will be announced by March 15, 1988. Please mail applications to:

JANE C. MACKNIGHT
Garden Club of America
Scholarships in Tropical Botany
World Wildlife Fund
1250 Twenty-fourth Street, NW
Washington, D.C. 20037

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Phenology and Pollination Biology of Sabal etonia (Palmae) in Southeastern Florida

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In southeastern Florida, along the crests of Pleistocene dunes of the Atlantic Coastal Ridge, is found a unique habitat known as "scrubby flatwoods" (Abrahamson et al. 1984), in which can be found *Sabal etonia* Swingle ex Nash (Palmae: Coryphoideae). The scrubby flatwoods habitat is essentially sand pine scrub in which sand pine, *Pinus clausa* (Chapm. ex Englm.) Vassey ex Sarg., is either absent or replaced by slash pine, *Pinus elliotii* Englm. var. *densa* Little & Doorman. The characteristic xerophytic oaks (e.g., *Quercus geminata* Small, *Q. myrtifolia* Willd.) and many other associated sand pine scrub species are typically present (see Richardson 1977, Abrahamson et al. 1984, Zona and Judd 1986). A special effort was made to study this palm in southeastern Florida because the scrubby flatwoods there are threatened by urban development.

The diversity of pollinators in the Palmae has only recently become evident (Henderson 1986). For example, beetles (Henderson 1984), flies (Schmid 1970), bees (Brown 1976), and bats (Beach 1986) are now known to be pollen vectors. Wind pollination is also known in the Palmae (Read 1975). *Sabal etonia* exhibits many of the typical features of a biotic pollination "syndrome" (Faegri and van der Pijl 1979): conspicuous floral display, anthesis synchronized with potential pollinator activity, sticky pollen, floral fragrance, and nectar production. This study, however, is the first to document the insect visitors of *S. etonia*.

Materials and Methods

Field observations and collections were made of the insect visitors to *S. etonia* in a relatively undisturbed remnant of scrubby flatwoods in Boynton Beach, Palm Beach County, Florida. Continuous surveillance of four inflorescences was undertaken between 03:20 and 15:20 on 11 June 1986; observations of phenology and censuses of insect visitors were made at 20 minute intervals. Supplemental observations were made on 17 additional inflorescences from 10–19 June 1986. All times are given in 24 hour notation and in Eastern Standard Time equivalents.

Pollen loads of insects were sampled using fuchsin glycerine jelly (Beattie 1971). Bee collections are deposited at the Los Angeles County Museum of Natural History; syrphid flies are deposited in the United States National Collection of Insects, Washington, D.C. Voucher herbarium specimens are deposited at Rancho Santa Ana Botanic Garden.

Phenology

Sabal etonia is usually a low-growing palm, with 3–5 leaves arising from the subterranean stem. It flowers in late May through July. Each individual produces from 1–5, but typically 2–3, interfoliar inflorescences, which are densely branched and bear ca. 500–800 creamy white, fragrant hermaphroditic flowers. Rachillae are exserted well beyond the dry, papery peduncular bracts. The flowers have 3

minute tooth-like calyx lobes, 3 petals each ca. 3.1 mm long, 6 stamens about as long as the petals, and one gynoecium of 3 fused carpels. Anther dehiscence is latrorse, by longitudinal slits. Septal nectaries are present at the base of the gynoecium; the gynoecium and calyx lobes are heavily invested with tannins (Zona, pers. obs.).

The first flowers to open are those at the basal portion of the inflorescence, with anthesis progressing acropetally up the inflorescence. Flowers function for only one day, and all flowers in an inflorescence have opened within 5–7 days. Additional inflorescences on a plant may be at various stages of maturity and anthesis.

Anthesis begins when the buds first begin to open at approximately 02:40. Fragrance production begins around 03:00. The fragrance is sweet, pungent, and very noticeable even though the flower buds have only just begun to open. By 05:00, nectar is visible as small droplets at the base of the gynoecium. At this time the petals have not fully spread, and the stamens are held together around the gynoecium by the petals in such a way that the undehisced dorsifixed anthers obscure the stigma. At 07:00, the petals are spread, and the flowers are fully open.

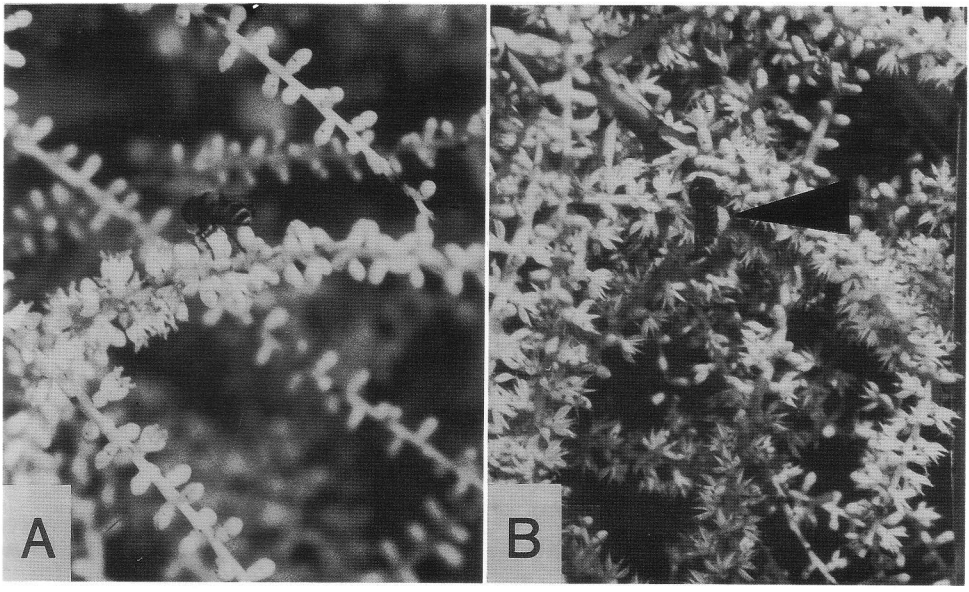
Anther dehiscence occurs at 07:20–08:00. Dehiscence occurs first in those flowers exposed to sun; shaded anthers dehisce somewhat later.

No visible change occurs in the stigma that might indicate its receptiveness. The stigmatic surface is dry and white and remains so until pollen and/or dust discolors it. Pollen was first observed on stigmas collected at 09:50, well after anther dehiscence, despite the fact that immediately after dehiscence, insects carrying pollen were seen foraging on the flowers. The pattern of pollen accumulation suggests that the flowers are weakly protandrous.

By 13:00, the anther sacs are empty, and by 14:20, nectar is detectable in only trace amounts. Fragrance production

Table 1. Insect visitors to Sabal etonia *in Palm Beach Co., Florida. Asterisk indicates the presence of* S. etonia *pollen on collected specimens.*

Orthoptera
Gryllidae
1 sp. indet. (Trigonidiinae)
Thysanoptera
Heterothripidae
1 sp. indet.
Hemiptera
Miridae
1 sp. indet.
Lygaeidae
**Lygaeus* sp.
Coleoptera
Scarabaeidae
**Euphoria sepulchralis* (Fabricius)
Elateridae
*1 sp. indet.
Lathridiidae
1 sp. indet.
Lepidoptera
Lycaenidae
Euristrymon favonius (Smith)
Diptera
Syrphidae
**Palpada agrorum* (Fabricius)
Ocyptamus dimidiatus (Fabricius)
**Ornidia obesa* (Fabricius)
**Meromacrus acutus* (Fabricius)
**Ceriana floridensis* (Shannon)
**Copestylum mexicanum* (Macquart)
Calliphoridae
Cochliomyia macellaria (Fabricius)
Bombyliidae
*2 spp. indet.
1 sp. indet.
Asilidae
Laphria sp.
Hymenoptera
Formicidae
2 spp. indet.
Scoliidae
**Scolia nobilitata* (Fabricius)
Colletidae
**Colletes mandibularis* (F. Smith)
Anthophoridae
**Xylocopa micans* (Lepeletier)
Apidae
**Apis mellifera* (L.)
Megachilidae
**Megachile albitarsis* (Cresson)
**M. xylocopoides* (F. Smith)
**Coelioxys asteris* (Crawford)
Halictidae
**Agapostemon splendens* (Lepeletier)
**Augochloropsis metallica* (Fabricius)



1. Insect visitors to *Sabal etonia*. A. *Palpada agrorum*, a common syrphid fly. B. *Megachile albitarsis*, the principal pollinator. Arrow points to a conspicuous abdominal pollen load.

ceases between 18:20 and 20:00, and by 03:00 on the following day, the flowers are brownish and attract no insects.

Insect Visitors

Insects from the following orders were collected from the flowers of *Sabal etonia*: Orthoptera, Thysanoptera, Hemiptera, Coleoptera, Lepidoptera, Diptera, and Hymenoptera (Table 1).

The order Orthoptera is represented by only one species of nocturnal cricket (Trigonidiinae), which was observed on the inflorescences on four occasions. Its nocturnal visits were infrequent and sedentary, and it carried no pollen. Thrips (Thysanoptera) were very abundant in the flowers.

Two species of Hemiptera were collected from the inflorescences. The first, a small nocturnal species (Miridae), carried no pollen and was observed only three times. The second, a diurnal *Lygaeus* sp. (Lygaeidae), was observed on two occasions. This phytophagous insect apparently feeds on the inflorescence of *Sabal etonia* and was found to carry pollen on its body.

Three species of beetles (Coleoptera) were collected on the inflorescences. A nocturnal beetle (Lathridiidae) was observed on ten occasions, but it bore no pollen. The common phytophagous *Euphoria sepulchralis* (Scarabaeidae) was observed feeding on floral tissues on three occasions. A click beetle (Elateridae) was found only once. It actively probed the base of the gynoecium presumably seeking nectar and carried pollen on the ventral surface of its body.

The butterfly, *Euristrymon favonius* (Lepidoptera: Lycaenidae) was observed foraging for nectar on four occasions. Its visits were sporadic and haphazard, and the species carried no pollen on its body.

Diptera were very common visitors. Syrphid flies (Syrphidae) were represented by 6 species, most frequently by *Palpada agrorum* (Fig. 1A) and *Copestylum mexicanum*. Other Diptera collected from

inflorescences include: *Cochliomyia macellaria* (Calliphoridae) and 3 unidentified species of Bombyliidae. Most of these are represented by a single collection.

The order Hymenoptera is abundantly represented by two species of ants (Formicidae), one wasp (Scoliidae), and eight bees (see Table 1). The ants were frequently observed on the rachillae but never in the flowers. The wasp was observed only once but carried a significant pollen load. The bees carried large loads of pollen and were very abundant and active during the period of pollen availability.

Discussion

Several of the insect species which visited *S. etonia* were found to carry no pollen loads (see Table 1). Furthermore, all of these insects were infrequent visitors. For these reasons, they are discounted as pollen vectors. The thrips (Thysanoptera) are likewise not considered to be pollinators because they remained at the base of the gynoecium never contacting the anthers or stigmas.

The infrequent pollen-bearing visitors, *Lygaeus* sp., *Euphoria sepulchralis*, *Scolia nobilitata*, *Ceriana floridensis*, and click beetle, are probably not important pollinators of *S. etonia*. They carried appreciable amounts of pollen, but their numbers were few, their visits sporadic. Furthermore, *Lygaeus* and *Euphoria sepulchralis* were very sedentary feeders. Their contribution to the pollination of *S. etonia* is probably not significant.

The syrphids most frequently foraged on nectar during two periods, the first, before the anthers had dehisced and later, after the anthers had been cleaned of pollen by bees. Syrphids were not abundant when bees were actively foraging. The syrphids carried pollen and occasionally appeared to contact the stigmas while foraging. They are probable pollen vectors; however, their foraging behavior was more erratic compared with the behavior of bees, and their pollen loads were smaller. Syrphids probably contribute modestly to the pollination of *S. etonia*.

The pollen-gathering bees *Megachile albitarsis*, *M. xylocopoides*, *Augochloropsis metallica*, *Xylocopa micans*, *Colletes mandibularis*, and *Apis mellifera* were all observed with conspicuous corbicular or abdominal pollen loads. *Agapostemon splendens* and *Coelioxys asteris* carried less conspicuous amounts of pollen on their bodies. The pollen loads of *C. mandibularis*, *A. splendens*, and *A. mellifera* were notably homogeneous in composition. The bees forage systematically through inflorescences, spending up to six minutes (for *M. albitarsis*) in one inflorescence before flying to another. They are very abundant and frequent visitors especially in the hours immediately following anther dehiscence. Of the bees, *M. albitarsis* was the most abundant (Fig. 1B), followed by *M. xylocopoides*, *A. metallica*, and *X. micans*. *Megachile albitarsis* was the most common of all insect visitors (excluding thrips); on 11 June, one to four individuals of *M. albitarsus* were present continuously on each inflorescence from 08:00 to 13:00. The behavior, abundance, frequency, and pollen loads of the bees (especialy the Megachilidae and Halictidae) suggest that they are the most likely pollinators, and that *S. etonia* is predominantly bee-pollinated.

Wind pollination is highly unlikely because the pollen of *S. etonia* is not transported by wind. The pollen is sticky and cannot be dislodged from the anthers by wind nor by shaking the flowers.

Information is now available for comparisons to be made of phenology and pollination biology of three species of *Sabal* found in Florida. Brown (1973, 1976) provides such information for *S. palmetto* (Walt.) Lodd. ex J. A. & J. H. Schultes, and Kunth (1909), citing earlier work by Delpino, provides a very brief assessment of the phenology and pollinators of *S. minor* (Jacq.) Pers. This information sheds new

light on the phenological and ecological isolating mechanisms among these species of *Sabal*.

The phenological observations presented here for *S. etonia* differ somewhat from those of *S. palmetto* and *S. minor*. Both *S. palmetto* and *S. minor* are reported to be protogynous; whereas *S. etonia* appears to be protandrous. Couriously, protogyny, as reported for *S. palmetto* and *S. minor*, is not typical of bee-pollinated palms (Henderson 1986).

The difference in timing of stigma receptivity in *S. etonia* as compared with the other two species appears to represent an interspecific difference. Brown (1976) reports that stigma receptivity in *S. palmetto* begins at 05:00, but at that hour the stigma of *S. etonia* is obscurred beneath the undehisced dorsifixed anthers. Insect visitors would not likely contact the stigma of *S. etonia* at this stage of anthesis. The timing of anther dehiscence is similar for both species, occuring at 07:30–09:10 in *S. palmetto* (Brown 1976) and at 07:20–08:00 in *S. etonia*.

The pollinators of *S. minor*, a wasp (*Polistes*) and *Halictus* bees (Kunth 1909), differ markedly from those of *S. etonia*. This difference is not surprising given the very different habitats of these palms (mesic deciduous forests, for *S. minor*). The different pollinators and habitats are formidable barriers to hybridization between these two species. Of the 24 spp. of bees visiting *S. palmetto*, the primary pollinators are *Apis mellifera*, *Augachlora pura* (Say), *Agapostemon splendens*, and *Dialictus* spp. (Brown 1976). *Sabal palmetto* is isolated from *S. etonia* by habitat and, to a great extent, by bee pollinators, but *S. etonia* has five bees in common with *S. palmetto*. They are: *Agapostemon splendens*, *Megachile albitarsis*, *M. xylocopoides*, and *Xylocopa micans* along with the introduced *Apis mellifera* (Graenicher 1930; Brown 1973, 1976). The wasp *Scolia nobilitata* also visits both palms (Brown 1973). The shared native pollinators and the close proximity of habitats of *S. etonia* and *S. palmetto* in South Florida give credence to the hypothesis (Zona 1985) that hybridization in ancient times may have given rise to another species, *S. miamiensis* Zona.

Sabal etonia is a characteristic species of the sand pine scrub habitat of the Central Florida Ridge (Zona and Judd 1986); however, its pollination biology throughout the entirity of its range is not known. While collecting *S. etonia* in Polk County, I observed honeybees, *Apis mellifera*, lovebugs, *Plecia neartica* Hardy (Diptera: Bibionidae), and weevils (Curculionidae: Baridinae) attracted to the inflorescences in great abundance. Large populations of honeybees are maintained in the area by local citrus growers, so it is likely that the honeybee is a significant pollinator in certain locales. The roles of the lovebug and the weevil are uncertain.

Summary

In southeastern Florida, *Sabal etonia* flowers in May–July. *Sabal etonia* has many characteristics of an entomophilous palm. Its flowers are protrandrous, producing fragrance and nectar. The most common insect visitors are flies (Diptera: Syrphidae) and bees (Hymenoptera: five families). Their behavior, their abundance and frequency, and their large pollen loads suggest that bees, especially *Megachile albitarsis*, are the major pollinators.

Acknowledgments

I am grateful to Roy R. Snelling, Los Angeles County Museum of Natural History, for identifying the wasp and bees. The calliphorid and syrphid flies were kindly identified by N.E. Woodley and F. C. Thompson, Systematic Entomology Laboratory, United States Department of Agriculture. For his comments on the manuscript, I thank Andrew Henderson. I thank Patricia and Roger Zona for their assistance in the field. This study was

funded in part by a grant from the Southern California Botanists.

LITERATURE CITED

ABRAHAMSON, W. G., A. F. JOHNSON, J. N. LAYNE, AND P. A. PERONI. 1984. Vegetation of the Archbold Biological Station, Florida: an example of the southern Lake Wales Ridge. Florida Scientist 47(4): 209–250.

BEACH, J. H. 1986. Pollination biology of spadices and spicate inflorescences in Cyclanthaceae and Palmae. American Jour. Bot. 73(5): 615–616 (abstract).

BEATTIE, A. J. 1971. A technique for the study of insect-borne pollen. Pan-Pacific Entomologist 47(1): 82.

BROWN, K. E. 1973. Ecological life history and geographical distribution of the cabbage palm, *Sabal palmetto*. Ph.D. dissertation, North Carolina State University, Raleigh, North Carolina.

BROWN, K. E. 1976. Ecological studies of the cabbage palm, *Sabal palmetto*. Principes 20(1): 3–10.

FAEGRI, K. AND L. VAN DER PIJL. 1979. The Principles of Pollination Ecology, 3rd ed. Pergamon Press, Oxford. 244 pp.

GRAENICHER, S. 1930. Bee-fauna and vegetation of the Miami region of Florida. Ann. Ent. Soc. America 23: 153–174.

HENDERSON, A. 1984. Observations on pollination of *Chryosophila albida*. Principes 28(3): 120–126.

——— 1986. A review of palm pollination studies. Bot. Rev. 52(3): 221–259.

KUNTH, P. 1909. Handbook of Flower Pollination, 3 vol. [Transl. by J. R. Ainsworth Davis]. Clarendon Press, Oxford. 1729 pp.

READ, R. W. 1975. The genus *Thrinax* (Palmae: Coryphoideae). Smithsonian Contr. Bot. 19: 1–98.

RICHARDSON, D. R. 1977. Vegetation of the Atlantic Coastal Ridge of Palm Beach County, Florida. Florida Scientist 40(4): 281–330.

SCHMID, R. 1970. Notes on the reproductive biology of *Asterogyne martiana* (Palmae). II. Pollination by syrphid flies. Principes 14(2): 39–49.

ZONA, S. 1985. A new species of *Sabal* (Palmae) from Florida. Brittonia 37(4): 366–368.

ZONA, S. AND W. S. JUDD. 1986. *Sabal etonia* (Palmae): systematics, distribution, ecology, and comparisons to other Florida scrub endemics. Sida 11(4): 417–427.

Warning: ROUNDUP Herbicide Can Be Harmful to Your Palms' Health

We read with interest the July article which included a study on the use of a post-emergent herbicide ROUNDUP. This chemical is a non-selective, very effective, potent plant killer. Extreme caution should be used when applying ROUNDUP for weed control. It should never be sprayed near valuable plants. This chemical is usually applied with a wick applicator which is used to "wipe" the tops of weeds. Always mix and dilute according to the label—a tiny amount will go a long way. As an example, a whole clump of bamboo can be destroyed if one leaf of one cane is dipped in undiluted ROUNDUP. The chemical spreads quickly throughout the entire plant system and provides a sure, quick kill. To eliminate irritating patches of poison ivy, fill a cup with ROUNDUP diluted by half with water and using a small paintbrush, stroke one leaf of each ivy. It is also very effective on cat-tails.

While ROUNDUP may not affect some woody ornamentals or mature palms, it is far too dangerous to use without extreme caution and complete knowledge of its potency. Be aware and beware.

LYNN AND KENNETH MCKAMEY

Principes, 31(4), 1987, pp. 183–186

Propagation of Chilean Wine Palm (Jubaea chilensis) by Means of in Vitro Embryo Culture

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ABSTRACT

It has been demonstrated that *in vitro* culture of embryos of the Chilean wine palm (*Jubaea chilensis* (Mol.) Baillon) accelerated and considerably increased their growth and development. Traditionally, fruits of this species sown in conventional ways have exhibited poor germination. Embryos were cultured in solid medium, Murashige-Skoog (MS), without hormones and with activated charcoal (4 gr/l) in the first stage of culture. After 30 to 40 days 25% of the embryos initially cultured were ready to be transplanted into soil.

The Chilean wine palm *Jubaea chilensis* (Mol.) Baillon is native in continental Chile. It is a very long-lived plant and due to its morpho-anatomy is well adapted to xerophytic climatic zones. In Chile it is distributed from south of the Limarí River (31° latitude South) to the mouth of the Maule River (35°18′ latitude South). Nevertheless, the greatest concentration of specimens appears in the Valleys of Ocoa (V región) and Cocalán (VI región). This plant is used for reforestation since oil is obtained from its fruits and honey from the sap. The Chilean wine palm is propagated exclusively from seeds; their poor germination and slow growth constitute the principal difficulties to its culture. The percentage of germination obtained in nurseries with traditional methods is less than 2% (from 36,000 fruits sown after a year only 600 germinated (Trobok, personal communication)).

One of the methods currently used to accelerate or solve the difficulties in germination is the culture of embryos *in vitro* (Figs. 2,3,4). This allows the development of the plant under controlled conditions, eliminating such possible causes of dormancy as impermeability of the outer cover of fruit or seed and or the presence of inhibitors or immature embryos.

The present work investigates the possibility of propagating the Chilean wine palm rapidly and efficiently by means of *in vitro* embryo culture.

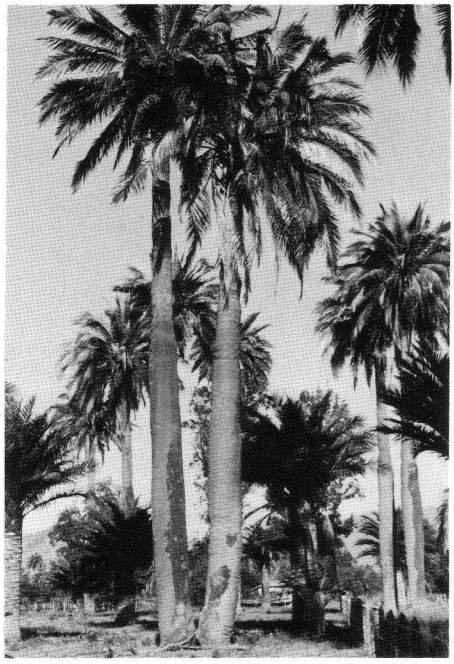
Materials and Methods

In the autumn of 1984 ripe fruits* were gathered from 400 year-old Chilean wine palms situated in the palm farm of Cocalán (Fig. 1).

Previous to *in vitro* culture, fruits and embryos were classified into two groups according to size and weight (Table 1). This was to facilitate comparison studies of these two groups in their subsequent growth and development.

Extraction of embryos involved cracking seeds (Figs. 2,3) and sterilizing their embryos in a 3% sodium hypochlorite solution for 15 minutes followed by rinsing three times in sterile water. The medium used for culture was Murashige and Skoog (MS) (1) with naphthalene acetic acid (NAA, 2 mg/l); (2) MS with benzylaminopurine (BAP, 2 mg/l) and without hormones. All the media was supplied with saccharose (30 g/l), adjusted to a pH of 7.

* We call "fruit" the seed plus endocarp which is the traditional structure used in propagation.



1. Specimens of the Chilean wine palm from which the fruits for this research were obtained.

Liquid and solid media (agar 7 g/l) were used. Later attempts included activated charcoal (4 g/l) and polyvinylpyrrolidone (4 g/l) in the MS liquid and MS/2 solid media without hormones. All media were sterilized in an autoclave at 110° C for 15 minutes.

Five embryos were cultured in each 125 ml erlenmeyer flask containing 25 ml of nutrient medium. Preliminary attempts to determine the most favorable medium and temperature for growth and development were done using three erlenmeyers (15 embryos total for each treatment). Later, fifty erlenmeyers with solid MS media and without hormones were cultured, 25 with small embryos and 25 with big embryos. Cultures were kept in a climatic chamber at 30° C ± 3 with an intensity of 54 uE (PAR) and a photoperiod of 16 hours of light.

Evaluation of different media was done eight days after culturing. Embryos that managed to develop were subcultured to a fresh medium of the same chemical composition and a definitive evaluation took place 20 days after the transplant.

Simultaneously and for comparison, fruits were sown in a sandy substrate under the same conditions as embryos *in vitro*.

Table 1. Average size and weight of 20 embryos of Chilean wine palm.

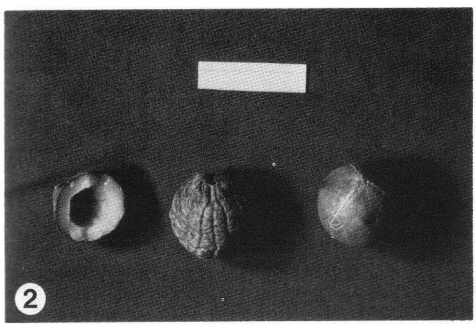
	Weight (gr)	Diameter (mm)	Length (mm)
Big fruits	8.85	27.05	—
Small fruits	4.91	20.81	—
	(mg)		
Big embryos	3.78	1.24	3.13
Small embryos	3.09	1.08	2.98

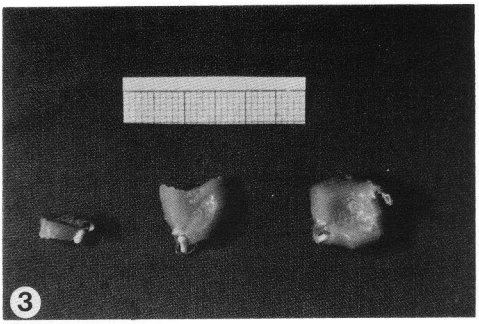
Results

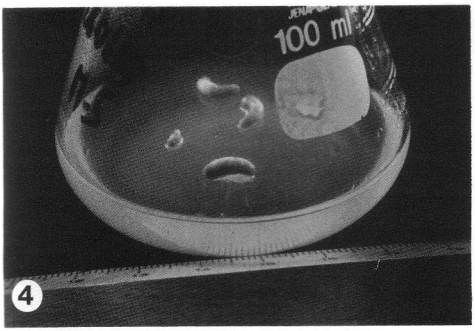
The results of the preliminary experiments showed that in a solid medium (MS) without hormones, the embryos began to grow after five to eight days of culture. Growth was initiated on 79% and 85% of the big and small fruits respectively. Also, the size of the embryos was three to five times larger than their initial size (Fig. 4). All were kept at a temperature of 30° C since it was observed that at temperatures lower than 25° C there was very little or no growth.

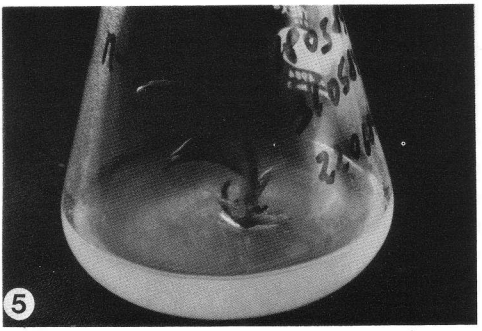
Embryos cultured in a liquid MS medium without hormones only increased in size without showing further development. Embryos put in a solid MS medium with different combinations of growth regulators did not develop and slowly decayed.

Eight days after culturing, embryos that began to germinate were subcultured in a fresh medium of equal chemical composition. After thirty days 58% of them had developed shoots, 8% had roots, and only 6% had shoots and roots (Figs. 5). This low percentage of development was overcome by a new culture of embryos in the same nutrient medium but adding acti-





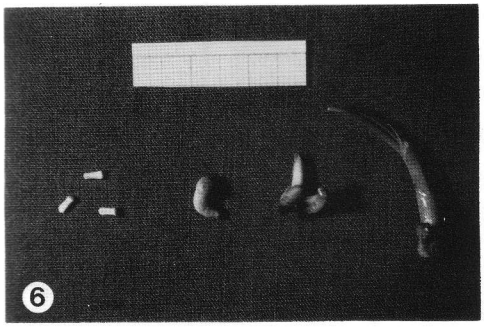


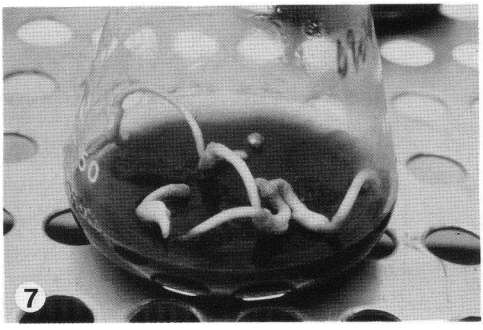


2. A fruit of a Chilean wine palm with and without mesocarp. 3. Position of the embryo in the fruit of a Chilean wine palm. 4. Initiation of germination *in vitro*. 5. Seedling 30–40 days after being sown.

vated charcoal (4 g/l). This resulted in 45% of the embryos developing radicles (Fig. 7). After 15 days in this medium embryos were removed to the same nutrient medium but without activated charcoal where approximately 50% of them developed shoots.

Thirty to forty days after initial culturing, 25% of the embryos were ready to be transplanted to a sand : vermiculite (60: 40) substrate. Preliminary results of this phase of the investigation give low percentage of survival, about 20% after seven months.





6. Development of embryos of Chilean wine palm in a solid MS nutrient medium without hormones. After only 30–40 days development of shoots was obtained. 7. Initiation of root development ten days after sowing when activated charcoal is added to MS medium; later they will be removed to a nutrient medium without activated charcoal where the development of shoots will take place.

Contrary to previous results, fruits shown under the same environmental conditions did not show any germination after three months. Notwithstanding, when embryos were removed from the fruits they were completely hydrated and when cultured *in vitro* they began to germinate normally.

Discussion

In the present research it is suggested that seed of the Chilean wine palm does not germinate under natural conditions due to various possible factors: 1, mechanical impediment of part of the endocarp or endosperm for expansion of the embryo; 2, inhibition caused by chemical stimuli on part of the endocarp, endosperm, or seed coat during imbibition; 3, accumulation of natural growth inhibitors in the endosperm which once imbibed cannot be overcome by the embryo; and 4, surrounding conditions inappropriate for natural germination that differ from those required for growth *in vitro*.

Later observations showed that accumulation of natural growth inhibitors was not a determining factor since when ten embryos were cultured in only 3. ml of the nutrient medium mentioned above, they began to develop without any difficulty even under this condition of crowding.

While finishing this work several attempts are taking place to establish in pots plants produced *in vitro* as well as the propagation by direct sowing with different treatments and environmental conditions.

Acknowledgments

I wish to sincerely express my gratitude to Mrs. Claudia Botti, Ing. Agr. MS. Professor of Botany, Facultad CS. Agraria y Forestales, U. de Chile, for her help in revising and correcting the text of this publication.

RESULTS OF THE WRITING CONTEST

Nine papers were submitted to the contest to write an article about growing palms or on a favorite palm. The papers were all very interesting and the four judges had difficulty reaching decisions. Four winners were finally chosen:

First Prize: **Garrin Fullington,** "*Parajubaea*—an unsurpassed palm for cool, mild areas"

Second Prize: **Charles J. Reynolds,** "An unappreciated native: *Sabal palmetto*"

Third Prize: **Leonard Goldstein,** "Growing palms in cold areas of South Florida"

Fourth Prize: **Ralph Velez,** "My forty-two years as a palmophile"

All articles submitted will appear eventually in *Principes*, beginning with Garrin Fullington's in this issue (see pp. 172–176). The winners can expect their prizes in due course.

THE EDITORS

Principes, 31(4), 1987, pp. 187–188

LETTERS

A Letter from North Queensland

My love affair with palms began in 1978, when with no experience in either department, I commenced business as a small Art Gallery owner and Palm Nursery woman. I was attracted to the fact that if you don't sell your palms as infants, they can only become more valuable as you pot them on.

This small venture continued until 1985 when for personal reasons it was closed. However the passion for palms was running stronger than ever, my tubbed collection was growing steadily, and I was ready and happy to devote all my spare time to palms.

I have been a member of the International Palm Society since 1981 and in 1983 commenced receiving seed from the Seed Bank. I had not joined immediately as I felt some very special talent was needed in this field, and previously bought seedlings or sown seed of local and hardy palms such as *Carpentaria acuminata*, *Archontophoenix* spp. and others.

What a delight the Seed Bank participation has proved to be. It is a challenge to grow from seed rare and beautiful palms from around the world, and I have had an intoxicating success rate. The next challenge, of course, is to get them on to the stage where they can join your collection in the garden!

Mackay has a sub-tropical climate which is very favorable for germinating and growing many species of palms. I have no special aids in the form of shade houses etc., but the 801 sq. meter allotment where specimens are now planted is partly covered with big paper bark trees under which I plant shade loving palms, and the remainder is used for sun loving palms such as *Bismarckia nobilis*, *Carpentaria acuminata*, etc. There is a continuous fall of narrow paper bark leaflets creating a permanent mulch.

Planting of tub specimens began in April 1986 and progress made since then is quite substantial. The palms have shown how happy they were to get their roots down into the loose sandy loam. In particular a *Pritchardia pacifica* is looking very impressive with a light canopy from the paper bark trees. A coconut that my son had sent from the Markham Valley in New Guinea, had burst its tub, and since planting has leapt along. This coconut reportedly can produce nuts the size and shape of a soccer ball, so a position well away from boundaries and buildings needed to be thought about before planting. In New Guinea I saw a native boy climb a Markham Valley tree and kick down half ripe nuts which left a sizeable depression in the lawn.

Whilst in New Guinea, with the help of Ronito Capino, Horticulturist at the Lae Botanical Gardens, I collected seed of various *Ptychosperma* species, *Arenga westerhoutii*, and *Hyphaene crinita*.

Hyphaene crinita seed was collected from putrid swampy water surrounding the palm. After soaking, scrubbing, and defuzzing the woolly surface, the smell lingered on and in fact, accompanied us all the way back to Mackay. The huge quantity of seed on the palm was too high to reach so we had to collect the seed on the ground.

On returning home I divided the seed into lots of three and distributed it to palm loving friends here. Three have had success in germination so far; however, one attempted to plant the seed after germination, and as there is no top growth, it seems to be lost. The second friend also has no top growth. He left the seed exposed on the potting mix and it may be that they have dehydrated. As we have learned, *Hyphaene* should be planted in a very deep container or *in situ*, as the big fleshy young shoot should not be disturbed. And

so to the third friend. He planted the seed in a 12″ tub and when the seed germinated it was a matter of two to three weeks and the root was growing out the bottom of the tub. In fact it had penetrated the gravel of the shade house floor. He had gone on holiday for a few weeks and when he returned something had to be done—pronto! After due consideration he decided to offer the *Hyphaene* back to me, as his allotment could not carry a palm of the eventual size this species grows to be. So on 7/12/86 we planted the *Hyphaene* on my allotment, in a rather unorthodox manner. We dug the hole and lowered the palm, complete with tub so as not to damage the root.

On the day of planting there was a small sword leaf just emerging on the surface of the potting mix, and on 30/12/86 this incredible leaf had expanded to 31 cm. This without a doubt is the fastest growth of a palm seedling leaf I have seen, and this includes a *Pigafetta filaris* seedling I am watching with interest. I wonder how long it will grow at this rate. We hope that eventually the tub will burst and disintegrate with no ill effects to the palm.

Below is listed the palms thriving in my collection. There has been one loss, a beautiful *Socratea* which made great progess then collapsed and died.

NB: Three weeks after the *Hyphaene crinita* had reached a length of 40″ then ceased growing and a second leaf began to shoot.

List of Palms

Archontophoenix sp. (Iron Range)
Archontophoenix alexandrae
Areca catechu
Areca triandra
Bismarckia nobilis
Carpentaria acuminata
Caryota cumingii
Chamaedorea atrovirens
Chamaedorea costaricana
Chamaedorea erumpens
Chamaedorea glaucifolia
Chamaedorea microspadix
Chamaedorea seifrizii
Chrysalidocarpus cabadae
Chrysalidocarpus lutescens
Chrysalidocarpus madagascariensis var. *lucubensis*
Coccothrinax argentea
Cocos nucifera (Markham Valley)
Cocos nucifera (Malay Dwarf)
Elaeis guineensis
Hydriastele wendlandiana
Hyophorbe lagenicaulis
Hyophorbe verschaffeltii
Hyphaene crinita
Laccospadix australasica
Licuala ramsayi
Licuala spinosa
Neodypsis decaryi
Normanbya normanbyi
Phoenicophorium borsigianum
Pigafetta filaris
Pinanga kuhlii
Pritchardia pacifica
Rhapis excelsa
Roystonea sp.
Wodyetia bifurcata

LOIS MCGREGOR

SEED BANK NEWS

Some Come With Stripes

When I visited Iquitos last February (see *Principes* 31(3):152) I noticed right on the Plaza de Armas in Iquitos a newly planted palm area. Of course I examined the species present in my everlasting quest for something interesting for the Seed Bank. To my amazement I found that four euterpes with yellow striped crownshafts were on each corner of the Plaza. Unfortunately they were not in seed. My curiosity was aroused and when I took the afternoon trip around the general area of Iquitos I made a point of tracking down this oddity. On the very end of a dirt road we came upon a little forest of these interesting trees with more or less stripes on their crownshafts, but no pure green (normal) *Euterpe* among them. So they were not odd balls as I had feared but there was a whole colony of them freely interbreeding.

As soon as I had established a firm supply line with a German landscape artist in Iquitos I asked him to go and find that little enclave of variegated *Euterpe precatoria*. The first seed has arrived and has been distributed by the Seed Bank under the number 87-PS-379 *Euterpe precatoria* "variegata." They should make a striking subject for our tropical growers; a real conversation piece in any garden.

INGE HOFFMANN

Attention Hawaiian Seed Bank Subscribers

The following letter from the Hawaiian Department of Agriculture prevents the Seed Bank from sending any further shipments of seeds to our Hawaiian subscribers from this date forward. This is due to the strict requirements spelled out in this letter with which we cannot comply. If any of you have credit with the Seed Bank, we will gladly refund all of your monies.

If any of you should be able to influence the Department to accept the Certificate of Origin that has been provided by the International Palm Society Seed Bank up to this time, I can assure you that your work would be worthwhile.

Regretfully yours,

INGE HOFFMANN
DAVID SYLVIA

Dear Mr. Sylvia:

It has been reported that the International Palm Society (IPS) through The Seed Bank sends the seeds of rare palms to members nationwide. Hawaii has promulgated quarantine regulations governing the importation of palm plants and plant parts to protect our ecology and nursery industries.

Attached please find a copy of Chapter 70, Plant Import Rules, and Memorandum dated 5/2/85 expanding the list of countries in which lethal yellowing, Cadang Cadang, Guam disease, and other similar diseases of palm, are known to occur. Your cooperation in adhering to these regulations would be appreciated.

Generally, palm seeds being sent to Hawaii from IPS shall be accompanied by an official Certificate of Origin. Official meaning a certificate signed by a State Agricultural Officer indicating the locality in which the seeds were grown and that the locality is free of the palm diseases listed in Chapter 70, Subchapter 12, Section 4-70-43. If seeds are of foreign origin, the certificate should be signed by an Agricultural Officer of the Country of Origin.

Thank you for any help you may provide to keep lethal yellowing and similar diseases out of Hawaii. If you should require more information, feel free to write or call (808) 548-7175.

Sincerely,

GLENN TAKAHASHI
Maritime Supervisor
Department of Agriculture
Plant Quarantine Branch
701 Ilalo Street
Honolulu, Hawaii 96813-5524

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