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THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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Contents for July

Cover Picture

Chamaedorea tenerrima has one of the most striking leaves in the genus and, perhaps, in the entire palm family. Photo by D. R. Hodel. See pp. 133–138.

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Principes, 35(3), 1991, p. 123

Editorial

Plans for the next biennial meeting of our society are well under way. The meeting is to be held in Florida in November 1992 and we are sure this will be a very special event. One proposed post-Biennial tour is to Costa Rica and for all those joining this tour, a highlight will be a visit to one of the finest palm collections in the world—the Jardin Botanico Robert y Catherine Wilson, formerly known as Las Cruces Botanical Garden. Jim Mintken and Bill Gunther have written a brief but mouth-watering account of this wonderful collection that should encourage many to join the post-Biennial tour. Dick Phillips from Fiji presents an account of the Botanical Gardens of the South Pacific, with its increasing collection of palms, that clearly reflects Dick's enthusiasm.

The Wilson Botanical Garden is particularly rich in species of *Chamaedorea*, of which many remained unnamed until Don Hodel began preparing his manuscript for his new book on *Chamaedorea*. In this number of Principes we have yet more descriptions of new species of *Chamaedorea*, this time two diminutive species from Panama. This is one of the last of the papers where new names are validated. We all look forward to the final publication of a long-awaited account of this most popular genus. A quite different aspect of the genus *Chamaedorea* is touched on by Ken Oyama who describes how seeds of *C. tepejilote* are predated by a beetle. The large quantities of seed produced by many palms may represent an adaptation to overcoming the effects of predation by animals, rather than a profligacy that justifies over-enthusiastic seed-collection by us.

It is remarkable how large palms can be overlooked, even in well-botanized areas. Father Matthew continues to work away in Southern India, turning up new records of all sorts of interesting plants. He reports here on a significant palm find—a major extension in the range of the very local *Bentinckia condapanna*, a palm much less familiar to growers than its handsome relative from the Nicobars, *B. nicobarica*.

Given the wide distribution in geological past of the mangrove palm, *Nypa fruticans*, it is remarkable that the palm is confined to the Indo-Malaysian region and the west Pacific today. In the early part of this century it was introduced to west Africa, where it is now well established in estuaries in Nigeria and Cameroon. Indeed, one of your editors (JD) saw *Nypa* growing luxuriantly near Limbe in Cameroon in June, looking so very much at home that one had to remind oneself that Limbe is in Africa, not Asia. Norman Duke reports for the first time the occurrence of *Nypa* in mangroves in Panama. Perhaps we may ultimately come to regard this apparent introduction as irresponsible, if *Nypa* spreads further and competes with the indigenous mangroves.

Another aspect of the introduction of organisms to new areas is discussed by R. M. Giblin-Davis in his article on the Red Ring Nematode. This destructive organism presents a real threat to palm horticulture and the article clearly demonstrates the need for responsible attitudes to plant quarantine.

Two aspects of the coconut are covered in this issue. Hugh Harries, whose name is almost synonymous with coconuts, has pioneered the establishment of an authority for the registration of coconut varieties for the International Society for Horticultural Science. In his article he provides clear justification for the authority. David H. Romney describes a simple, but highly effective and rewarding, fertilizer trial with coconuts, and goes on to encourage palm-growers to experiment with other palms. William Hahn has made some comments on Acanthococos.

Finally, and as usual, there is plenty of news of the activities of the IPS and its Chapters.

JOHN DRANSFIELD
NATALIE W. UHL

Principes, 35(3), 1991, pp. 124–126

The Wilson Botanical Garden

JIM MINTKEN AND BILL GUNTHER
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Most folks have never even heard of it, but probably the second largest collection of palm species on earth grows far from any major city, at the southern extremity of Costa Rica, almost on the Panamanian border.

Not just a huge collection of palms, it is one of the most complete of all tropical botanical gardens. In addition to about 600 species of palms, it also boasts remarkable collections of cycads, heliconias, bromeliads, tree ferns, orchids, marantas, and bamboos, all of them located on 342 acres of rolling land, part of which is beautifully landscaped, but most of which remains as natural rainforest.

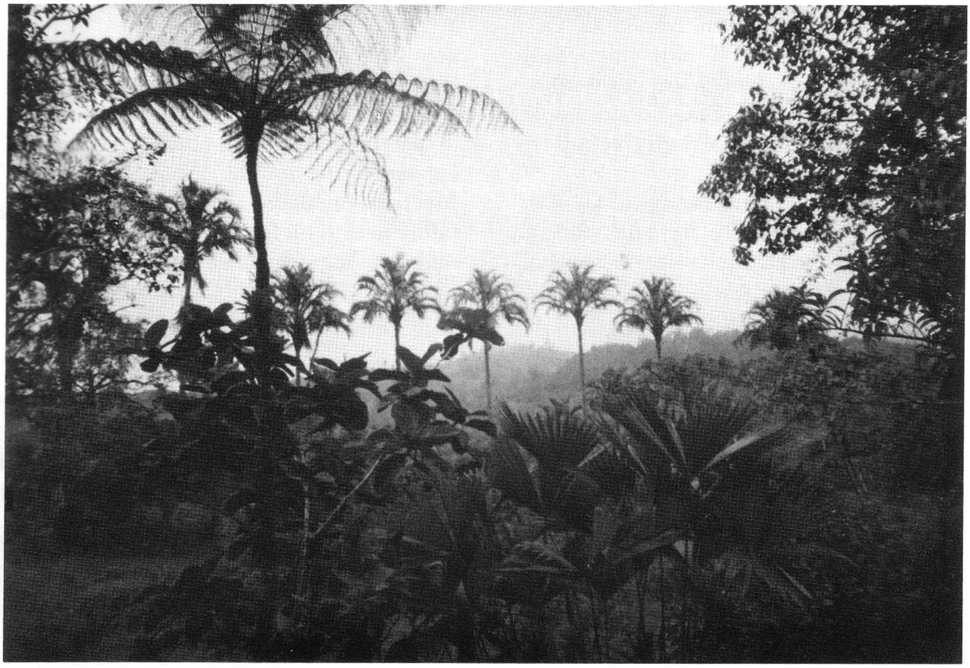
It is the Wilson Botanical Garden; also known as the Jardin Botanico Robert y Catherine Wilson; previously known as the Las Cruces Botanical Garden. The Garden was established in 1963 by an American named Bob Wilson. In 1973 the property was transferred to the OTS (Organization for Tropical Studies, a consortium of universities which offer courses in tropical biology and agroecology). In 1986, due to Wilson's age and failing health, Luis Gomez took over as Director. Bob Wilson died in 1989.

Because it is a biological field station, the Wilson Botanical Garden also possesses a research/residence building with newly expanded laboratory facilities, and with sleeping and dining facilities for up to about 40 students and guests. Additional living facilities are available in the nearby town of San Vito; reservations in advance are advisable.

The schedules of various tropical biology courses based at the Garden vary from year to year, so reservations for space in the residence building at the Wilson Botanical Garden are necessary well in advance. That fact, right now, is pressingly urgent to the International Palm Society—for the reason that the 1992 Biennial meeting of that society already has been scheduled to be centered in Miami, Florida, with a "probable" post-biennial meeting in Costa Rica.

Now, back to the features of the Wilson Botanical Garden.

Yes, this Garden is out of the way; it is located on the southern extremity of Costa Rica. But the five-hour bus trip from San Jose (the capital city of that nation, where planes from Miami land) to the Gardens will not be a monotony. Far from it—interspersed during that trip are several small towns, each of which has shops selling locally made items, and each of which has cafes which serve local specialties. The road traverses forested highlands, and immediately beside the road in many places are the strikingly huge leaves of the attractive plant Gunnera. Immediately after your bus leaves the pan-American highway for the side road to San Vito, it reaches the alligator infested Rio Terraba River, over which a bridge has been started, but which, as of this writing, is not completed. So your bus crosses via a ferry-scow which seems precariously small and unsafe. For certain, no passenger will be sleeping here! And starting immediately after the river crossing are assorted native and exotic palms; these continue intermittently until the bus enters the Wilson Garden, when palms



1. This photo, taken at the Jardin Botanico Wilson, features a lineup of *Pigafetta filaris*, David's Fairchild's favorite palm, native to the Moluccas, Sulawesi, and New Guinea.

become conspicuous rather than an occasional sight.

The photos which illustrate this article provide but a few examples of the wealth of mature tropical palms on display, not just as single specimens but rather in groups and groves. Seemingly, whatever might be one's main specialty palm interest, here that specialty abounds. For example, Don Hodel, in researching his soon-to-be published book on Chamaedorea palms, found many of the previously unnamed *Chamaedorea* species already collected from the wild, already planted, and already growing happily in the ideal palm environment at the Wilson Botanical Gardens—

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2. Profiled in the center of this photo is a rare Madagascan palm, *Phloga polystachya*, one of the 600 exotic and native palm species which have been accessioned at Jardin Botanico Wilson in Costa Rica.

where nature provides an average of 157 inches of annual rainfall plus other ideal growing conditions which in most other botanical gardens, and in most of our home gardens, must be artificially synthesized by man.

Study at the Wilson Botanical Garden is almost a prerequisite for any student who desires a graduate degree in tropical horticulture. Similarly, a visit to the Wilson Botanical Garden is equally important to any serious palm enthusiast. And the most enjoyable time to visit it is in company with fellow members of the International Palm Society.

So, when the first opportunity comes for signing up for the 1992 IPS Biennial Meeting, simultaneously make a deliberate effort to sign up for any offered post-biennial meeting which includes the Wilson Botanical Garden, in Costa Rica. Visiting it will be something like life's fulfillment.

BOOKSTORE

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COCONUT PALM FROND WEAVING (Wm. H. Goodloe, 1972, 132 pp.)	4.95
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HARVEST OF THE PALM (J. J. Fox, 1977, 244 pp.)	24.00
INDEX TO PRINCIPES (Vols. 1–20, 1956–1976, H. E. Moore, Jr., 68 pp.)	4.00
***KEY GUIDE TO AUSTRALIAN PALMS** (L. Cronin, 1989, 180 pp., 85 pp. color)	21.00
MAJOR TRENDS OF EVOLUTION IN PALMS (H. E. Moore, Jr., N. W. Uhl, 1982, 69 pp.)	6.00
OIL PALMS AND OTHER OILSEEDS OF THE AMAZON (C. Pesce, 1941, translated and edited by D. Johnson, 1985, 199 pp.)	24.95
PALEM INDONESIA (in Indonesian) (Sastraprdja, Mogea, Sangat, Afriastini, 1978. 52 illustrations, 120 pp. For English translation add $2.00)	5.50
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PALMS OF THE WORLD (Formerly **PALMS,** A. Blombery & T. Rodd, 1982, 192 pp., 212 color photographs)	34.95
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PALMS FOR THE HOME AND GARDEN (L. Stewart, 1981, 72 pp., some color)	19.95

(Continued on p. 146)

Principes, 35(3), 1991, pp. 127–132

Nypa in the Mangroves of Central America: Introduced or Relict?

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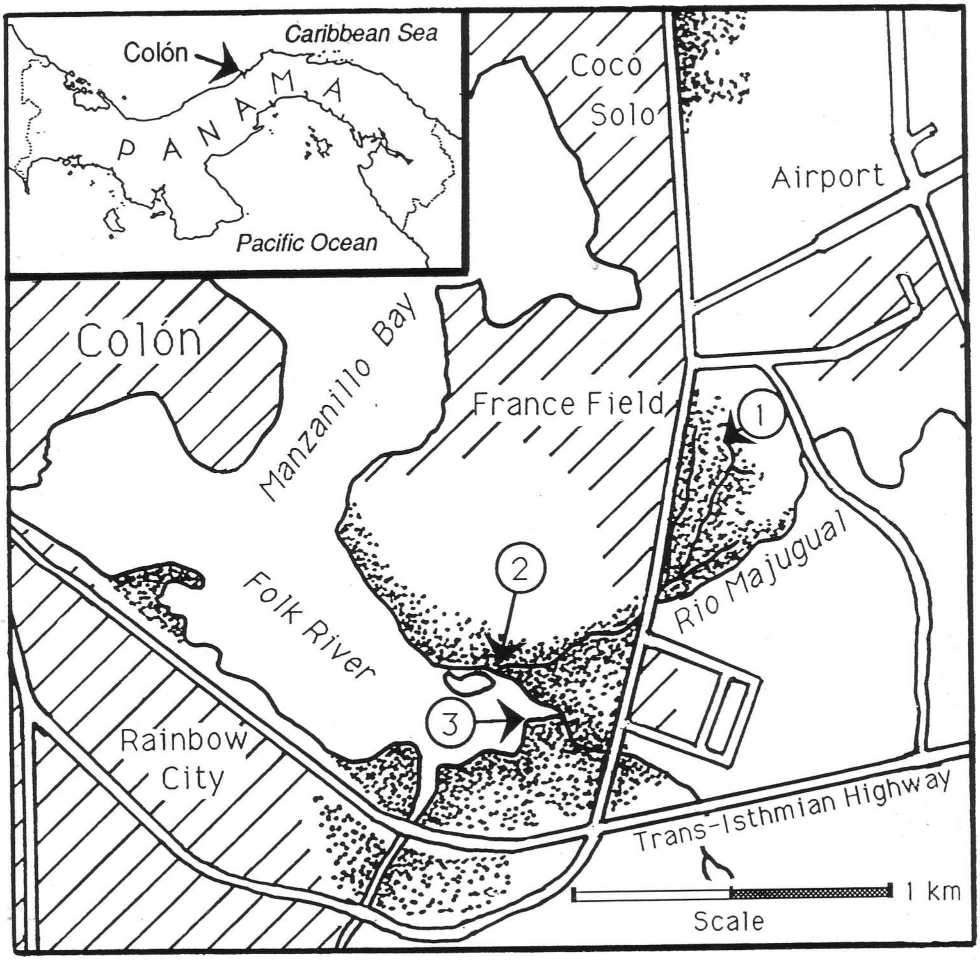
Nypa fruticans Wurmb. is well-known within the tropical Indo-Western Pacific region as the mangrove palm (Tomlinson 1986). It occurs there in protected, brackish, estuarine locations, and is distributed widely from Ceylon, the Ganges Delta, Burma, Indochina and the Malay Peninsula through Indonesia to New Guinea, northern Australia and the Solomon Islands, and northward to the Philippines and Ryukyu Islands.

However, while there are no records of extant natural populations bordering the tropical Atlantic or eastern Pacific Oceans, the palm was reportedly introduced into coastal Nigeria, West Africa (Russell 1968). There it was planted near Calabar in 1906 from the Singapore Botanic Garden, and then in 1912 it was also introduced to Oron, nearby. From there it spread naturally to the Cross River and the Delta of the Niger, where it has since flourished (P. de Saint-Palais and A. R. Drexler, pers. comm.). Such observations are extremely valuable because they tell us a lot about the biogeography of this palm, especially as regards its localized dispersal ability and its suitability for growing in different locations. However, a lack of other reports regarding similar introductions, or unusual occurrences, of this very distinctive mangrove, tells us that human interference has been relatively minimal (i.e., beyond the extant natural range described above). Therefore, the discovery of another well-established population, this time on the Caribbean coast of Panama, is of further scientific interest. The present finding represents the only known occurrence of the palm in the Neotropics.

At the time of discovery, around April–May 1989, many palms were flowering and fruiting. Flowers were prolific and had a sickly-sweet smell which appeared to attract some flies, but the most numerous visitors were large stingless bees, *Trigona (trigona) amalthea silvestriana* Yachal (Apidae: Meliponinae). These are well-known in the region as an aggressive pollen collector, and it is probably the chief pollinator of the palm in this region.

The Panama population of Nypa is isolated and quite small in extent, although it comprises mature individuals up to ten meters tall, equalling those in New Guinea and Northern Australia (Covacevich and Covacevich 1978; Covacevich 1981). Initial investigations found about 100 mature palms alongside the Rio Majugual tidal stream, located near a busy main road and the city of Colón, the Atlantic seaport of the Panama Canal. Plants occurred chiefly in two or three monotypic stands of up to 40–50 palms, although their numbers appeared to be increasing rapidly, based on the large number of immature individuals. Furthermore, this increase was apparently aided by the asexual bifurcation of the large subterranean rhizome. In total, mature plants and seedlings ranged along more than one kilometer of this tidal stream. Upstream these were associated with *Laguncularia racemosa* (L.) Gaertn.f. and *Acrostichum* sp., while downstream they



1. The map locates the small, but well-established population of mangrove palm, *Nypa fruticans*, found in April 1989. The site was alongside a small tidal stream, Rio Majugual, close to Colón on the Caribbean coast of Panama. Mature trees carrying many seeds, and surrounded by numerous seedlings, were found at the upper tidal reach (site 1), while only immature trees were observed downstream from a road bridge, extending to the Folk River estuary (site 2 and 3). The map also shows the proximity of surrounding mangrove forests (stipled) and "built-up" areas (diagonal shading), including major roads and a civil airport.

were growing with *Rhizophora mangle* L. mainly, and *Avicennia germinans* (L.) L. occasionally.

The relative numbers of mature and immature plants of *Nypa* were not equal along the stream, suggesting that the population was expanding downstream. Thus, mature forms were found chiefly in the

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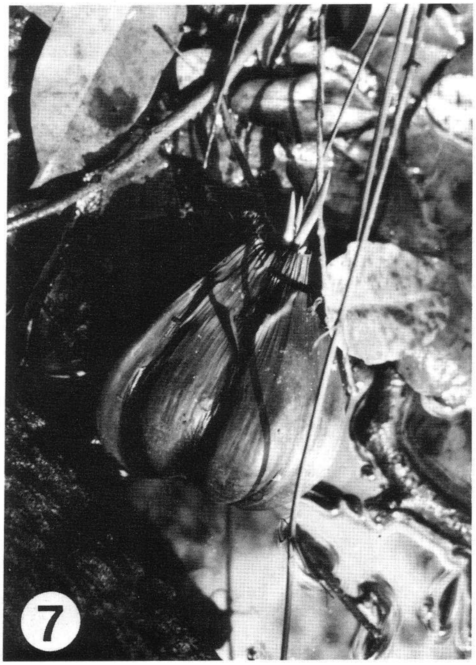
2. A series of photographs illustrates some important aspects of this population. This photo shows a male flower with many Trigonid bees. Flowers of both sexes were common, and these bees were very active collecting and transporting pollen. 3. This photo shows the dense and luxuriant upstream stands of mature *Nypa* (site 1 on the map), with fronds reaching 10 meters, or more. 4. Further downstream from site 1 on the map, this photo

shows smaller isolated clusters, with newly matured individuals, growing under tall *Laguncularia* trees that formed a relatively thin over-canopy at around 25 meters. 5. Fruiting stalks were plentiful in upstream stands and this photo shows a well-developed one, still in its erect posture. Later as fruits mature, the stem bends over placing the head closer to the ground. Note also the expended and withered male flowers on associated stalks.



6. This photo shows an immature plant in a downstream site near the Folk River (site 2 on the map). It was doing very well there, in association with *Rhizophora mangle.* 7. Propagules and germinating seedlings were found all along the Rio Majugual leading upstream to the tributary draining the dense mature stands. This photo shows a newly fallen propagule, about 15 cm long, with emergent fronds. There were no visible roots, as these would appear later alongside the fronds. This represents the most active dispersal phase.

upper reaches, delimited by land reclamation and sealed, built-up roads, while immature palms were concentrated downstream to the edge of the open estuary. Dispersal downstream presumably took place in several stages, probably during periods of localized, record flooding (J. Cubit, pers. comm.). Nevertheless, the lower stands now appear poised to broadcast their progeny to other Caribbean sites.

The origin of this New World population of *Nypa* is unknown, but it seems to have been introduced. This view is supported by its small size, a lack of others nearby, its occurrence in such a busy place, and the preponderance of immature plants displaced downstream. If this is the case, its propensity to spread (notably, via water of its tough, buoyant propagules) and its suitability for this environment, makes its dispersal throughout the region inevitable. In addition, this dispersal is expected to be further accelerated when local people discover the many uses of this palm (note Tomlinson 1986). In Panama, durable palm fronds are sought-after for roof thatching, an already important local industry. Such factors may explain why *Nypa* was introduced in the first place, although there was no evidence of this stand being used in any way. If it was introduced, the size and extent of the mature stands suggest that this took place at least 30 years ago.

One important piece of evidence, however, may confound this explanation of the palms origin in Panama. Tomlinson noted that "*Nypa* has had a much wider distribution outside its present range because fossil fruits are known from the Paleocene in Brazil . . .," and many other places in

8. A small, isolated cluster of immature palms face the estuary of the Folk River (note site 3 on the map), across from the junction with the Rio Majugual. These were backed by larger trees of *Rhizophora mangle* and *Laguncularia racemosa* which normally border the estuary.

New and Old Worlds (also note, Biosca and Via 1987). Therefore, while local extinction was believed to have occurred during drier climatic conditions, this assumption must now be re-assessed. For the moment however, it is difficult to believe that this characteristic and prolific palm could have escaped detection until now, if it had been in the region since the Paleocene. That is to say, during that time, surely it would have again flourished, recovering quickly once conditions returned to the present day wetter climate. In this, it was assumed that fossil and extant forms represent the same species, based on a lack of convincing morphological evidence separating them (Tralau 1964, Biosca and Via 1987). In either case, present data clearly favor the notion that this population, like that in Nigeria, was introduced.

Acknowledgments

These observations were made during surveys associated with mangrove studies funded by the Minerals Management Service of the U.S. Department of the Interior, and the Smithsonian Tropical Research Institute. Dr. Dave Roubik identified the stingless bee, and photographs were taken by Carl Hansen and the author. I also thank Prof. Tomlinson for his comments on the manuscript, and Dr. Dransfield for drawing my attention to the West African occurrence, notably in the report by A. Russell.

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NEWS OF THE SOCIETY

Palm Research: The Palm Flora of Vanuatu

Research toward the compilation of a Palm Flora of Vanuatu is being undertaken by John Dowe (Editor, member of the Publication Fund, Palm and Cycad Societies of Australia) and Pierre Cabalion (ORSTOM, Research Unit on Natural Substances of Biological Interest, Paris). The authors are seeking information in regards to Vanuatu (formerly New Hebrides) palm collections contained in numerous herbaria throughout the world and those species presently being cultivated in either private or public gardens.

The Palm Flora of Vanuatu will include a number of new species, the descriptions of which are now in preparation. Field study is needed to obtain complete samples for study and to clarify the status of a number of taxa. Funds are being sought for this purpose.

Correspondence, enquiries, and/or donations may be forwarded to the authors: MR. JOHN L. DOWE, 18 Amelia St., Albion, Queensland 4010, Australia, or PIERRE CABALION, 9, rue Suetone, 67200 Strasbourg, France.

Principes, 35(3), 1991, pp. 133–138

Two New Species of Chamaedorea (Arecaceae) from Panama

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Abstract

Chamaedorea deneversiana and *C. verecunda* are described as new, the former from Veraguas Province and the Comarca de San Blas in central Panama, the latter from the La Fortuna region of Chiriquí Province in western Panama. Both are simple-leaved species of very wet, mid-elevation forests. Staminate and pistillate specimens of each species are illustrated with photographs.

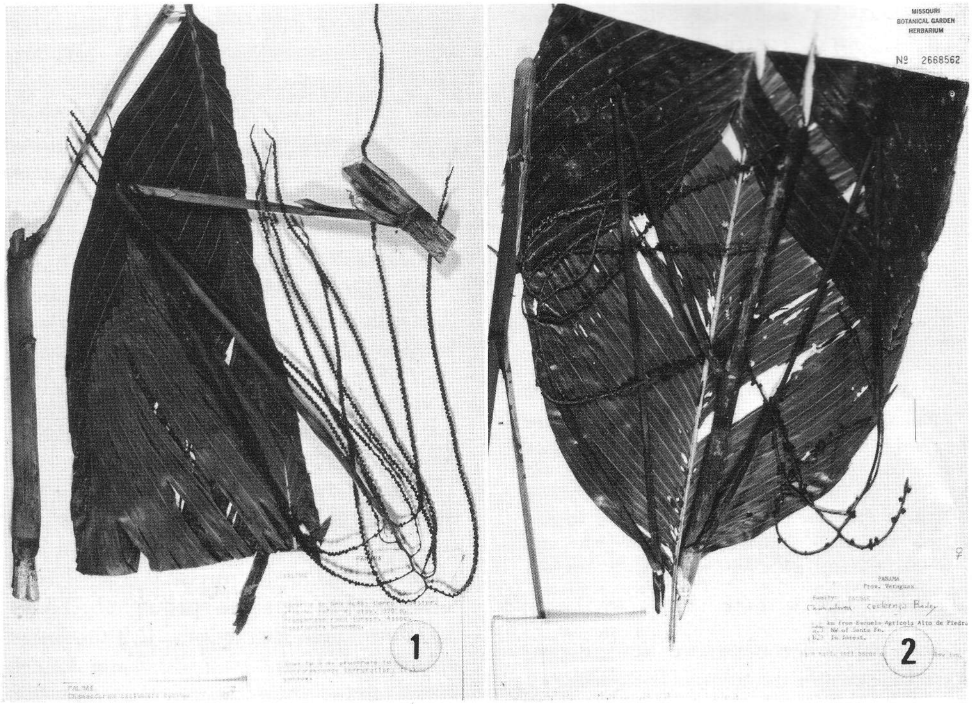
This paper describes two new simple-leaved species of the genus *Chamaedorea* (Arecaceae) from wet forests of central and western Panama. It is among the last papers in a series (Hodel 1990b, 1990c, 1990d, 1991a; Hodel and Castillo Mont 1990, 1991; Hodel and Uhl 1990a, 1990b, 1990c) describing new taxa of *Chamaedorea* in preparation for the imminent publication of Hodel's (1991b) comprehensive account of the genus.

The two species described below are not closely related, probably belonging in separate subgenera according to the classification of Burret (1933). Both species are of very restricted distribution and unknown in cultivation, and must be regarded as endangered.

Chamaedorea deneversiana *Grayum & Hodel*, sp. nov.

Caulis 1.5–3 m altus 1.3–1.6 cm diametro; petiolus ultra vaginam 14.4–45.9 cm longus; lamina simplex oblonga apice bifida secus costam 34.9–61.2 cm longa ad marginem lateralem versus apicem grosse serrata; lamina nervis utroque costae latere 20–24; inflorescentia mascula pedunculo ca. 40.9 cm longo rhachidi ca. 4.8 cm longa rachillis 10, pendentibus 25.4–33.1 cm longis; flores masculi 1.1–1.3 mm longi 1.8–1.9 mm lati corolla depresso-oblata petalis enervibus vel obscure nervatis antheris ca. 0.6 mm longis pistillodio incudiformi ca. 0.4 mm longo; inflorescentia feminea pedunculo 18.3–59.8 cm longo rhachidi ca. 2.3 cm longa rachillis (3?)4–6, 10.2–30.2 cm longis; flores feminei 2.2–2.5 mm longi 2.5–2.8 mm lati lobis corollae extus obscure nervatis intus prominenter ca. 15-nervatis pistillo 1.5–1.9 mm longo; fructus late ellipsoideis in sicco 6.8–7.5 mm longis 5.6–5.8 mm latis. TYPUS: Panama. San Blas: Cerro Brewster, 9°18′N, 79°16′W, 850 m, *de Nevers et al. 5553A* (holotype, MO; isotype, CAS). Figures 1,2.

Stem prostrate to erect, probably solitary (but no data), 1.5–3 m tall, the internodes 5.5–12.3 cm long, 1.3–1.6 cm wide. Leaves 4 (*Mori & Kallunki 5352*). Sheath ca. 19–26 cm long; rest of petiole 14.4–45.9 cm long. Lamina simple, oblong, bifid apically, 34.9–61.2 cm along midrib, 15.6–17.1 cm along upper margin, 12.4–25.0 cm between apices of lobes; lateral margins coarsely serrate toward apex; major veins 20–24 per side, knife-edge-raised above, prominent below, the larger ones somewhat erose-margined; midrib broad and yellowish below, overhanging and scurfy-roughened laterally. Inflorescences infrafoliar, borne to at least 1 m below crown (*Mori & Kallunki 3208*).



1. *Chamaedorea deneversiana* (*de Nevers et al. 5553A*); staminate specimen. 2. *Chamaedorea deneversiana* (*Mori & Kallunki 3208*); pistillate specimen.

Staminate inflorescence (just one seen) branched, with drooping rachillae; peduncle 40.9 cm long, bearing 6 bracts; rachis 4.8 cm long, slightly zigzag; rachillae 10, 25.4–33.1 cm long. Staminate flowers 1.1–1.3 × 1.8–1.9 mm at anthesis; calyx 0.3–0.4 mm high, lobed ca. halfway to base, the lobes hyaline, nerveless; corolla depressed-oblate, the petals valvate in bud, nerveless or obscurely nerved, apparently free at anthesis; stamens 6, the anthers ca. 0.6 mm long, somewhat reniform; pistillode stout, ca. 0.4 mm long, anvil-shaped. Pistillate inflorescence branched, the axes becoming yellow to orange in fruit; peduncle 18.3–59.8 cm long, bearing 5–6 bracts; rachis ca. 2.3 cm long, slightly zigzag; rachillae (3?) 4–6, 10.2–30.2 cm long. Pistillate flowers 2.2–2.5 mm long at anthesis; calyx 0.5–0.6 × 2.5–2.8 mm, moderately 3-lobed, the lobes 5-nerved; corolla suburceolate, constricted toward the base where the lobes are fused in a tube ca. 0.2–0.3 mm high, the lobes obscurely nerved externally, prominently ca. 15-nerved within; staminodes not observed; pistil 1.5–1.9 mm long, the style trifid. Fruits broadly ellipsoidal, 6.8–7.5 × 5.6–5.8 mm when dry, described as "green" (*Mori & Kallunki 5352*) or "yellow" (*de Nevers et al. 5553B*) hence presumably immature.

Additional Specimens Examined. PANAMA. SAN BLAS: Cerro Brewster, 9°18′N, 79°16′W, 850 m, *de Nevers et al. 5435* (MO), *5553B* (CAS, MO). VERAGUAS: vicinity of Escuela Agrícola Alto de Piedra, *Mori & Kallunki 3208*; NW of Santa Fe, *Mori & Kallunki 5352* (MO).

Distribution and Phenology. Chamaedorea deneversiana is known from just five collections, three from the Cerro Brewster region of the Comarca de San Blas, and two others from the vicinity of Cerro Tute, Veraguas Province. These are both very wet sites near the Continental Divide in central Panama. Only one of the specimens (*de Nevers et al. 5553A*) is staminate. The species was first collected in 1974 by S. Mori and J. Kallunki. Habitat data for *C. deneversiana* are practically nonexistent; *Mori & Kallunki 5352* grew on a "rocky streambank." Fertile specimens have been collected from November through April.

Chamaedorea deneversiana possibly belongs in subgenus *Chamaedorea*, on the basis of its relatively small staminate flowers on long, slender, drooping rachillae (Fig. 1). Typically, in this subgenus, the staminate petals are apically connate and prominently nerved; the single staminate specimen of *C. deneversiana* may have somewhat immature flowers.

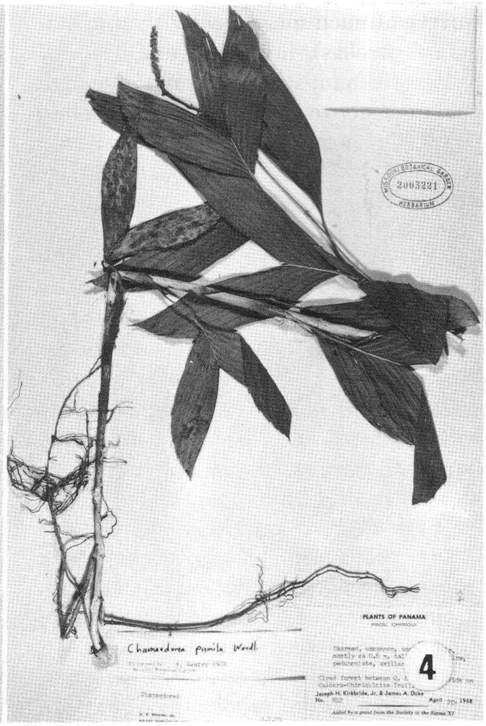
Specimens of *Chamaedorea deneversiana* have been misidentified as "*C. coclensis* L. Bailey" (= *C. amabilis* H. A. Wendl. ex Dammer; Hodel 1990a), an ostensibly related species occurring in similar habitats from Costa Rica south to the Chocó. Indeed, the two species bear a striking resemblance in their simple, relatively shallowly bifid leaves with a peculiar, oblong shape, prominently serrate margins and numerous lateral veins. However, *Chamaedorea deneversiana* is a taller palm with larger leaves and more numerous and considerably longer staminate rachillae, which are drooping rather than erect as in *C. amabilis*. Furthermore, the pistillate inflorescences of *C. deneversiana* are branched, with 4–6 rachillae (Fig. 2), whereas those of *C. amabilis* are simple, or occasionally bifid.

The new species is dedicated to Gregory C. de Nevers, collector of three of the five known specimens, whose pioneering botanical explorations in the Comarca de San Blas and special interest in palms have forged a sterling contribution to Panamanian floristics.

Chamaedorea verecunda *Grayum & Hodel*, sp. nov.

Caulis gracilis 50–75 cm altus 3.5–5.0 mm diametro; petiolus ultra vaginam 1.7–4.4 cm longus; lamina simplex obovata profunde bifida secus costam 2.75–5.40 cm longa ad marginem lateralem versus apicem crenata vel serrata; lamina nervis utroque costae latere 6–9; inflorescentia mascula spicata pedunculo 13.3–18.9 cm longo rhachidi 6.5–9.7 cm longa maturatione florum basipeta; flores masculi lutei cernui 3.6–5.1 mm longi 1.7–2.0 mm lati corolla anguste campanulata lobis corollae sub anthesi apice liberis fere enervibus ovatis 2.6–3.3 mm longis 1.8–1.9 mm latis apice rotundatis vel subacutis antheris 1.2–1.5 mm longis pistillodio 2.3–2.8 mm longo; inflorescentia feminea spicata pedunculo 14.3–22.1 cm longo rhachidi 4.2–5.4 cm longa maturatione florum basipeta; flores feminei lutei cernui 2.1–2.3 mm longi 1.6–1.7 mm lati corolla late campanulata vel suburceolata lobis corollae obscure 5–7-nervatis late ovatis pistillo (supra insertionem loborum corollarum) 1.8–2.2 mm longo; fructus in sicco usque ad minimum 1 cm longis. TYPUS: Panama. Chiriquí: N. of Hornito, 4,200 ft., *Hammel 6221* (holotype, MO-3622575). Figures 3,4.

Small, slender palm ca. 50–75 cm tall, lacking stilt-roots (*Kirkbride & Duke 942*), the "trunk often decumbent" (*Hammel 2254*), probably solitary (but no data). Internodes surpassed by sheaths, 1.7–3.8 cm long, 3.5–5.0 mm wide. Leaves ca. 8–11, "grey-green" (*Hammel 6221*). Sheath 2.2–5.3 cm long, rather loose, oblique at orifice, the veins prominent and obscurely nodulose; rest of petiole 1.7–4.4 cm long. Lamina simple, obovate, deeply bifid, 2.75–5.40 cm along midrib, 6.3–9.7 cm along upper margin, 7.7–10.1 cm between apices of lobes; lateral margins crenate to serrate, especially toward apex; major veins 6–9 per side, knife-edge-raised on both



3. *Chamaedorea verecunda* (*Hammel 6221*); staminate specimen. Note basipetal maturation of flowers, those in the upper half of the spike having already fallen off. 4. *Chamaedorea verecunda* (*Kirkbride & Duke 942*); pistillate specimen.

surfaces. Inflorescences of both sexes spicate, interfoliar. Staminate inflorescences (two seen) with peduncle included in sheath of subtending leaf, 13.3–18.9 cm long, bearing 2–3 bracts; rachis 6.5–9.7 cm long, the flowers maturing basipetally. Staminate flowers yellow, 3.6–5.1 mm long at anthesis, nodding; calyx ca. 0.5–1.0 × 1.7–2.0 mm, truncate or merely notched apically, hyaline, nerveless; corolla narrowly campanulate, narrowed at base where the lobes are fused in a tube ca. 1.1–1.6 mm high, the lobes valvate in bud, free at anthesis, virtually nerveless, ovate, 2.6–3.3 × 1.8–1.9 mm, rounded to obtuse or subacute apically; stamens 6, the anthers 1.2–1.5 mm long, narrowly ovate, somewhat narrowed apically, subsagittate at the base, the thecae loosely attached, dehiscing longitudinally, the filaments very short (0.1–0.4 mm) and attached at base of pistillode; pistillode prominent, 2.3–2.8 mm long, much surpassing stamens, clearly differentiated into a style and somewhat lobed stigma. Pistillate inflorescence (three seen) with peduncle 14.3–22.1 cm long, bearing 2–3 bracts; rachis 4.2–5.4 cm long, the flowers maturing basipetally. Pistillate flowers yellow, 2.1–2.3 mm long at anthesis, nodding; calyx similar to that of staminate flowers, 0.4–0.5 × 1.6–1.7 mm, truncate or somewhat sinuate apically; corolla broadly campanulate to suburceolate, rather abruptly (more so than staminate corollas) narrowed at the base where the lobes are fused in a tube ca. 0.4 mm long adnate to the basal part of the pistil, the lobes imbricate in bud, obscurely 5–

7-nerved (much more clearly than in staminate corollas), broadly ovate, 1.5–1.7 × 1.6–1.8 mm; staminodes not observed; pistil (part above insertion of corolla lobes) 1.8–2.2 mm long, narrowed above in a thickened style with 3 stigmas. Fruits to at least 1 cm long (when dry).

Additional Specimens Examined. PANAMA. CHIRIQUI: *de Nevers et al. 8807* (CAS); La Fortuna hydroelectric project, 1,200–1,400 m, *Hammel 2124* (MO), *2254* (MO); cloud forest between Q. Hondo (sic) and divide, *Kirkbride & Duke 942* (MO).

Distribution and Phenology. Chamaedorea verecunda is presently known from just five specimens, all from cloud forests near the Continental Divide at 1,200–1,400 m elevation in the general vicinity of the La Fortuna hydroelectric project, Chiriquí Province, Panama. It was first collected by J. Kirkbride and J. Duke in 1968. Habitat data are limited. *Hammel 2124* and *2254* were both collected "in forest," whereas *Hammel 6221* was growing "on (a) forested ridge along (a) small stream." The species may be regarded as broadly restricted to the La Fortuna region, which is known to harbor many endemic plant species. Fertile specimens have been collected from February through April.

Chamaedorea verecunda belongs in subgenus *Chamaedoropsis*, on the basis of its relatively large staminate flowers with the corolla lobes nerveless and apically free at anthesis. This is one of the most distinctive of the numerous dwarf, simple-leaved, cloud-forest *Chamaedorea* species now known from Central America. It may be easily recognized by its caulescent habit; very small, broad, deeply bifid laminae with few lateral veins; spicate inflorescences in both sexes; and nodding, basipetally maturing flowers, the staminate ones relatively large and with a prominent pistillode (Figs. 3,4).

Most specimens of *Chamaedorea verecunda* have been previously identified as *C. pumila* H. A. Wendl. ex Dammer, a widespread Costa Rican species. The latter, however, is acaulescent, has relatively narrower and less deeply bifid laminae with more numerous lateral veins, and has four or more staminate rachillae.

The closest relatives of *Chamaedorea verecunda* are undoubtedly the recently described *C. correae* Hodel & Uhl and *C. guntheriana* Hodel & Uhl (1990c), which occur in similar habitats in central Panama. *Chamaedorea correae*, known from several localities in Coclé, Colón and Veraguas Provinces, appears to be a coarser, taller palm than *C. verecunda*, with somewhat larger leaves. Both staminate and pistillate rachillae of *C. correae* are much longer than their counterparts in *C. verecunda*; moreover, the staminate inflorescence of *C. correae* normally consists of 2–3 rachillae (it may rarely be spicate). The staminate flowers of *Chamaedorea correae* are considerably smaller (ca. 2.5 mm long at anthesis) than those of *C. verecunda*, with correspondingly smaller anthers (1.2–1.5 mm) and pistillodes (1.5–2 mm), and mature simultaneously rather than basipetally.

Chamaedorea guntheriana, which is apparently endemic to the Cerro Jefe region, differs from *C. verecunda* in its usually pinnate, markedly coriaceous leaves, usually bifid staminate inflorescences with somewhat longer rachillae, and smaller (2.5 mm long) staminate flowers with much smaller anthers (0.5 mm). In addition, the staminate flowers of *C. guntheriana* mature acropetally, rather than basipetally as in *C. verecunda*.

We suggest that *Chamaedorea verecunda, C. correae, C. guntheriana* and perhaps other related cloud-forest species of similarly restricted geographic range ultimately derive from a single, wide-ranging ancestral species, from which they have speciated allopatrically in the isolated cordilleras of Panama and adjacent regions.

The specific epithet derives from the Latin *verecundus*, meaning "modest" or "shy," and alludes to various attributes of these plants, including their small size, nodding flowers and apparent scarcity.

Acknowledgments

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Notes on the Front Cover Picture

Chamaedorea tenerrima Burret has one of the most striking leaves in the genus and, perhaps, in the entire palm family. In addition to the unusual, broadly flared terminal lobes and reflexed lower pinnae, each leaflet has a distinctive auricle at its base that forms a small spur shooting through mid-air and across the underside of the rachis. It's difficult to imagine that these plants first develop fairly large, simple leaves; in fact, they often flower initially with undivided leaves. *C. tenerrima* grows in dense, mountain rainforest and cloud forest in Alta Verapaz, Guatemala. Rain, mist, clouds, fog, and cool temperatures characterize this area. We found this specimen, *Hodel & Castillo 1009*, with three simple-leaved species, *C. simplex*, *C. tuerckheimii*, and *C. castillo-montii*. Photo by Donald R. Hodel.

DON HODEL

Principes, 35(3), 1991, pp. 139–141

Notes on the Distribution of Bentinckia condapanna on the Palni Hills in Peninsular India

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Bentinckia condapanna A. Berry has been known as endemic to the Kalakkad forests (Western Ghats) in the extreme south of peninsular India (Fig. 1). The population in the type locality itself is now restricted to sheltered pockets, often to crevices of steep rocks, inaccessible to elephants and humans, both of whom relish the delicious terminal bud!

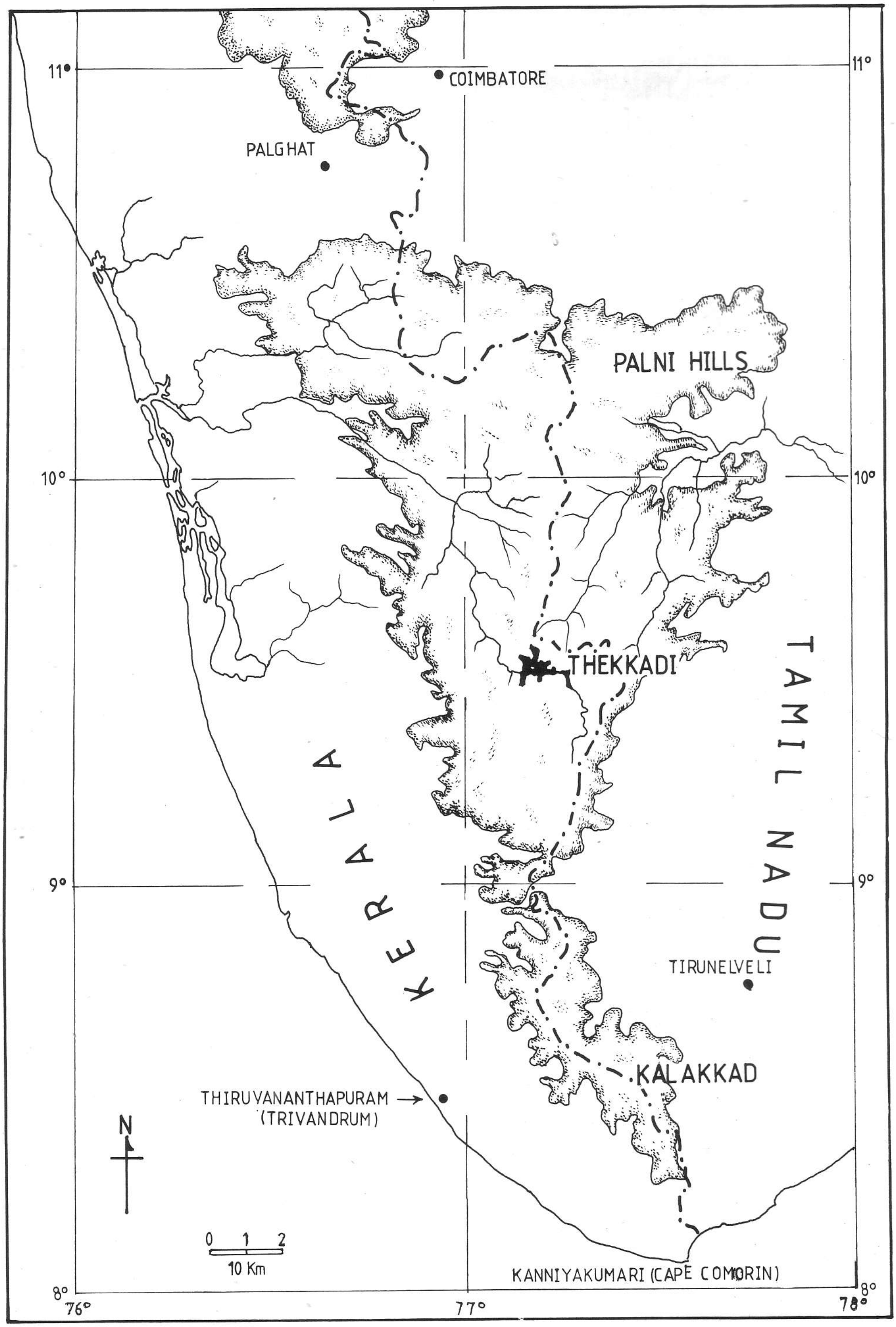
The present report refers to the occurrence of the species on the Palni (Pulney) Hills (Fig. 1), an eastward spur of the same Western Ghats, about 200 km to the north of the type locality. The palm is so exclusively associated with the Kalakkad forests that even in cultivation its identity goes unrecognized, as happened in the present case. A row of palms at The Anglade Institute of Natural History, Shembaganur, Kodaikanal, on the Palni Hills (Fig. 2) was taken for another "unknown palm" until a comprehensive collection (RHT *53232a, b, c, d, e, f,* & *g*) was checked at Kew against the type, assisted by Dr. J. Dransfield, and found to be identical.

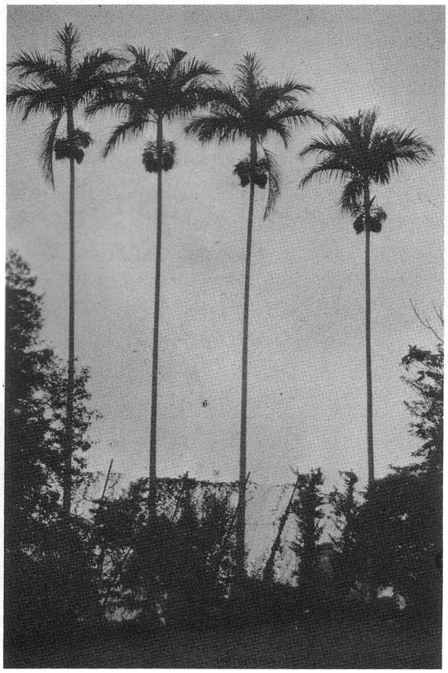
This identification made me re-examine my previous collections and field notes which information is the matter of this note. The species does occur sporadically in the precipitous ravines on the slopes of the Palni Hills. It is locally called "wild Areca." Though it has no specific use, its populations must have suffered from large scale habitat destruction. Consequently, its present pattern of occurrence: isolated trees left in totally unapproachable ravines. For instance RHT *52764* (vegetative materials only) and RHT *54097a, b, c, d,* & *e* (fruiting materials) were collected from localities where only two specimens each were left.

The extension of the distribution of this endemic species is interesting indeed, but the story does not end here. The occurrence here of three other species associated with the evergreen belt of the Western Ghats is noteworthy: (1) *Arenga wightii* Griffith (RHT *44813* & *49985*); (2) *Artocarpus hirsutus* Lam. (RHT *42210, 44814, 48729* & *49987*); and (3) *Cycas circinalis* L. (RHT *42103, 44308, 45022, 46688* (♀), *46696, 48614* (♂), *48698* (♂), *52589* (♂) & *52591* (♀)—(flowering and fruiting materials are specifically marked).

The following observations are in order:

1. The occurrence of these three species (of the evergreen belt of the Western Ghats with two monsoons a year, while the Palnis in the rainshadow region of the Ghats with only one monsoon), seems to suggest that the Palnis in the past had a more moist climate.
2. The occurrence of *Bentinckia condapanna* along with the above species seems to reinforce this conclusion.
3. If so, these surviving specimens now occurring in the least accessible places (especially unsuitable for human habitation or cultivation) are absolutely the last sentinels of a long bygone age.


11°
COIMBATORE
PALGHAT
PALNI HILLS
10°
THEKKADI
TAMIL NADU
KERALA
9°
TIRUNELVELI
KALAKKAD
THIRUVANANTHAPURAM
(TRIVANDRUM)
N
0 1 2
10 Km
KANNIYAKUMARI (CAPE COMORIN)
8°
76°
77°
78°



2. *Bentinckia condapanna* on the Palni Hills at the Anglade Institute of Natural History, Shembaganur, Kodaikanal.

4. A thorough search across the Western Ghats in the peninsula, at least south of the Palghat gap (see Fig. 1), to record accurately the occurrence and distribution of *Bentinckia condapanna* is in order. This could prepare for a monograph on the genus on which so little is known. The Palni members appear to be notably more robust than those in the type locality.

Specimens of the cited numbers of the species are deposited at RHT. Further information on the vegetation of the Palni Hills may be had from the author's *A Handbook of the Anglade Institute of Natural History* (reviewed in Kew Bull. 44: 550–551. 1989); his definitive illustrated *Flora of the Palni Hills* is due for 1992.

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1. Map showing the location of the Kalakkad forests and the Palni Hills where *Bentinckia condapanna* is found.

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Phenolic Constituents of Coccothrinax (Palmae)

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ABSTRACT

Flavonoids and phenolic acids were extracted from five species of *Coccothrinax*. Nine compounds (caffeic acid, chlorogenic acid, kaempferol, luteolin, luteolin 7-O-glucoside, orientin, quercetin, tricin, and vitexin) were characterized and identified by a combination of one-dimensional chromatography, UV-VIS spectrophotometry, and high pressure liquid chromatography. Chemical variation was limited, but certain species and species groupings could be distinguished by their chemical profiles.

Chemotaxonomy of plants, that is, the comparison of phytochemical data among species of related genera, families, or orders, has developed over the last thirty years as a useful tool in systematics and phylogeny. Because the techniques for isolating and identifying phenolic compounds are relatively simple and inexpensive, they have been adopted by many morphologically oriented taxonomists as a standard source of comparative data (Harborne and Turner 1984). Because palms are large, woody and tropical, typical morphological data are difficult to collect and many taxonomic problems remain. Thus, chemical approaches may aid in our understanding of palms (Williams et al. 1973; Harborne et al. 1974; Williams et al. 1983; Hirai et al. 1984*a*, *b*; Zona and Scogin 1988; Zona 1990). In these previous studies, two or more congeneric species often were distinguished by phenolic profiles.

Coccothrinax Sarg. is a taxonomically problematic genus (Uhl and Dransfield 1987), in which estimates of the number of actual species range from about 20 (Moore 1973) to 50 (Muñiz and Borhidi 1982, Borhidi and Muñiz 1985, Uhl and Dransfield 1987). The genus is restricted to the Caribbean region with a center of diversity in Cuba where 60% of the taxa occur. Because *Coccothrinax* is well represented in Fairchild Tropical Garden, we undertook a preliminary survey of foliar phenolic compounds in a limited sample of species to ascertain whether phenolic constituents have potential as systematic characters in the group.

Little is known concerning phenolics in *Coccothrinax*. Williams et al. (1973) chromatographically surveyed 125 species of palms for hydrolyzed and charged flavonoids. They included 32 species of the tribe Corypheae to which *Coccothrinax* belongs, but they analyzed only one sample of one species of *Coccothrinax*, *C. barbadensis* (Lodd. ex Mart.) Becc. (as *C. dussiana* Bailey). The species yielded leucocyanidin and mixtures of unidentified charged flavonoids and flavone C-glycosides. No other work on *Coccothrinax* is known to us.

Materials and Methods

Plant Material. Leaves were collected from garden-grown plants and air dried.

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All plants are accessions in Fairchild Tropical Garden, and all vouchers are deposited in the Garden's herbarium (acronym FTG) as follows: *C. argentata* (Jacq.) Bailey: acc. no. 58823E, *Nauman 1751. C. inaguensis* Read—sample 1: acc. no. 60802F, *Nauman 1749*; sample 2: acc. no. 64284G, *Nauman 1759*; sample 3: acc. no. 5842D, *Nauman 1757. C. jamaicensis* Read: acc. no. 79333A, *Nauman 1747. C. miraguama* (HBK) León—sample 1: acc. no. 70482A, *Nauman 1752*; sample 2: acc. no. 70482B, *Nauman 1758*; sample 3: acc. no. 5861M, *Nauman 1754*; sample 4: acc. no. 58819, *Nauman 1755. C. readii* Quero: acc. no. 591031A, *Nauman 1748.*

The plant samples were chosen to check chemical diversity at several levels of relationship.

Extraction, Isolation and Identification of Flavonoids. From each sample, 35 g of dried leaves were ground and extracted with 75% aqueous MeOH (230 ml) under reflux. The extracts were evaporated to dryness under vacuum, then the residue (ca. 5 g) was extracted with hot water. After 24 hours of refrigeration, the precipitate was filtered off, and the clear filtrate was extracted by shaking with ethyl acetate, which was evaporated to dryness under vacuum. Flavonoid compounds from the crude ethyl acetate extracts were separated by one-dimensional chromatography on TLC polyamide sheets with $CHCl_3$-MeOH-$EtCOH_2$-Ac_2CH_2 (25:10:5:1 v/v; system 1).

All flavonoid bands were eluted with MeOH. The filtrates were analyzed by co-chromatography and UV spectral analysis. One-dimensional co-chromatography with authentic compounds was performed on Whatman No. 1 paper in three systems, *n*-BuOH-AcOH-H_2O (4:1:5 v/v, BAW, organic phase), *n*-BuOH-AcOH-H_2O (40:100:7 v/v), and 15% AcOH; and on TLC polyamide 6-UV_{254} in two systems, $CHCl_3$-MeOH-$EtCOH_2$-Ac_2CH_2 (25:10:5:1 v/v) and C_6H_6-Et_2O-MeOH-$CHCl_3$ (2:1:1:1 v/v). Standard UV spectral analyses (240–400 nm) using the classical shift reagents (Mabry et al. 1970) were performed on a Perkin-Elmer Lambda 4B UV-VIS spectrophotometer.

Flavone C-glycosides were further characterized by high pressure liquid chromatography (HPLC). Twenty μl of each fraction containing the flavonoids were injected into the HPLC (Hewlett-Packard Model 1090M). Separations were performed on a Hypersil ODS column (5 μ; 4.6 × 100 mm), at 40° C using a water/acetonitrile solvent gradient from 0% to 100% acetonitrile over 10 minutes. Both solvents contained 1% acetic acid. The chromatograms and UV-VIS spectra of individual compounds were recorded with a Hewlett-Packard diode array detector.

The sugar of the flavone 7-O-glycoside was removed by acid hydrolysis and characterized. The compound was refluxed for two hours with 2 N HCl, cooled, and extracted with ether. The concentrated ether layer (dried over sodium sulfate) was co-chromatographed with known markers in one dimension on Whatman No. 1 paper in two systems, 60% AcOH, and AcOH-conc. HCl-H_2O (30:3:10 v/v; Forestal system); and on TLC polyamide sheets in $CHCl_3$-MeOH-$EtCOH_2$-Ac_2CH_2 (25:10:5:1 v/v). The aglycone was identified by direct comparison of R_f and color reactions in UV light with and without ammonia. The aqueous layer was neutralized with barium carbonate, filtered and concentrated to about 1 ml, then was co-chromatographed against standards of sugars on silica gel TLC plates in EtOAc-H_2O-MeOH-HOAc (13:3:3:4 v/v) and pyridine-EtOAc-H_2O (6:3:2 v/v). The sugar was visualized by spraying with aniline phthalate.

Phenolic acids were separated on TLC polyamide sheets with system 1, eluted with MeOH, and identified by means of UV spectra, color reactions and co-chromatography with standards (Kowalska 1971).

Table 1. Distribution of phenolic compounds among the samples of Coccothrinax. Compounds: 1 = orientin, 2 = vitexin, 3 = tricin, 4 = luteolin, 5 = luteolin-7-O-glucoside, 6 = quercetin, 7 = kaempferol, 8 = caffeic acid, 9 = chlorogenic acid. + = present, − = absent, ? = uncertain.

	Compounds								
	Flavone C-glycosides		Flavones			Flavonols		Phenolic acids	
Taxa	1	2	3	4	5	6	7	8	9
C. argentata	+	+	+	−	−	+	+	−	+
C. jamaicensis	+	+	+	−	−	+	+	+	+
C. readii	+	+	+	−	−	+	+	−	+
C. inaguensis sample 1	+	+	+	−	+	+	?	−	+
sample 2	+	+	+	−	+	+	?	−	+
sample 3	+	+	+	−	+	?	?	−	+
C. miraguama sample 1	+	+	+	+	−	−	−	+	+
sample 2	+	+	+	+	−	−	−	+	+
sample 3	+	+	+	+	−	−	−	+	+
sample 4	+	+	+	?	−	−	−	?	+

Results and Discussion

A total of approximately 11 phenolic constituents appeared in preliminary chromatographs. Nine of these were isolated, characterized, and identified (Table 1). These nine represent C-glycosyl flavones (orientin, vitexin), flavones (luteolin, luteolin 7-O-glucoside, tricin), flavonols (quercetin, kaempferol), and phenolic acids (caffeic acid, chlorogenic acid).

Samples 1 and 2 of *C. miraguama* are separate plants from the same seed lot (either from same parent tree or different trees in same population). The identical profiles document consistency of the phenolic constituents among genetically similar plants.

Within *C. miraguama*, the first two samples can be identified with subsp. *havanensis* (León) Borhidi & Muñiz, the third with subsp. *roseocarpa* (León) Muñiz & Borhidi, and the fourth with subsp. *miraguama*. In that sample, the questionable occurrence of luteolin and caffeic acid is due to the heavy concentration of comigrating compounds. If present, these compounds suggest a species-specific uniform profile; if absent, they suggest differentiation among subspecies. Either distributional pattern is consistent with the taxonomy (Nauman and Sanders 1991).

Likewise, the three samples of *C. inaguensis* present a more or less consistent species-specific profile. In sample 3, quercetin was much less concentrated than in the other two samples, and was partly obscured by the other compounds. In all three samples, faint, partly obscured spots were also present in the position of kaempferol. However, if present, kaempferol is not accumulated in as large amounts as in *C. argentata*, *C. jamaicensis* or *C. readii*.

Based on recent morphological comparisons (Nauman and Sanders, 1991, in press), *Coccothrinax* is considered to comprise three major species groups—the argentea-group, represented by *C. barbadensis* in the study by Williams et al. (1973); the pauciramosa-group, represented by *C. miraguama*; and the argentata-group, represented by the remaining four species. Within the argentata-group, *C. jamaicensis* and *C. readii* appear to be very closely related, possibly conspecific. Among the sampled species of the argentata-group, *C. argentata* is thought to be next most closely related to the pair; and *C. inaguensis*, least closely related.

In the systematic context of the argentata-group, the similar phenolic profiles of *C. jamaicensis* and *C. readii* support their close relationship. They differ only by the occurrence of caffeic acid in the former. These two species share with *C. argentata* the accumulation of the flavonol aglycones quercetin and kaempferol. *C. inaguensis* is unique in possessing luteolin 7-O-glucoside, but it is similar to the other three in the occurrence of quercetin and the probable occurrence of kaempferol. Thus, the data support a closer relationship among the first three than between any of these to *C. inaguensis*.

Coccothrinax miraguama is distinctive in having caffeic acid and luteolin as an aglycone; whereas, *C. barbadensis* is distinguished by the loss of tricin. Whether these differences characterize only these individual species or all of the species in their respective species groups is unknown.

Because orientin, vitexin, tricin, and chlorogenic acid (and possibly caffeic acid) occur in at least two of the three species groups, these compounds appear to compose a basic profile for the genus. Individual species either have the basic profile unchanged or have it modified by the addition or loss of one or two compounds. The total number of additional compounds identified in our sample is only five. Thus the diversity of profiles may be rather limited in the genus. The report by Williams et al. (1973) of unspecified C-glycosyl flavones in *C. barbadensis* is consistent with our recognition of orientin and vitexin.

However, Williams et al. (1973) also document that C-glycosyl flavones pervade the whole family. Thus, this class of flavonoids serves not to characterize *Coccothrinax* but indicates its evolution early in the history of palms, and it may indicate a common ancestory of the Palmae and Poales. Likewise, because tricin is quite common throughout the Palmae (although tending to be absent from the Arecoideae), it, too, is not a marker for *Coccothrinax*.

Our techniques and those of Williams et al. (1973) do not allow the comparisons of negatively charged flavonoids, leucoanthocyanins, and phenolic acids. Also, because we examined only small leaf samples (ca. 35 g dry wt.), the compounds listed are those that accumulate in leaf tissues; trace compounds are not reported.

The total profile of only nine to eleven compounds lacks sufficient complexity to distinguish all 50+ taxa in the genus. However, the patterns established in this study suggest that, while only certain species can be distinguished by one or possibly two distinctive compounds, proposed relationships can be supported by the systematic distribution of phenolics. Therefore, we conclude that a broader taxonomic sampling concomitant with a complete characterization of phenolic constituents can assist in solving some systematic problems in *Coccothrinax*.

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The Potential for Introduction and Establishment of the Red Ring Nematode in Florida

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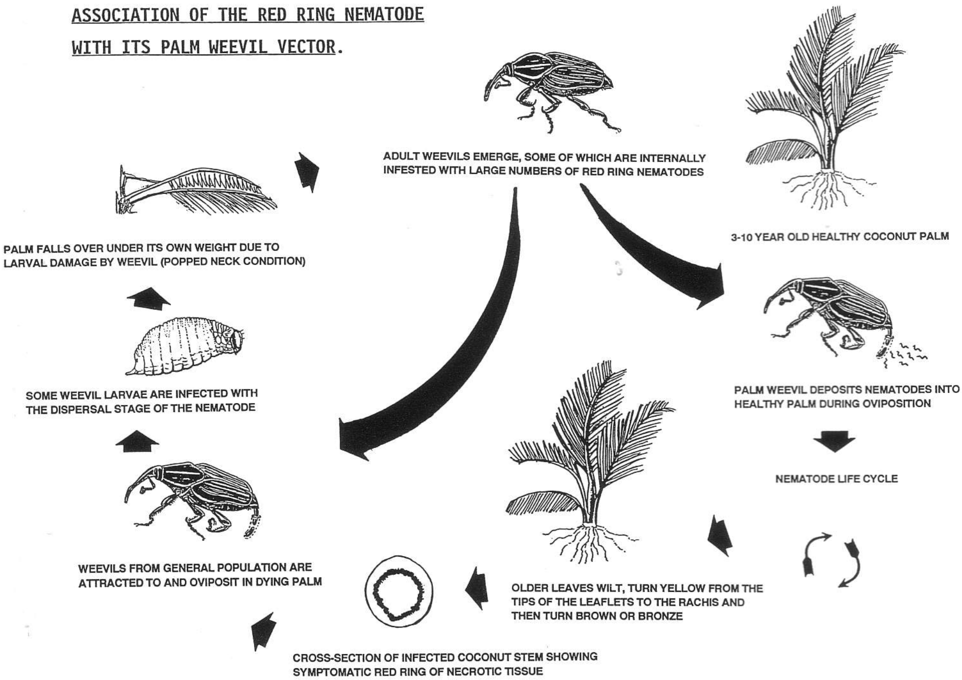
Background

Red ring nematode, *Bursaphelenchus cocophilus* (Cobb) (=*Rhadinaphelenchus cocophilus*), causes the red ring disease (RRD) of palms and is a very important pest of various palm species in the Neotropics (Griffith 1987). *Bursaphelenchus cocophilus* parasitizes the palm weevil, *Rhynchophorus palmarum* L., which transmits it to the agronomically and aesthetically important coconut palm, *Cocos nucifera* L., and the oil palm, *Elaeis guineensis* Jacq. (Griffith 1987). Research on the culture of this nematode suggests that it is an obligate plant-parasite which also has the ability to parasitize its weevil vector. It is not a facultative phytoparasite or mycophagous like the rest of the known members of the genus *Bursaphelenchus* and requires palm parenchymal tissue for reproduction (Giblin-Davis et al. 1989a).

Red ring disease of coconuts was first reported in 1905 in Trinidad (Hart 1905). Nowell (1919) reported that there was an association between the red ring disease and a nematode, which was sent to and later described by Cobb (1919) as *Aphelenchus cocophilus,* and has been known since 1960 as *Rhadinaphelenchus cocophilus* (Brathwaite and Siddiqi 1975). Recently, the monotypic subfamily Rhadinaphelenchinae was eliminated and the genus *Rhadinaphelenchus* was put into synonomy with *Bursaphelenchus* (Baujard 1989). Morphological research with different host isolates of *B. cocophilus* supports this decision (Gerber et al. 1989, Giblin-Davis et al. 1989b). Ashby (1921) and Cobb (1922) first incriminated the palm weevil, *R. palmarum,* as a vector for the red ring nematode in the early 1920's.

Life Cycle

A schematic drawing of the association of *B. cocophilus* with its weevil and coconut hosts in Trinidad is presented in Figure 1. Adult *R. palmarum* females that are internally infested with *B. cocophilus* disperse to a healthy coconut palm and deposit the juvenile stage of the nematode during oviposition (Griffith 1987). The nematode enters the oviposition wounds and begins its life cycle, which takes approximately 9–10 days from egg to egg (Blair 1965). In 5–6 year-old coconut palms that were artifically inoculated with *B. cocophilus*-infested tissue, infections started in about 1–2 weeks, nematode establishment took about 2–3 weeks during which red discoloration occurred in the stem and older leaves. The infestation spread more slowly into the roots where the nematodes and red discoloration of tissue occurred 6–10 weeks after inoculation (Goberdhan 1964). Weevils in the genus *Rhynchophorus* are strongly attracted to stressed or dying palms (Wattanapongsiri 1966) and the red ring diseased palm attracts weevils which oviposit in and colonize it. The weevil larvae are parasitized by juveniles of *B. coco-*



1. Schematic drawing of the association of *Bursaphelenchus cocophilus* with its weevil and coconut hosts in Trinidad.

philus which persist in the insect through metamorphosis, apparently without molting, and appear to aggregate around the genital capsule of the adult weevil (Gerber and Giblin-Davis 1990, Griffith 1987). The adult weevils emerge from their cocoons in the rotted palm and disperse to apparently healthy or stressed and dying palms, completing the life cycle.

Symptoms

The earliest external symptoms in coconut palms (3–10 years old) in Trinidad were noted in 1–2 months (Goberdhan 1964, Martyn 1953). External symptoms include premature fruit drop and death of the oldest leaf and progressive yellowing that starts with the older leaves and affects increasingly younger leaves (Goberdhan 1964). A 2.5–6.0 cm red ring often occurs 2.0–6.0 cm inside the stem. The cortex of roots and the petioles can also be discolored red. Nematodes can be recovered in densities $>10{,}000$/g of coconut stem tissue (Blair 1969). In addition to the symptoms caused by the nematode, feeding by the large larvae of *R. palmarum* compromises the structural integrity of the coconut palm and it often falls over under its own weight.

External and internal symptoms of the red ring disease can vary according to palm species, cultivar, and environmental conditions (Dean and Velis 1976, Maas 1970, Schuiling and van Dinther 1981). Variability in the age when palms are most susceptible to the disease, distinctness and color of the internal red ring, and general symptomatology have been reported for different coconut cultivars from different geographical areas (Dean and Velis 1976). In addition "Little leaf" symptoms have been reported for *B. cocophilus*-infested coconut and oilpalms (Maas 1970, Hoof and Seinhorst 1962).

Distribution and Economic Importance

The range of *R. palmarum* apparently extends from the southern parts of California and Texas southward through Mexico into South America and eastward in the West Indies up to Cuba (Wattanapongsiri 1966). The red ring nematode is co-distributed with *R. palmarum* in the lower Antilles, and Mexico southward into South America. *Bursaphelenchus cocophilus* has never been reported from the continental United States, Puerto Rico, Virgin Islands, or Hawaii.

Coconut palms are most susceptible to the RRD from ages 3–10 years old in Trinidad and may be killed in as little as 2 months post-infection by the nematode (Griffith 1987). This is a tremendous loss considering that it takes 4–8 years for both coconut and oil palms to begin to bear fruit, and that once established, these palms can be productive for at least 30 years and can serve as woody ornamentals for more than 80 years. This disease is especially problematic during the first ten years after establishing a coconut plantation and has been reported to cause coconut crop losses of up to 80% (Dean 1979, Griffith 1987).

Coconut Seednut Supply and Demand in Florida

Ornamental horticulturists in southern Florida have become interested in increasing production of coconut palms for use in Florida landscapes. Consumer demand is for lethal yellowing resistant coconut cultivars to replace the thousands of coconut palms that were lost to this disease in recent decades. This mycoplasmalike organism (MLO) caused disease has almost eliminated the 'Jamaica Tall' cultivar of coconut in Jamaica, southeastern Florida, the Yucatan Peninsula, and Mexico, and continues to pose a threat to susceptible palms in the Western Hemisphere. The golden (=red), yellow, and green 'Malayan Dwarf' cultivars, and the 'Maypan' hybrid ('Malayan Dwarf' × 'Panama Tall') are thus far the only coconut types that have been investigated enough to warrant their recommendation as lethal yellowing resistant.

Unfortunately, the phenetic differences between lethal yellowing resistant coconut cultivars and susceptible cultivars are not discrete, making it almost impossible in the early stages of coconut development and difficult at later stages to classify palm heritage. Currently, there are two sources of certified seednut of 'Malayan Dwarf' and 'Maypan' coconuts in Florida. The Division of Forestry Seed Orchard in Miami serves replanting needs of park departments and other public agencies. Commercial growers must import certified seednut from the Coconut Industry Board in Jamaica. These two sources are not enough to supply the increasing demands for inexpensive, quality-controlled coconut seednut for nurseries in southern Florida. This has led to requests for the loosening of restrictions placed on the importation of coconut seednuts into Florida from foreign countries. One location that is viewed as a possible new source of 'Malayan Dwarf' coconut seednuts is Costa Rica, where red ring disease is endemic. Of course this brings up all kinds of regulatory questions.

Plant Protection and Quarantine Procedures

First, let us examine the regulation that could be changed. Before 1912, when the Plant Quarantine Act was passed, there were no federal regulations for the importation of plant materials from foreign countries into the U.S. Although several states enacted their own plant quarantine laws to protect their agricultural industries, no federal regulations governing the importation of foreign propagative materials were passed until 1919 when quarantine 37 (7

CFR 319.37) became effective. These regulations have been modified several times since 1919 further restricting, or relaxing, the movement of live plants and seeds into the U.S. from foreign countries. Amendments to Q-37 are based on new knowledge of plant pest distribution, modification in trade practices, and pesticide technology and availability.

Prior to the last revision of Q-37 in 1979, there were no restrictions on the importation of foreign coconut seednuts other than a plant import permit and inspection at a designated USDA plant inspection station. In light of problems with lethal yellowing disease in Florida in the 1970's and the possibility of introducing Cadang-cadang disease and a diversity of other exotic palm diseases into the U.S., Q-37 was amended to prohibit the introduction of coconut palms or seednuts from foreign countries into the the U.S. Currently, seednuts of *C. nucifera* entering the U.S. have to be accompanied by a phytosanitary certificate of inspection which declares that they were found by the plant protection service of Jamaica to be 'Malayan Dwarf' or 'Maypan' cultivars. This effectively makes Jamaica the sole source for introduction of lethal yellowing resistant seednuts from foreign sources.

Potential for Introduction of Red Ring Disease to Florida

Esser (1969) has suggested that red ring disease could easily be introduced into Florida from the Neotropics. There are two routes for the accidental introduction and establishment of the red ring disease complex into southern Florida via importation of seednut of *C. nucifera*. The first and most likely route for introduction of the disease complex would be through the introduction of red ring nematode-infested *R. palmarum* that had traveled undetected in a shipment of coconut seednuts. The second route could be through the introduction of a red ring nematode-infested coconut seednut that would develop symptoms as the palm matured.

Management to prevent the introduction of the red ring disease complex could be facilitated by: 1) fumigation of seednuts to kill hitchhiking weevils, 2) harvesting seednuts from areas that are certified free of red ring disease, and 3) use of the embryo rescue technique to avoid sending whole seednuts which could act as harborage for nematode-infested weevils. Research suggests that in *R. palmarum* from Trinidad, where the red ring disease complex has been known the longest (since 1905), over 90% of the newly emerged weevils had red ring nematodes internally and greater than 50% of the population had more than 1,000 nematodes (Gerber and Giblin-Davis 1990). However, in Ecuador, where *R. palmarum* has been known to exist since at least 1918 but the red ring disease has been only recently documented, only 31% of the newly emerged weevils were parasitized internally with red ring nematodes (Gerber et al. 1990). Thus, the chances of introducing and establishing the red ring disease complex with a hitchhiking weevil(s) from a red ring disease hot spot like Trinidad could be much greater than from areas where the red ring nematode has only become recently established.

R. palmarum is not currently distributed in the southeastern U.S. suggesting that the weevil may not be adapted for survival in this geographical region. Even if the weevil could survive and reproduce in the southeast there is still the question of what its preferred hosts would be. Inoculation of red ring nematode-infested palm tissue causes the disease in a wide variety of palms (Brathwaite and Siddiqi 1975). However, in nature the nematode is transmitted mainly to palms that are attractive to the weevils. For example, in Brazil, the red ring disease complex probably cycles through *Oenocarpus distichus* Mart. in the jungle. When oil palm is established in large plantations in these same areas and pruned, creating wounds that are attractive to *R. palmarum*, the red ring nematode is introduced into and can kill this palm species (Schuiling and van Dinther 1981). Most observations of *R. palmarum* in oil palm suggest that *R. palmarum* cannot complete its life cycle in this palm host. This means that the red ring disease complex occurs in oil palm plantations because of attractive wounds caused by cultural practices. The disease complex is maintained in native palms in the area. In southern Florida, coconut palms are distributed from the Keys north to Lake Okeechobee. Obviously these palms would be good hosts for maintaining the red ring disease complex in. But what about *Sabal palmetto* (Walt.) Lodd ex Schultes or *Phoenix canariensis* Hort. ex Chab. which are more widely distributed in the state of Florida and the southeastern U.S.? The answer to this question is not known. The big thatch palm, *S. blackburniana* Glazebr. ex Schult. & Schult.f., and the carat palm, *Sabal* sp., have been reported as hosts of *R. palmarum* (Wattanapongsiri 1966). The common practice of transplanting mature *S. palmetto* and *P. canariensis* is known to predispose these palms to attack from *R. cruentatus*, which is endemic to the southeastern U.S. (Giblin-Davis and Howard 1989).

Is *R. cruentatus* a potential vector for red ring nematode? There is no direct evidence for making this statement. However, research concerning the vectors of RRD in Trinidad and Ecuador has demonstrated that the palm weevil, *Dynamis borassi* Fabricius, in Ecuador can carry over 1,000 red ring nematodes through metamorphosis (Gerber et al. 1990). This suggests that under certain circumstances *D. borassi* may also serve as a vector for the nematode. It also suggests that other members of the genus *Rhynchophorus*, which are more closely related to *R. palmarum* than *D. borassi*, such as *R. cruentatus* may be capable vectors for the red ring nematode (Giblin et al. 1987, Giblin-Davis and Howard 1988). It must be emphasized that the most common hosts for *R. cruentatus* are *S. palmetto* and *P. canariensis* (Giblin-Davis and Howard 1988, 1989). *Rhynchophorus cruentatus* has been reported from *C. nucifera* only a few times (Giblin-Davis and Howard 1989). The most likely way that *R. cruentatus* could become associated with the red ring nematode would be if it were introduced into a preferred host, such as *S. palmetto* or *P. canariensis*.

The second route for introduction of the red ring disease complex to southern Florida could be through the introduction of red ring nematode-infested seednuts. Fenwick and Mohammed (1964) reviewed the scant literature on the potential for seednut infection by *B. cocophilus*. Early reports stated that red ring nematode could penetrate the husks of nearly mature fruits on wet soil (Ashby 1921) and that large green fruits could be infested with nematodes by inoculating with infested fragments of stem tissue (Ashby and Nowell 1924). Harvested immature coconut fruits have subsequently been shown to be suitable for sustaining the reproduction of the nematode for several weeks (Blair 1965). Inoculation experiments showed that the nematodes could not infest trees from inoculated fruits on the palm, suggesting that the nematodes could not migrate through the dense tissue of the inflorescence to infest the stem or crown (Blair and Darling 1968). Esser and Meredith (1987), however, reported that on rare occasions red ring nematodes were recovered from the endosperm of immature coconut fruits. Most observations suggest that premature fruit drop occurs during red ring nematode infestations (Griffith 1987, Nowell 1919).

Two papers have dealt with the issue of seednut and/or seedling infestations by red ring nematode. Both papers suggest that the inoculated seednuts or seedlings of *C. nucifera* (Fenwick and Mohammed 1964) or inoculated seedlings of *E. guineensis* (Dao and Oostenbrink 1967) do not sustain red ring nematode infestations. Fenwick and Mohammed (1964) inoculated the husks of 100 coconut seednuts of unknown age and 102 apparently healthy seedlings (ca. 8–12 months old) with suspensions of ca. 4,000 red ring nematodes in volumes of 1 ml. Seednuts and seedlings were inoculated 3 weeks after planting in the field and 3 seednuts and 4 seedlings were randomly chosen for examination every 4 weeks up to 24 weeks, then every 8 weeks up to 64 weeks for seedlings and 56 weeks for seednuts. Nematodes were recovered from the husks of all seednuts 4 weeks after inoculation. However, after 24 weeks there were no traces of infection in any part of the plants from inoculated seednuts. Nematodes were recovered at 4, 8, and 12 weeks post-inoculation from the husk, roots and boles of inoculated seedlings. At 16 and 20 weeks nematodes were recovered from the haustorial region (apple), roots, and petioles of inoculated seedlings. However, 40 weeks after inoculation no living nematodes were recovered from inoculated seedlings suggesting that infections of seedlings are short-lived and not carried into later development. Dao and Oostenbrink (1967) inoculated a total of 125 five-month-old oil palm seedlings with 3,500 nematodes per palm in 10 ml volumes. No red ring nematodes were recovered from seedlings after 4 months. These experiments suggest that this route for the introduction of red ring disease into Florida is highly unlikely. Even if a seedling were to be introduced that later died from a red ring nematode infestation, there is little chance that there would be enough tissue for a palm weevil to use it for complete metamorphosis and to become associated with the nematode.

Conclusion

Regulatory personnel cannot "tempt fate" and must "play it safe" in decisions to exclude potential pests from the U.S. At the present time it is prudent not to import coconut seednuts from foreign countries into Florida. As I have outlined in arguments above the major risk to Florida for introducing red ring disease would be in importing red ring nematode-parasitized *R. palmarum* with seednuts from areas where the disease is endemic. If methods for controlling or inspecting the seednuts for hitchhiking *R. palmarum* cannot be implemented, then efforts should be focused on providing cost effective embryo rescue techniques and facilities. Quality control could be easily accomplished and the chance of introducing nematodes or other diseases would be minimized using the embryo rescue technique (R. Litz, pers. comm.).

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The ISHS Coconut Registration Authority*

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Coconut palms are supposed to have a thousand-and-one uses in India and as many uses as there are stars in the sky in Indonesia. They have almost as many names.

Scientifically, there is only one species of coconut (*Cocos nucifera* L.) with two plant habits (tall or dwarf) and three basic color forms (yellow, red and green). But the actual range of intermediate palm habits and colors, exhibit every possible combination. This is particularly so for the size, shape and appearance of the fruits (the hard-shelled, dry, brown nut enclosed in a thick, fibrous, smooth-skinned husk). Attributing the names and the descriptions to inherited genetic traits is extremely difficult. Even if the plant breeding work is done before the palms get too tall, the low number of fruit set per pollination, the twelve months taken before the seed is mature and the five or more years it then takes to bring the next generation into bearing, make it practically impossible to study coconut genetics.

All plants are essential to civilization and none more so than the coconut palm, which has had a long association with mankind. It is important that plants should be named according to a precise, stable and internationally accepted system. The International Code of Botanical Nomenclature governs the use of botanical names in Latin for both wild and cultivated plants. There is also an International Code of Nomenclature for Cultivated Plants. This aims to promote uniformity, accuracy and stability in the naming of cultivars (varieties). This is done through the establishment of International Registration Authorities under the guidance of the International Society for Horticultural Science (ISHS). There are registration authorities for many ornamental plants and for fruit tree crops, such as mango. Until now there has not been one for any palm genera.

The International Coconut Cultivar Registration Authority has been set up by the appointment of an International Registrar and a work program has been laid down. There are three stages:

(a) to compile and publish a checklist of coconut cultivars;
(b) to regularly add to, and amend, the checklist; and
(c) to offer registration facilities for new cultivars and hybrids.

The ISHS expressed an interest in making a checklist of coconut cultivars in 1973. At that time, when F_1 hybrid coconuts had begun to be produced in commercial quantities, it became important to know all about the hybrids and about their parentage. In 1968 a Coconut Breeders' Consultative Committee had been set up by the Food and Agriculture Organization of the United Nations (FAO), through its Technical Working Party on Coconut Production, Protection & Processing. This *ad hoc* committee proposed the establishment of a Hybrid Register using the recommendations of the International Code of Nomenclature for Cultivated Plants but the

*Since going to press the International Board for Plant Genetic Resources (IBPGR) have held a Coconut Genetic Resources Network steering committee meeting, at which the assistance of ICCRA, and specifically the computer database of coconut cultivars, was made available.

initiative did not survive the closure of the FAO Technical Working Party in 1981.

The International Board for Plant Genetic Resources (IBPGR) began to take an interest in coconut germplasm in 1975 and there have been meetings (sponsored by IBPGR and FAO) in the Philippines (1987) and in Thailand (1988) which have included recommendations for cataloguing and characterizing coconut germplasm collections. The IBPGR Coordinator for South and Southeast Asia is presently planning to establish a coconut germplasm database. National organizations, such as the Philippine Coconut Authority and the Institut de Récherches de Huiles et Oléagineux also maintain coconut germplasm databases. It might be asked whether ICCRA is needed if it merely duplicates the other national and international efforts. That is not the intention.

National organizations that do research into coconut need to keep detailed records of the varieties that grow in their country and of any that are introduced for research purposes. In the same countries there are likely to be variety release committees who have to pass judgement on whether new varieties and hybrids are suitable to be grown by farmers. Because of the long generation time and other delays to successful breeding programs, the release of new coconut varieties tends to be a fairly rare event, so that the existence of coconut cultivar registration authorities will assist variety release panels to make judgements that are consistent to generally accepted standards. ICCRA would not attempt to interfere in these national, statutory, governmental operations. But it would encourage the responsible individuals from those national organizations to appoint one of their members to act as a national registrar, affiliated to the International Registration Authority.

The possibility of a regional or international coconut germplasm database, whether organized by IBPGR or any other agency, does not conflict with ICCRA. In addition to identifying germplasm resources wherever they occur, the IBPGR has a major role to play in ensuring that these resources are available to future generations. IBPGR is concerned with encouraging national and international efforts to conserve germplasm. Coconut germplasm is under threat of extinction from replanting with superior coconut varieties, or other crops, from removal by logging, from devastation by pests and diseases or from rises in sea level caused by global warming. The IBPGR database organizers might not need to be involved with ICCRA but a checklist of coconut cultivars and information on locations, origins, descriptions and so on, would greatly assist the further development of an IBPGR coconut database. Similarly, coconut research organizations have many objectives competing for first priority and germplasm will have to share attention with other subjects. The information that could be received from ICCRA will allow efforts to be concentrated on other equally important matters, such as improving disease and drought tolerance, and generally bringing coconut cultivation, processing and marketing into the twenty-first century.

The ICCRA approach takes these important criteria into account but also concerns itself with aspects such as the sources used by, and the stocks held in, private and commercial seedgardens and nurseries; the interests of the palm society amateur gardener as well as the professional botanical garden superintendent; the information needs of the high-school teacher as well as those of the university taxonomist. By using commonly available computer hardware and software, listings can be readily exchanged. Information will appear in scientific, technical or popular publications, as appropriate. Above all, by appointing voluntary registrars who will be bound only by their own interest and initiative, ICCRA will be as useful as its contributors care to make it.

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Seed Predation by a Curculionid Beetle on the Dioecious Palm Chamaedorea tepejilote

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ABSTRACT

Seed predation by a curculionid beetle (unidentified yet) on the fruits of the dioecious palm *Chamaedorea tepejilote* is reported. Pre-dispersal and post-absission predation, and the removal of seeds from the soil were studied. More than 60% of the seeds on the maternal plant were damaged by predation before dispersion and very few seeds were damaged after the fruits fall on the soil. Levels of damage were correlated with the density of fruits on the plants. Fallen fruits were removed by small mammals in one night. The demographic consequences of seed predation in *C. tepejilote* and possible mechanisms of plants defense against seed predators are discussed.

RESUMEN

Se reporta la depredacion de semillas de los frutos de la palma dioica *Chamaedorea tepejilote* por un curculiónido (aun no identificado). Se estudió la depredación pre-dispersión y post-absision, asi como la remoción de frutos en el suelo. Más del 60% de los frutos en el suelo fueron depredados antes de la dispersión y muy pocos frutos fueron depredados después de que cayeron al suelo. Los niveles de depredación estuvieron correlacionados con la densidad de frutos en las plantas. Los frutos en el suelo fueron removidos por mamíferos pequeños en una noche. Se discute las consecuencias demográficas de la depredación de semillas en *C. tepejilote* y sus posibles mecanismos de defensa.

Seed predation is one of the main factors influencing the mortality of plants (for a review see Janzen 1971) and many studies on tropical plant species have been reported (Janzen 1975; Moore 1978*a*, *b*; Silander 1978; De Steven 1981, among others). The influence of seed predation on the determination of the structure and diversity of tropical communities has been also evaluated (Hubbell 1980). However, very few studies have reported the effects of seed predation on the population dynamics of tropical plants (Sarukhan 1980, Piñero and Sarukhan 1982).

In 1981, a long-term project on the population biology of the dioecious palm *Chamaedorea tepejilote* Liebm. was initiated, and until now the demography (Oyama 1987, unpublished), resource allocation (Oyama and Dirzo 1988), herbivory (Oyama 1984, Oyama and Dirzo, unpublished), and artificial defoliation (Oyama 1987, Oyama and Mendoza, unpublished) have been reported. In this paper, I present the results of the levels of predation suffered by the seeds of *C. tepejilote* by a curculionid insect (unidentified yet) in a Mexican lowland rain forest.

Materials and Methods

Study Site. This study was conducted at the 700 ha reserve "Estacion de Biologia Tropical Los Tuxtlas" owned and operated by the Instituto de Biologia of Universidad Nacional Autonoma de Mexico. This reserve is located at 95°04′–95°09′W and 18°34′–18°36′N in the state of Veracruz. The forest of Los Tuxtlas is classified as Tropical Rain Forest with trees reaching heights up to 35 m. Elevations range from

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150–700 m. Mean annual rainfall is approximately 4,500 mm and mean daily temperature is 24° 132C. The palm flora of Los Tuxtlas is described in Ibarra-Manriquez (1988) and Ibarra-Manriquez and Sinaca-Colin (1987).

Chamaedorea tepejilote Liebm. in Mart. is one of the most common palms in the understory of the forest at Los Tuxtlas (Oyama 1984, Bongers et al. 1988). The tallest individuals reach up to 5.0 m in height. The ripe fruits are black (green when immature), ovoid, 10–15 mm large and 6–8.5 mm wide; with thin exocarp, mucilaginous mesocarp and endocarp with fiber and thin membrane. The seeds are yellow-brown, 9–11 mm large and 5–6.5 mm wide (Aguilar-Amar 1986). Each fruit has only one seed. Taxonomical description of *C. tepejilote* is provided by Ibarra-Manriquez (1988).

Flowering is from September to March. The fruiting peak is concentrated in July–August. The fruits remain on the maternal palm for a long time (sometimes more than one year). The seed predator is a larva (Curculionidae as yet unidentified) that parasitizes the fruits before ripening. When this occurs a black dot is observed in the green immature fruits. In a preliminary study, I collected more than 500 fruits from 16 infructescences of 8 palms, and in more than 95% of the fruits with a black dot, a weevil larva was observed. The presence of a dot was therefore used to indicate weevil predation, thereby avoiding the harvesting of fruits. Further germination experiments with damaged seeds were not carried out because the seeds were completely destroyed.

The seeds of *C. tepejilote* have been observed in the mouth-pocket of a heteromyid mouse, *Heteromys desmarentianus*. This mouse eats seeds of more than 20 species at Los Tuxtlas but the seeds of *C. tepejilote* are among the five more common ones used by the mouse. From 1–4 seeds per pocket have been observed but most of them were fragmented suggesting a post-dispersal predation (V. Sanchez-Cordero, pers. comm.). Otherwise, infructescences of *C. tepejilote* are visited by some species of birds (D. Van Dorp, pers. comm.).

Methods

Pre-Dispersal Predation. Thirty-seven palms comprising 105 infructescences and 2,084 fruits were observed from August through October, 1985. The degree of ripening and the presence or absence of a curculionid larvae (noting the black dot) were recorded every month. The number of abortive fruits were also recorded as identified by the abnormal morphology of the fruits. The differences between two consecutive measurements were considered as "fruits removed". These 37 palms were used to compare the density of fruits with the intensity of seed predation.

Post-Absission Predation. Seventeen reproductive palms along a 100 m transect were chosen and a 1 m diameter basket was placed at the base of each palm, just below the infructescences, to catch all the fallen fruits. The fruits in the baskets were classified as ripe, unripe, damaged by predation, undamaged and aborted. Because the fruit-seed damaged by the weevil was easily recognized, only fruits with a different type of damage were considered as showing post-absission predation.

Removal of Seeds from the Soil. Thirty sets of 20 undamaged ripe fruits were placed randomly on one 600 m^2 (30 m × 20 m) permanent plot. Ten sets were covered with a mesh of 0.5 cm^2; another 10 with a mesh of 2.0 cm^2 and the rest without any mesh. This experiment was designed to measure rates of predation or dispersal on the soil.

Results

Pre-Dispersal Predation. The weevil larva was the only seed predator. At the beginning of this study, 1,283 of 2,084 fruits (61.56%) were damaged by weevil-

Table 1. Pre-dispersal seed predation on Chamaedorea tepejilote. *Total number of seeds sampled = 2,084 in 37 palms. The number in parentheses represents the proportion of fruits (seeds) in relation to the total fruits sampled.*

	August			September			October		
	UN	RI	Total	UN	RI	Total	UN	RI	Total
Damaged seeds	1,219 (58.19)	64 (3.07)	1,283 (61.56)	326 (15.64)	337 (16.17)	663 (31.81)	211 (10.12)	45 (2.16)	256 (12.28)
Undamaged seeds	669 (32.10)	116 (5.57)	785 (37.67)	506 (24.28)	201 (9.64)	707 (33.92)	80 (3.84)	356 (17.08)	436 (20.92)
Aborted seeds	—	16 (0.77)	16 (0.77)	7 (0.34)	149 (7.15)	156 (7.49)	—	222 (10.65)	222 (10.65)
Removed seeds		—			558 (26.78)			1,170 (56.14)	
Total		2,084			2,084			2,084	

predation: 1,219 of unripened fruits and only 64 of ripe fruits. Very few fruits were aborted. In September, the proportion of fruits damaged was only 31.81% (326 of unripe and 337 of ripe fruits) and 558 fruits (26.78%) were removed. I assumed that most of the fruits removed were damaged the month before. The fruits removed and the fruits predated on this month were 58.59% of all the fruits. This value is low compared with the 61.56% recorded in the month before, and could be expressing the error associated with the use of the dot-marker. Also, the rate of predation did not increase suggesting that the attack of the weevil was concentrated in the months before August. In October, only 256 fruits (12.28%) were predated and 1,170 were removed (Table 1).

Post-Absission Predation. In the first month, 192 of 924 fruits (20.7%) were removed from the maternal plants. Ninety-two fruits dropped under the maternal plants and of these, only 26 (2.81% of the total) were damaged by the same pre-dispersal weevil. One hundred fruits were considered dispersed. After the second month, 457 of 924 fruits (50.5%) were removed from the maternal plant and only 34 fruits (3.68%) were damaged, again by the same weevil (Table 2).

Density Dependence. The intensity of

Table 2. Post-absission seed predation on fruits of Chamaedorea tepejilote. *Total number of fruits (seeds) = 924. The number in parentheses represents the proportion of fruits (seeds).*

Month	Number of Seeds	Seeds Predated	Safe Seeds
(a) Fruits (seeds) under the maternal plant			
August–September	92 (9.96)	26 (2.81)	66 (7.14)
September–October	211 (22.84)	34 (3.68)	177 (19.16)
(b) Fruits removed (dispersed)			
August–September	100 (10.82)		
September–October	246 (26.62)		
(c) Fruits (seeds) on the crown			
August–September	732 (79.22)		
September–October	467 (50.54)		

(a) = means fruits collected in the 17 baskets under the maternal plants.

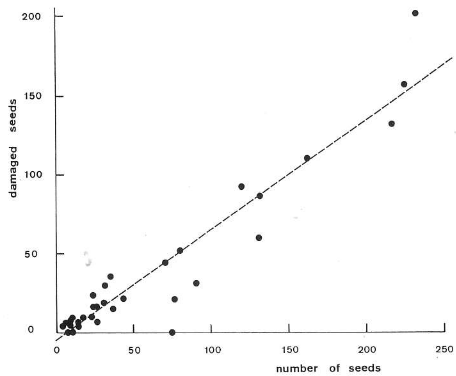
seed predation was correlated with the density of fruits on the palms ($R^2 = 0.90$) Fig. 1.

Dispersion of Seeds. Seeds without mesh were removed in one night but seeds covered with mesh were left for three months. Any sign of parasites or fungus was recorded.

Discussion

More than 60% of the fruits produced by *C. tepejilote* are damaged by larvae of the curculionid insect. This percentage of damage is higher than the values reported for other species (Janzen 1971). Seed predation has been reported for other species at Los Tuxtlas (Cordova 1985, Alvarez-Buylla 1986) and in the case of *Astrocaryum mexicanum* 90% of the seeds are damaged influencing the population dynamics of this species (Sarukhan 1978, Piñero and Sarukhan 1982). In *C. tepejilote,* seed predation constituted the main factor of mortality in the life cycle influencing the intrinsic rate of population growth based on sensitivity analysis (Oyama 1987).

One curculionid species was observed during the study period and probably was a specialist insect that could drill the protected exocarp of *C. tepejilote* fruits. Several mechanisms of defense against seed predation have been reported for plants. Chemical compounds (Rosenthal and Janzen 1979) and "escape" in time and space (Janzen 1978) have been suggested. The data available for *C. tepejilote* suggest in part an "escape" by satiation of predators (see Janzen 1978). Some individual plants of *C. tepejilote* produce enough fruits to satisfy the food requirements of the curculionid insect leaving a number of safe fruits for the establishment and propagation of *C. tepejilote* at Los Tuxtlas. There is not a precise definition of the term "satiation" but if some seeds can escape predation then the efficiency of escape could be evaluated. The simplest case of satiation



1. Correlation between density of fruits (seeds) and the intensity of predation.

of predators occurs when the number of predators is independent of the seed crop produced and the rate of removal by dispersal agents (Janzen 1978). However, in *C. tepejilote* density-independence of seed predation occurred although this palm produced a wide range of fruits per individual (Oyama 1987; unpublished). Seed predators could have played a significant role on the selection of the fruits produced.

The rate of seed predation on the maternal palm and the rapid removal of seeds from the soil, also determine the pattern of spatial distribution of *C. tepejilote* at Los Tuxtlas. Few seeds (compared with the entire seed crop) can germinate and establish, mainly near the parental palm or some meters far away (removed by dispersors), producing the aggregated pattern of spatial distribution of this species (Oyama 1984, Oyama et al., unpublished).

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A Simple Fertilizer Trial with Coconuts

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ABSTRACT

Young coconuts grew significantly better with 8-8-8 or potassium nitrate than without fertilizer; there was no difference between the fertilizers. Response (+19%) was measurable within 7 weeks, and increased to over 30%. After 15 weeks without fertilizer, the control palms were fertilized and their growth rate caught up with the previously fertilized palms after 4 weeks. Maypan hybrids grew significantly faster than Malayan Yellow Dwarf which in turn grew faster than Malayan Green Dwarf. All varieties responded equally to fertilizer. It is suggested that palm growers carry out their own trials.

Fertilizing may not be the most expensive of palm growers' maintenance procedures, but it is desirable to use the most suitable type of fertilizer if young palms are to grow fast and flower early, and mature palms are to have a healthy appearance.

Much research has been done in the world on fertilizing of palms, mainly oil palm (*Elaeis guineensis*), coconut (*Cocos nucifera*) and date (*Phoenix dactylifera*), and the literature on this subject is correspondingly profuse. The best fertilizer depends upon the nutrient needs of that particular palm species and on the nutrient supplying power of the particular soil. However, there is a need in most cases for a steady supply of nitrogen, especially for young palms, and a heavy requirement for potash, particularly with palms bearing large amounts of fruit. Phosphate is needed only in specific areas of deficiency, and then in quite limited amounts (Romney 1987). Magnesium may be useful, especially when large quantities of potash have been used (Brunin 1970). Deficiency of sulphur occurs only in certain soils of Papua New Guinea (Galasch 1976), of iron and manganese in the corals of Tahitian atolls, and of chlorine in some Pacific soils (de Taffin and Quencez 1980): palms receiving sulphate of ammonia and potassium chloride are anyway not likely to suffer from deficiency of sulphate or chlorine. Boron deficiency may occur in very calcareous soils or after very cold weather (Donselman 1981).

The formulation of a general fertilizer for palms has to provide those nutrients known to be needed, but also to include at least small quantities of other nutrients that might be required and whose absence might result in unbalanced nutrition. Hence the general advice given by Donselman (1981) can be followed without fear.

The main procedures used by growers to determine the specific nutrient needs of their palms are soil and leaf analysis, and these can be very good guides. However, soil analysis measures the nutrients extracted from the soil by a chemical solution, which does not always correspond to the amounts extractable by the roots of the plant. Leaf analysis shows the quantities of nutrients which have been extracted by the plant. With both, the answers are reliable only if the correct sample is taken, and an expert is required to interpret the results. A field trial, on the other hand, shows exactly how the palms react to the different fertilizers in the soil where they are being grown.

The purpose of the trial reported here was to determine a suitable fertilizer mixture for an artificial soil-mix used to grow coconut plants on from the age of 5 months post-sprouting (up to which time nutrients are normally adequately provided by the endosperm in the nut) for a further 12–18 months. The reason for reporting it was to demonstrate how growers can test fertilizers with their own palms. The desiderata for this procedure are (a) possession of some preliminary knowledge of probable suitable fertilizers, (b) test plants with some botanical feature that enables their growth to be monitored easily, and (c) sufficient of these plants to enable the trial to give reliable and analyzable data.

Materials and Methods

The trial was carried out at Romney Farm, South Dade County.

The plants under test comprised Malayan Green-fruited Dwarfs, Malayan Yellow-fruited Dwarfs and Maypan Hybrids (F1 hybrids between yellow-fruited Malayan Dwarf mother-palms and Panama Tall pollen parents) (Harries and Romney 1974). All seeds were obtained from Jamaica, harvested from palms which have shown their resistance to lethal yellowing disease for many years in the diseased area. The seeds were set to sprout in July, 1988, and transferred to 7-gallon black polybags in August and September, 1988. The plants were approximately 2 ft. above soil level by January, 1989, when they were moved to 25-gallon polythene tubs.

The soil-mix used in both polybags and tubs consisted of stable sweepings and fine calcareous sand in the approximate proportions of 9:1 by volume. The soil surface was treated with Ronstar granular herbicide. No fertilizer was used prior to the trial.

Fertilizer treatments were used as follows:

A. 3 ounces of 8-8-8 applied per palm on 3/2/89, 3/17/89 and 5/16/89.

B. 1 oz. potassium nitrate (15-0-45) applied per palm on 3/2/89, 3/17/89 and 5/16/89.

C. No fertilizer used until 6/15/89, when 2 ounces of potassium nitrate were applied per palm to encourage the latter to catch up with treatments A and B fertilized since 3/2/89 (15 weeks previously).

Each fertilized "plot" comprised 2 palms, and there were 3 such plots for each fertilizer treatment, i.e., 3 replicates. Thus 18 palms were used for each of the varieties. The partition of degrees of freedom in the statistical analysis of variation was therefore:

	Source of variation	Degrees of freedom
3	Replicates	2
3	Varieties	2
3	Fertilizers	2
	Interaction (Var. × Fert.)	4
	Error	16
	Total	26

For readers not familiar with statistical analysis of data, it should be explained that this analysis investigates whether the differences between palms treated differently (e.g., fertilizer) are significantly greater than the natural differences between palms treated alike (error). In the analysis of the data in this trial, a difference was considered to be significant if it could be expected at least 5 out of every 100 times that the trial was carried out. The least difference for this level of significance (LSD) is shown in the table for each measurement period. Any difference less than the LSD is considered to be due to chance variation.

Growth was assessed every 2 weeks by measuring the height above ground level of the tip of the spike (the central youngest leaf); such growth is linear during its most active period (Romney 1964). When a new spike appeared, its length was measured and it took the place of the previously measured leaf.

Table 1. Mean spike growth (inches/week).

Fert./ Var.	Period 3/22–4/5	4/5–4/19	4/19–5/3	5/3–5/17	5/17–5/31	5/31–6/14	6/28–7/12
0	2.5a	2.6b	3.3b	2.8b	3.9b	4.5b	6.4a
8-8-8	2.7a	2.7b	3.7a	3.2a	4.8a	6.0a	6.2a
14-0-45	2.9a	3.1a	3.9a	3.4a	5.0a	6.2a	6.4a
LSD	.4	.4	.3	.3	.4	.4	.5
M.Gre.D	2.4b	2.4b	2.9c	2.2c	3.3b	4.1c	5.3c
M.Yel.D	2.5b	2.7b	3.8b	3.3b	4.6a	5.7b	6.2b
Maypan	3.2a	3.3a	4.3a	3.8a	4.9a	6.9a	7.5a

Note: means followed by the same letter (a, b, c) are not significantly different.

Results

Discussion and Conclusions

For leaf growth (Table 1), by the 2-week period ending 4/19 (7 weeks after the first fertilizer application), potassium nitrate had caused significantly greater growth and, from 4/19 onwards, both fertilizers gave more growth than control yet were not significantly different from each other. Evidently the phosphate in the 8-8-8 had no effect. Possibly the faster response from potassium nitrate was due to faster solubility of the nutrients. A larger and therefore more accurate trial might have detected a significant benefit of potassium nitrate over 8-8-8, but the present results simply show a response from fertilizer of 19% by 7 weeks after the first application increasing to 33–38% by 6/14. The 3 oz. 8-8-8 is approximately equal to 1 oz. potassium nitrate in cost and nutrient content.

By 7/12, the fertilizer applied to the control palms on 6/15 had caused their leaf growth to increase to a level not significantly different from those fertilized since 3/2, demonstrating how quickly the palms can be shown to respond if the measurements are sufficiently sensitive. The much greater growth as the experiment proceeded was due to the increasing ambient temperature (the relationship between coconut growth and temperature will be reported in a later paper).

In none of the time periods measured was the interaction significant between fertilizer treatment and coconut variety, i.e., the response to fertilizer was not different between varieties.

In terms of the number of new leaves produced from 3/8 to 6/14 (Table 2), both fertilizers were again significantly better than control. It is interesting to note that, if annual leaf production proceeded at the same rate as during the 14-week period 3/8–6/14, then fertilized palms would produce 12.9 leaves for this first year of life of the palm and unfertilized trees would produce 10.9 leaves.

Leaf production of MYD was significantly greater than for Maypan or MGD. However, 14 weeks is a rather short period over which to measure leaf production if meaningful results are to be obtained.

It is believed that palm growers could

Table 2. Mean no. new leaves per palm (3/8–6/14).

Fertilizer	0	2.94b	Variety	MGD	2.89b
	8-8-8	3.39a		MYD	3.83a
	14-0-45	3.56a		MP	3.17b
	LSD	.4		LSD	.4

carry out their own field trials to compare fertilizers, varieties, degrees of shade, types of soil, pesticides, etc. Leaf lengths and number of leaves are easy to measure. Some preliminary advice may be needed on the design of the trial and on the statistical analysis of the data, but trials in the grower's own field can give directly applicable results.

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The Botanical Gardens of the University of the South Pacific

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In September, 1988, the President of Fiji, Ratu Sir Penaia Ganilau, officially opened the Botanical Gardens at the University of the South Pacific in Suva, Fiji.

Some two years previously, a small group of people mainly from the University started to meet regularly to see what could be done to upgrade the gardens on the University campus. The Chairman was Dr. John Miller, an American botanist with the Department of Biology, School of Pure and Applied Sciences. The writer was the only non-university member. In the beginning, not a lot of progress was made although some improvement in the University gardens could be seen. Attempts were also made to get the students to take pride in their campus and to realize that, when they needed leaves and flowers for cultural or social occasions, they should not simply strip the closest trees and gardens. Students at the University come from the island nations of the South Pacific from the Cook Islands to the Solomon Islands, from Tonga to Kiribati.

The situation changed somewhat with the arrival of Ian Banner as the Director of Buildings and Grounds. He had previously been in Papua New Guinea and was enthusiastic about the appearance of the grounds. At about the same time, I realized that I would have to find a permanent home for many of my palms, cycads and hibiscus—most of these were reaching the stage when they could not stay in containers any longer. My garden was also overfull and I needed more space for the younger and smaller plants in my collection.

A small valley near the entrance to the University was chosen as an area where we could start. It had been used for many years by people living outside the University (and in no way connected to it) for food gardens but many of these had been abandoned or only partly used. In its existing state the valley contributed nothing to the appearance of the grounds. Taro (*Colocasia esculenta*) and Cassava (*Manihot esculenta*) had been the main food plants grown. Following the general clearing of the valley, Ian was able to find funds to build several bridges across the stream (drain) and to build a number of weirs to provide small bodies of water and to control silting. Even this small change made a dramatic difference to the appearance of the valley and staff and students began to use the area.

In my enthusiasm, I was probably not systematic in my planting and I have no doubt that a better arrangement could have been devised. I have more palms to add—probably another one hundred plants in thirty to forty species—and, I hope, these can be sited with a little more thought.

Just prior to the official opening of the Gardens, John Miller returned to America and, after a period of some months, his place was taken by Dr. David Greenwood, from Australia. Unfortunately, David has also left Fiji. However, during his time he continued the work of Chairman of our committee, with considerable ability and enthusiasm.

There is a well established Herbarium in Fiji, for many years a part of the Department of Agriculture. In 1982, the Herbarium was transferred to the University and occupied a building on the Lower Campus near the sea. Recently, it was moved to a renovated building within the immediate area of the Botanical Gardens. Both John Miller and David Greenwood did a lot of work in renovating and upgrading the specimens. Over the coming years it is hoped to make this the Herbarium for the whole South Pacific area.

As the first valley in the Gardens gradually filled, an adjacent valley has been cleared and an access road to the nursery upgraded. To date, the major action in this valley has been the building of a rather large pond, with water lilies, by damming the drainage stream. This, technically, is for use by the School of Natural Resources but, by siting it in the extension of the Gardens, it also adds to the beauty of the University grounds.

On lawns around the pond, I have planted about thirty cycads and it is likely that I shall move some of the cycads originally planted in the first valley to this valley. Further up the valley we shall be planting a wide range of local fruit and food trees.

Other plans include the planting of medicinal plants and the building up of collections of important cultural plants from all the islands of the University region—certain plants are important when particular ceremonies are held.

Funding for the development to date has come from within the University. It was particularly pleasing that in 1988 when funds were very limited, a committee made up of mainly Pacific Island members of staff insisted that the Botanical Gardens project was worthy of support. However, for any further expansion of the Gardens, it is likely that we shall have to look elsewhere for funding. I estimate that development has so far cost about $F 50,000 plus my own and other donations of plants.

Two other members of the committee deserve mention. Dr. Bill Aalbersberg, an American who may make Fiji his home, has acted as Chairman on occasions and has been an active member. Mrs. Leba Savu, the Laboratory Manager of S.P.A.S., is technically our secretary but her involvement goes much further. Her deep interest in local plants and committment to the Botanical Gardens project have been extremely valuable. Up to the present, much of the drive to develop the Gardens has come from Europeans—both short and long term residents of Fiji—but for the Gardens to develop further, local Pacific people must play an increasingly positive role. Leba is such a person and sufficiently senior in both the University and Fijian hierarchy to make her voice heard. It is hoped that in the coming years, the committee will have more members of her ability and interest.

Lists of palms, already planted in the Gardens and to be planted at a later date, are attached.

Palms Already Planted in the U.S.P. Botanical Gardens

Acrocomia sp.
Aiphanes caryotifolia
A. erosa
Alsmithia longipes
Archontophoenix alexandrae
A. cunninghamiana
Areca triandra
A. vestiaria
Arenga engleri (?)
Balaka longirostris
B. seemannii
Bentinckia nicobarica
Bismarckia nobilis
Calamus vitiensis
Carpentaria acuminata
Caryota mitis
C. urens
Chamaedorea elegans
Chrysalidocarpus cabadae
C. madagascariensis var. *lucubensis*
Cocos nucifera
Cryosophila albida
Cyrtostachys renda
Dictyosperma album
Drymophloeus oliviformis
Elaeis guineensis
Gulubia costata
Licuala grandis
Livistona australis
L. chinensis
L. rotundifolia
L. saribus
Metroxylon vitiense
M. sp.
Neoveitchia storckii
Normanbya normanbyi
Pelagodoxa henryana
Phoenix reclinata
Pritchardia pacifica
P. thurstonii
Raphia sp.
Reinhardtia latisecta
Rhapis excelsa
Rhopaloblaste sp. (*singaporensis*?)
Roystonea oleracea
Sabal minor
S. palmetto
Satakentia liukiuensis
Syagrus sp.
Veitchia pedionoma
Washingtonia filifera

Palms Yet to be Planted

Areca catechu
Arenga undulatifolia
Balaka microcarpa
Butia capitata
Carpoxylon macrospermum
Various chamaedorea species and hybrids
Chrysalidocarpus lutescens
Clinostigma exorrhizum
Coccothrinax miriguama (?)
Copernicia prunifera
Corypha utan
Deckenia nobilis
Drymophloeus beguinii
Geonoma sp.
Gronophyllum pinangoides
Heterospathe elata
Hyophorbe lagenicaulis
H. verschaffeltii
Johannesteismannia altifrons
Latania lontaroides
Licuala paludosa
L. sp.
Linospadix monostachya
Livistona decipiens
L. mariae
Marojejya darianii
Nephrosperma vanhoutteanum
Phoenicophorium borsigianum
Phoenix canariensis
P. dactylifera
P. roebelenii (possibly hybrid)
Physokentia rosea
Pigafetta filaris
Pinanga coronata
Ptychosperma ambiguum
P. furcatum
Rhapis sp. (miniature form)
Roscheria melanochaetes
Roystonea regia
Sommieria affinis
Syagrus romanzoffiana
Synechanthus sp.
Thrinax floridana
T. sp.
Verschaffeltia splendida
Veitchia joannis
V. merrillii
V. petiolata
V. sessilifolia
V. simulans
V. vitiensis
V. sp.
Zombia antillarum

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Notes on the Genus Acanthococos

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Several recent authors (Moore 1973; Dransfield and Uhl 1986; Uhl and Dransfield 1987) have listed the South American cerrado palm genus *Acanthococos* Barbosa Rodrigues as synonymous with the more widespread *Acrocomia* Martius without formal transfer of the type species. In addition, little or no discussion of the reasons behind this reduction nor of the relationships of the genus and its component species has been offered. Current work on the taxonomy of Paraguayan palms (Hahn 1990, in prep.) has required an examination of the genus and its three described species.

The type species, *Acanthococos hassleri*, was described by Joao Barbosa Rodrigues in 1900 based on a collection of Emil Hassler from Ype-hu in eastern Paraguay and illustrated with a colored plate in Barbosa Rodrigues' *Sertum Palmarum Brasiliensium* (1903). In the original publication, Barbosa Rodrigues speculated about the affinities of the newly described taxon concluding that it was intermediate to *Bactris* N. J. Jacquin and *Syagrus* Martius (under the then broadly defined *Cocos* L.) citing the presence of spines, free petals in the pistillate flowers, and what he took to be basal endocarp pores. This latter feature is anomolous for a spiny member of the *Cocoeae*. The nonspiny members of the tribe are variable in pore placement with a basal position most frequent (Uhl and Dransfield 1987). An examination of material from the type locality and numerous additional specimens from throughout the range of *Acanthococos*, however, shows an equatorial rather than basal position for the endocarp pores.

In the later publication (1903), Barbosa Rodrigues subdivided the "tribe" *Cocoineae* Bentham & Hooker (currently recognized as *Cocoeae* Martius) into seven subtribes, *Attaleaineae* Barbosa Rodrigues, *Eucocoineae* Drude, *Barbosineae* Barbosa Rodrigues, *Bactrisineae* Barbosa Rodrigues, *Astrocaryineae* Barbosa Rodrigues, *Manicariineae* Barbosa Rodrigues, and *Leopoldiniineae* Barbosa Rodrigues. *Manicariineae* and *Leopoldiniineae* are presently placed as subtribes in the tribe Areceae, *Attaleaineae* (= *Attaleinae* Drude) is currently recognized more or less intact as a subtribe in the *Cocoeae*, and *Barbosineae* has been united with *Eucocoineae* as subtribe *Butiineae* Saakov (Dransfield and Uhl 1986).

The two remaining subtribes, *Bactrisineae* (with *Acanthococos*, *Bactris*, *Guilielma* Martius, *Martinezia* auctores (= *Aiphanes* Willdenow), *Amylocarpus* Barbosa Rodrigues, and *Desmoncus* Martius) and *Astrocaryineae* (with *Acrocomia* Martius and *Astrocaryum* G. F. W. Meyer), are distinguished from the others by the presence of spines on some or all parts of the plant. These are currently united as subtribe *Bactridineae* J. D. Hooker (Dransfield and Uhl 1986).

No clear characters to differentiate the two spiny subtribes from each other were presented in Barbosa Rodrigues' subtribal descriptions nor in his analytical key (1903). Extracting information from Barbosa Rodrigues' generic descriptions, it would appear that the *Astrocaryineae* are separated by the staminate flowers sunken in pits on the rachillae accentuated by a rim of raised floral bracts. This character, which has been described as "honeycomblike" in appearance (Uhl and Dransfield 1987), is clearly illustrated in the color plate of *Acanthococos hassleri* (Barbosa Rodrigues, 1903) though no mention of it is made in the various descriptions of that taxon. The Cuban endemic *Gastrococos* Morales was not mentioned by Barbosa Rodrigues though it also bears the same characteristic rachilla pits.

A second species from the cerrado of Brazil, *Acanthococos sericea*, was described by Burret (1940) based on differences in tomentum and spine density, spine color, and subterranean stem thickness. The author noted the similarities of *Acanthococos* with *Bactris* but differentiated it from that genus based on the free petals of the pistillate flowers. No mention was made of endocarp pore position nor of the rachilla pits.

Toledo (1952) described a third species from Brazil, *Acanthococos emensis*, with two varieties, one each from the States of Sao Paulo (var. *emensis*) and Minas Gerais (var. *pubifera*), based on differences in stem thickness, spine density, length of staminate flower pedicels, and apparent differences in anther shape. His understanding of previously described species was based entirely on published descriptions and illustrations. An examination of specimens shows that stem thickness and spine density tend to be variable characters in both *Acanthococos* and the widespread *Acrocomia aculeata* (Jacquin) Lodd. ex Martius. In addition, basal staminate flowers are pedicellate in both of these taxa while the apical staminate flowers are predominantly sessile.

Toledo (1952) also discussed the taxonomic position of the genus correctly describing the illustrating of the equatorial rather than basal position of the endocarp pores. Based on this observation, he placed the genus in subtribe *Bactridinae* thus correcting the erroneous arguments offered by Barbosa Rodrigues and perpetuated by Dalla Torre and Harms (1907), Pilger (1908), and Lemée (1929, 1941) who included the genus in the otherwise nonspiny subtribe *Attaleinae.*

Toledo differentiated *Acanthococos* from genera of subtribe *Bactridinae* with sympetalous staminate flowers (*Bactris*, *Guilielma* (= *Bactris*), and *Astryocaryum*) stating that it occupies a position intermediate to these and the choripetalous genera of the subtribe (*Acrocomia*, *Aiphanes*, and *Desmoncus*). He called into question the subtribal separation of the spiny *Cocoeae* into groups by Barbosa Rodrigues pointing out the similarities between *Acanthococcos* and *Acrocomia* and between *Astrocaryum* and *Bactris.* No mention was made of the choripetalous *Gastrococos.*

Wessels-Boer (1965) mentioned the possibility that *Acanthococos* is synonymous with *Acrocomia* but did not make the new combination due to a lack of access to material.

Moore (1973) merely listed the name as synonymous with *Acrocomia* without additional justification. In *Genera Palmarum* (Uhl and Dransfield, 1987), a work based on Moore's notes, *Acanthococos* was informally placed in synonymy under *Acrocomia*. Justification for this was that the only difference between the two was in habit (p. 519). The generic description of *Acrocomia* in *Genera Palmarum* includes *Acanthococos* and states an equatorial position for the endocarp pores. In the subtribal description and in the key to genera, however, a basal pore position for *Acanthococos* (under *Acrocomia*) is maintained.

Generic boundaries in the *Bactridinae* are fairly well established (Uhl and Dransfield 1987, p. 516) though the relationships of the various genera to each other is still subject to debate. A basic separation of genera into choripetalous and sympetalous genera as per Toledo (1952) would seem to have considerable value though it is difficult to apply to intermediate genera such as *Gastrococos* and *Aiphanes*. The finely divided and inconsistent system proposed by Barbosa Rodrigues (1903) relies too heavily on similarities in gross structure and ignores many of the detailed features held in common.

In *Genera Palmarum*, no subdivision of the spiny *Bactridinae* is employed though the genera are presented in a sequence of proposed evolutionary advancement. Reduction in number of pistillate flowers and connation of perianth parts, especially in the pistillate flowers, are characteristics considered most important in assessing specialization.

The genus which has been most frequently associated with *Acrocomia*, *Gastrococos*, shares a similar floral arrangement, rachilla chambers, and a connate staminodial ring adnate to the corolla but can be differentiated by the connate sepals of both staminate and pistillate flowers, the pistillate petals distinctly connate basally, the erect filaments with basifixed anthers, and the absence of short mesocarp fibers adherent to the endocarp. The only other choripetalous genus in the subtribe, *Aiphanes*, shares rachilla chambers, free sepals, and a staminodial tube adnate to the corolla, but differs in its praemorse leaflet margins, erect filaments with basifixed anthers, basally connate pistillate petals, and absence of mesocarp fibers. In the sympetalous *Astrocaryum*, similar rachilla chambers and mesocarp fibers are present but the pistillate petals are connate beyond the middle and the staminodial tube is very small and not adnate to the corolla.

Characteristics shared by both *Acanthococos* and *Acrocomia* include a floral arrangement with a few, solitary pistillate flowers at the base with numerous paired or solitary staminate flowers toward the apex, distinctive rachilla chambers, free sepals of both staminate and pistillate flowers, filaments inflexed in bud with dorsifixed anthers, free or only very partially connate pistillate petals, adnation of the staminodial tube to the corolla, and abundant, short mesocarp fibers. With the correction of the erroneous original observation of endocarp pore position, the large number of similarities between the two genera justify placement of *Acanthococos* in synonymy under *Acrocomia*.

Due to the abundance of edible and industrial quality oil in the mesocarp and endosperm (Balick 1979, Lleras 1985), the genus *Acrocomia* has been the subject of considerable biosystematic and evolutionary study (e.g., Scariot 1987). The taxonomy of the genus, however, remains uncertain (Uhl and Dransfield 1987). Earlier workers (i.e., Bailey 1941, Glassman 1982) maintained the genus with a large number of species mostly based on narrow, typological definitions. Recent work concerning the systematics of neotropical palms, however, supports rather broad species concepts for many groups, particularly those which have been exploited by man or which occur in environments influenced by local human populations (Balick et al. 1987*a*, *b*; Anderson and Balick 1988). As the genus *Acanthococos* occurs in areas of frequent fire or tilling (Eiten 1963, 1972), these observations suggest that the three described species of *Acanthococos* are merely minor deviations of but one, somewhat variable species.

The northeastern corner of Paraguay has produced a number of unusual and apparently endemic taxa and is without doubt the most floristically diverse region of the country. Several of these taxa, however, were based on incomplete material or inaccurate interpretation of structures as in the case of *Schrankiastrum* Hassler (Barneby 1984). A similar situation appears to be present in *Acanthococos* in which the misinterpretation of endocarp pore position led to an improper taxonomic alignment of the genus. After clarification of this problem, lack of additional work on this and related genera left proper affinities obscured. Overemphasis of relatively minor variations in morphology and maintenance of typological species concepts led to inflated taxonomies and further obscured taxonomic relationships.

In light of the above arguments, I make the following new combination and unite in synonymy the two species of *Acanthococos* described after the type species, *A. hassleri*.

Acrocomia hassleri (Barbosa Rodrigues) Hahn, **comb. nov.**

Acanthococos hassleri Barbosa Rodrigues, Palmae Hasslerianae Novae 2. 1900. Syntypes: Paraguay, Ape-hu Hassler 4957, 5224 (presumably destroyed). Neotype: Paraguay, Yhu (Holotype: G).

Acanthococos sericea Burret, Notizblatt 15: 109. 1940. Type: Brasil, Mato Grosso. *Archer & Gehrt 36432.* (Holotype: SP; isotype: US).

Acanthococos emensis Toledo, Arquivos de Botanica do Estado de Sao Paulo, Nova Serie 3: 4, t. 1–2. 1952. Type: Brasil, Sao Paulo. *M. Rachid 52, 941.* (Holotype: SP).

Acanthococos emensis var. *pubifolia* Toledo, l.c. 3: 5. 1952. Type: Brasil, Minas Gerais. *L. Labouriau 53, 727.* (Holotype: SP).

The species is distributed sporadically throughout the Planalto of Central Brazil from the Sierra de Amambay in northeastern Paraguay to western Bahia and is locally common in cerrado vegetation. (Medeiros-Costa and Panizza 1983).

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CHAPTER NEWS AND EVENTS

New Journal for Temperate Zone Enthusiasts: *The Hardy Palm*

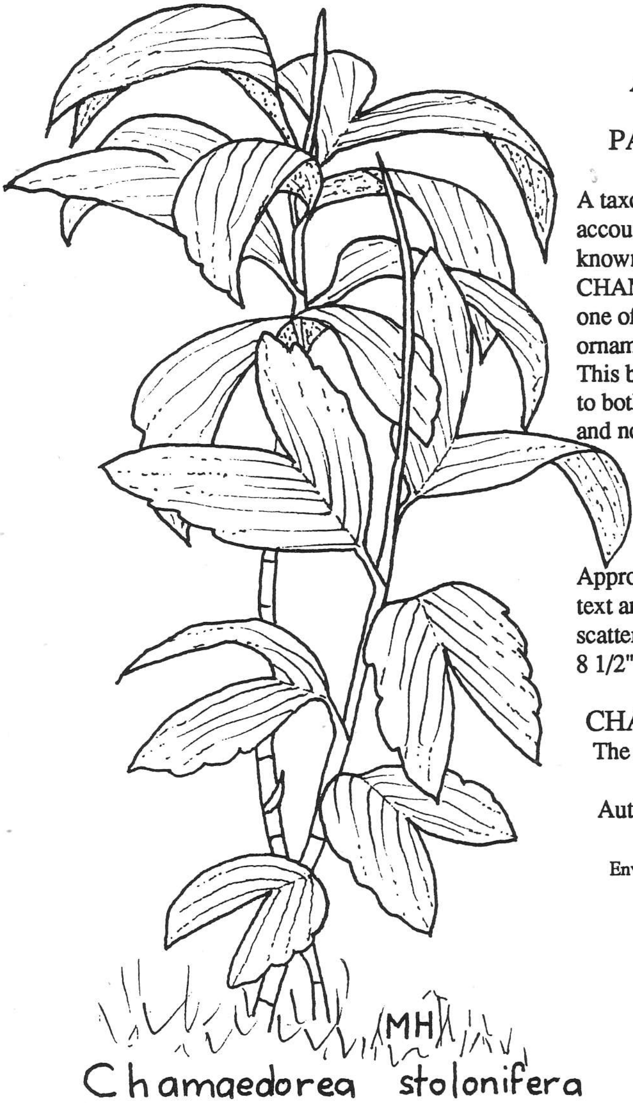
The Pacific Northwest Palm and Exotic Plant Society, an affiliated chapter of the IPS, has resumed publication of a Chapter Newsletter to meet the needs of Temperate Zone palm enthusiasts. *The Hardy Palm* carries articles of interest to palm hobbyists in colder regions. The editor is Nick Parker. *The Hardy Palm* averages 16–24 pages (5.5 by 8.5 inch size) and will be issued quarterly. Interested parties from other cold weather climatic zones are invited to subscribe. Subscription rates are US $12 per year for United States IPS members and Cdn $15 per year for Canadian members and Cdn $19 (or US $15.00) for mailings outside North America. Checks in US or Canadian currency payable to The Pacific Northwest Chapter, IPS, should be sent to Frank Hanaus (Canada) or Nick Parker (Canada). Articles and materials suitable for publication are also solicited and should be sent to Nick Parker, Editor (see roster).

NEWS OF THE SOCIETY

The IPS has lost three well known and influential members during the past few months. Obituaries for one of them, Hans Hoffmann, is given here. We will have articles on Ruth Shatz and Dr. Anthony Davis in October.—*eds.*

Pacific Northwest Chapter Meetings

The Pacific Northwest Chapter of the IPS held their Second General Meeting for 1991 on Tuesday, May 28, 1991 at the VanDusen Gardens in Vancouver, B.C., Canada, with guest speaker Gert Vander Meulen discussing the latest in greenhouse construction. The Third and Fourth 1991 General Meetings will be held on Mondays, August 26 and November 25, respectively, at the same venue. The group's third annual Palm Society BBQ will be held in July. Also plan to visit the Palm Society Booth at the PNE between August 18 and September 2, 1991.



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The species and their cultivation

Author: DONALD R. HODEL

Environmental Horticulture Advisor
University of California
Cooperative Extension

A SPECIAL PRE-PUBLICATION PRICE WILL BE AVAILABLE IN OCTOBER

Mackay (PACSOA) Recent Group Activities

The Mackay Palm and Cycad Society (PACSOM) of PACSOA travelled to Eungella National Park for a barbeque lunch, followed by a walk/talk through the rainforest with head ranger, Steve Pearson. Steve, a published author and authority on tropical and rainforest plants, answered all questions. Members were able to see all of the palms that grow in that environment of 2,000 feet (610 meters) above sea level and average annual rainfall of over 80 inches (200 cm), occurring mostly during the December to April rainy season. Species viewed included *Livistona* sp. var. *Eungella.* Steve says that this is an undescribed (as yet) palm, obviously a remnant from a previous time which had adapted to the conditions at Eungella. Millions of years ago, the east coast of Australia was much colder, perhaps more like current Tasmania. The area had many *Livistona* type palms. As the continents drifted apart, Australia moved north and the populations of plants were split into differing environments, changing in form and habit to suit local changing conditions. Today, we have *Livistona* groups in three highland range areas which are quite different. In the Carnarvon Gorge, when the *Livistona* trees flower, the leaves below the flowers droop while those above the inflorescences are erect, with the plants looking like two-piece palms. *Livistona* plants on the Blackdown Tableland hundreds of kilometers away have an erect flower habit, and those at Eungella are intermediate. Leaf characteristics vary similarly: Those at Carnarvon are long and droopy, at Blackdown they are stiff and erect, and at Eungella semierect with droopy ends. Steve pointed out that the environment is very different in these three highlands. Carnarvon Gorge is several hundred kilometers inland with east-west ranges and drier climate, while Eungella Range is relatively near the coast with a high rainfall. Examples of other palms seen in Eungella were *Calamus motii, Archontophoenix cunninghamiana* and *A. alexandraea.* The latter two apparently do not hybridize even when growing together as they have different flowering cycles.

Remember that the Mackay Horticultural Society will be holding the Plant Expo in August of 1991. The Mackay Palm and Cycad Society is supporting and participating, so plan accordingly.

In addition, The Mackay (PACSOM) group held recent meetings in March at the home of Henry and Juanita Duncan at North Mackay (with 105 palms planted there), in April at Robyn Paskin's place, in May at the Lois McGregor's residence in Slade Point and in June at Val and Percy Simonsen's Farmlet in Sarina. The May meeting marked the fourth anniversary of PACSOM.

Activities of Sydney Branch, PACSOA

The first Chapter outing of 1991 was a relaxed and informal day on the Central Coast of New South Wales attended by about 40 members. First stop was the home of Elizabeth and Paul Anderson in Empire Bay for a delicious morning tea of orange juice and croissants. The growth rate of some of the palms at Paul's garden was amazing. His *Caryota maxima* is about 9 meters (30 feet) after only two years in the ground. There also were some very nice *Wodyetia bifurcata.* The new koi pond is a great feature and has given the entire garden a dramatic boost. From the Anderson's, the tour moved to John Moreland's home at Umina. Of particular interest were extremely large specimens of *Phoenix roebelline* and *Lytocaryum weddellianum.* Then off to Gallery 460, an art gallery located in a valley where *Livistona australis* and *Archontophoenix cunninghamiana* grow in their natural habitat. The day concluded with a lunch at the Katandra Native Reserve and a walk through stands of *Archontophoenix cunninghamiana,* guided by John Moreland.

At the March 19th meeting, Gary Daley delivered an extremely interesting and informative lecture on animals, plants, and people of India, South and Central America gleaned from his mammoth trip of seven months encompassing these areas. Gary has written some excellent articles on the palm flora of Guatemala and Peru. Some unusual species of *Chamaedorea* were collected and these are being identified by Don Hodel.

The Sydney Branch also held a Northern Peninsular garden tour on Sunday, April 21st, with about 15 members attending this outing. The tour started off at Peter and Noreen Burn's Palm Land Nursery in Terry Hills, then moved to George and Vivien Short's garden and then up to David Stewart's garden.

Houston (Texas) Chapter Recent Activities

On Saturday, June 1, the Houston (Texas) Chapter of the IPS conducted a field trip to view the tall *Sabal* palms growing in Brazoria County. A guided tour was given by Mike Rayburn. Sixteen hardy members and guests braved the poison ivy and rain-threatening conditions to examine this unique palm stand. These tall palms are thought by Bob Read to be fertile hybrids of *Sabal mexicana* and *Sabal minor.* They were quite distinct from the carpet of *Sabal minor* which completely covered the floor of the dense hardwood forest—different in leaf form and color, inflorescence, and general growth habit. Whatever their species, this population represents the northernmost naturally occurring stand of tall palms (up to 27 feet or 9 meters) in the central United States and deserves protection and conservation measures. Bob Read believes that the ecology of the site had something to do with the original hybridization taking place at least 150 years ago. He considers the site "a living genetic laboratory which could hold the answers to the evolution of *Sabal* species, and a possible solution to the problem of why *S. minor,* particularly in the western part of its range, sometimes has a trunked form." Protecting them where they stand is relatively simple. There are no development pressures in the area and the palms need no special care, other than to protect them from human intervention. The Houston IPS Chapter joins with Landon Lockett and other Texas conservationists in soliciting IPS support for the purchase and maintenance of this natural palm habitat in its natural state. The land is currently being offered for sale and real danger exists that the land will be cleared for other uses. A significant part of the purchase price of the land has been collected in the "BNCAP Palm Fund" by the Brazosport Nature Center and Planetarium, P.O. Box 1464, Lake Jackson, Texas 77566, but additional funds are needed. Anyone interested in contributing toward the conservation of this habitat, please send your contributions as indicated above. See also the related article in the April 1991 issue of *Principes.*

Louisiana Chapter and Gulf Coast Chapter Meetings

The New Orleans group of the Louisiana Chapter met at the New Orleans Audubon Zoo on February 17 with 17 members and guests present. Chapter business was discussed and President Severn Doughty reported extensively from the survey data collected with Dan Gill in the aftermath of the Christmas '89 freeze. An abstract from that survey was published in the May 11 issue of *Et ceteras*, the Louisiana Chapter newsletter. Preserved *Nypa fruticans* fruit (actually unripened seed kernels) were served to all present as a "palmy treat."

The Spring Garden Show took place at the New Orleans Botanical Garden on March 16–17, with the Louisiana Chapter providing a booth. It rained continuously, but the booth was manned by a water-soaked trio comprised of Jack Chisholm and Marguerite and Wilbur LeGardeur. Severn Doughty, Danny Braud, and Jack Chisholm provided palms for the show. John (Hercules) Voss provided the loading, transporting, reloading, and unloading—this in conjunction with his other duties as President of the Louisiana Fern Society, which also displayed at the show.

The Spring meeting of the Louisiana Chapter of the IPS took place on Sunday, May 26th, 1991 at the home of "Mal" Mele, #1 River Road, Covington, Louisiana. The group met at noon for lunch at 12:30. Members and guests of the nearby Gulf Coast Chapter were also invited.

A joint meeting of the Louisiana and Gulf Coast chapters is planned for October at Maxwell Stewart's estate in Mobile, Alabama. Visitors are welcome, but should please contact Maxwell in advance so that attendance can be estimated.

Joint Meeting of Central Florida and Florida First Coast Chapters

The Central Florida Chapter and the Florida First Coast Chapter of the IPS held a joint meeting in Gainesville, Florida, on Saturday, April 13, organized by Dr. Merrill Wilcox. Noel Lake led the group on a selected tour of the University of Florida grounds. Formerly in charge of the overall grounds and now Landscape Architect for the University, Noel has long been an influence in the growing and changing of Florida's premier university, and its campus is certainly the better for his efforts. Next the group headed off to the young and progressing Kanapaha Botanical Garden. It is a sizable garden (although not all is developed) featuring Lake Kanapaha. Dr. Dan Goodman, Director, led the group on a garden tour. After the palm garden tour, the palm area was officially dedicated and renamed by Dr. Goodman as the "Charles Raulerson Palm Hammock" in honor of Mr. Raulerson, a long time Gainesville palm enthusiast who died several years ago. The day's planned activities ended with a Palm Sale.

South Florida Chapter Activities

The South Florida Chapter held their June 19 General Meeting Panel: All Aspects of Palms with Romney, Johnson, Corman and Hull forming the panel. Many questions were fielded. On July 20, the group will tour "Botanica" Gardens at Key Colony on Key Biscayne. The restaurant will be specially open for the Palm Society, with the Landscape Architect to speak. The next General Meeting will be held on August 21 at Fairchild Tropical Gardens. Mark your calendar for the Barbeque at Walled Garden on September 14 and the Fall Palm Sale at Fairchild to be held on November 2–3.

1991 Show at Mt Coot-tha Botanic Gardens, Brisbane

The South Queensland Group of PACSOA hosted the PACSOA annual Palm and Cycad Show and Sale on March 9–10, 1991 at Mt Coot-tha where, once again, another impressive show was held. Record crowd and sales figures were reported. The palm sales area was so crowded that one visitor from Sydney reported that they "bent down to pick up a bargain and could not stand up again—there was no room!" Congratulations on another great Show and Sale.

Hawaii Island Chapter Sales and Meetings

The Hawaii Island Palm Society held their Second Annual Rare Palm Auction for members on Sunday, June 9 at Onekahakaha Beach Park. The society made a bulk purchase of rare or unusual palms from Lyons Arboretum. Ray Baker of Lyon selected 30 palm varieties which are difficult to purchase locally and shipped them to the Big Island for the auction. A potluck lunch was shared before the auction began. All proceeds over plant costs and shipping will be used by the Chapter to fund other chapter projects.

The Hawaii Island chapter is also planning a palm sale for the public. This will be held on Saturday, August 3 in Hilo at the Mooheau Bandstand from 8 AM to 3 PM. Hopefully, the popular, nearby Farmer's Market will generate a large number of spontaneous visitors in addition to those resulting from advance publicity.

At a recent meeting, Jeff Marcus shared his slides and experiences collecting palms in Fiji and Australia. It was exciting to see rare palms growing in their native habitat. Liloa Willard won the door prize of a *Metroxylon vitiense* from Fiji. The meeting was well attended and everyone enjoyed the light refreshments.

Sunshine Coast (PACSOA) Group Activities

The Social Night Out to the Yandina Chinese Restaurant was a great success thoroughly enjoyed by all. At the May meeting Tom Turner gave a very informative and interesting talk on his trip through Guam. The June meeting was held at the Nambour Band Hall on June 3rd focusing on variegation and an open day was enjoyed at Lexia Pusterella's on Sunday, June 9th.

Northern Territory (PACSOA) News

Another successful planting afternoon followed by a barbeque tea was held earlier this year at the Palm Garden at Freds Pass Reserve. This Palm Garden has been an ongoing project of the Palm Society of the Northern Territory. About a dozen members helped plant the following: 3 *Gronophyllum ramsayii*, 4 *Cycas calcicola*, 4 *Livistona decipiens*, 10 *L. benthamii*, 12 *Sabal texana* (sic), 1 *Oncosperma fasciculatum*, 13 *O. tigillarium*, 3 *Hyophorbe lagenicaulis* and 1 *Arenga australasica*. Many thanks to Phil Brookes and the Community Service Order people for the spic and span appearance of the garden.

North Queensland Palm Society (PACSOA) Meetings

Nine members of the NQPS from the Townsville area made an extended field trip to the Cairns area on May 4–6. Saturday's portion of the trip featured variegated *Archontophoenix alexandrae* at the Ingham Botanical Gardens, the Cardwell Forestry building, the Glen Idle Nursery at Bramston Beach, and the Flecker Botanical Gardens in Cairns, where the NQPS group met with the Mackay Palm and Cycad group. For anyone visiting Cairns, the Flecker Gardens are a must. Some of the photographs in David Jones' book "Palms in Australia" were taken here and comparisons are quite interesting. On Sunday, the group continued to Port Douglas and Maria's Palmetum. Examples of advanced and mature palms in the ground at Maria's included *Neoveitchia*, *Neodypsis*, *Pinanga*, and *Drymophloeus*, to name a few. After lunch, the tour moved on to Curt's Nursery, recently moved, and thence to a private garden in Cairns to view some unusual mature palms, including *Chrysalidocarpus cabadae*, *Socratea durissima*, *Wallichia disticha*, *Coccothrinax* spp., *Copernicia* sp. and *Zombia* sp. Arthur, the host, was very helpful in answering questions. Monday opened with breakfast at Kuranda then on to Rosebud Farm, on its 20th anniversary. Many of the early plantings were examined. The last stop was Paronella Park for lunch. All were very impressed by what a man with a pick, shovel and trowel can do in a lifetime. To at least one attendee, "Jose Paronella was a romantic, who created paradise." Much of the original park is now accessible and a visit is highly recommended.

The NQPS met on Monday, June 3 to discuss *Neodypsis* species, seeds, seedlings, and potted specimen plants. Bob Flemming from Billabong Sanctuary also described the plan for landscaping the Tourist Info Centre on the Bruce Highway. A raffle was held with the prize being a large *Vershaffletia splendida.*

The 1991 Townsville Garden Competition will be held July 27–28 with a new category featuring Palms and Cycads. The NQPS will also feature a display of Palms and Cycads in Anderson Park on the same days.

Southern California Chapter Meetings

The Southern California Chapter of the IPS held their Annual Banquet on January 19 at the Hyatt Newporter in Newport Beach. Don Hodel gave a presentation entitled "Palms of the South Pacific."

The Chapter next met on March 16th in Ventura, hosted by Ventura Chairman John Tallman. Representative members attended from all localities stretching from the Mexican border to Fresno. Chapter members experiences over the previous winter were discussed in some detail. Some members reported low temperatures to 15° F (−9° C). Numerous specific palms were discussed, with many species showing more cold tolerance than expected.

The next meeting was held on Sunday, May 5, at the Huntington Library and Botanical Garden. The meeting featured a slide presentation by Dr. James Folsom, Director of the Botanical Garden, entitled "Conservatories of the United States." In addition, a tour was led by Ron Harris, Curator of the Palm and Jungle Garden, concentrating on a general survey and history of the garden. After the morning tour, a slide presentation was held in Friends

Hall and then the group reconvened at the residence of Jim Folsom for a potluck picnic on the lawn. The usual raffle and auction followed lunch, with the remainder of the afternoon free to visit the garden and galleries.

The July meeting of the Southern California Chapter will be held at Lake Park in Huntington Beach for a potluck barbeque and garden tour.

News from Northern California

In late 1989 Warren Dolby invited the Northern California Chapter of the IPS to hold their September 1990 meeting in his garden. After his passing in July, it was decided that the meeting should take place as Warren had planned. On September 16, the Northern California Chapter held its late summer meeting in Warren's garden. The host was Charles Cornell.

Dr. Herb Weber, in his remembrance, recalled how Warren had encouraged many future members to take up the cause and become palm gardeners and enthusiasts. Richard Douglas recounted the early years when there were just six individuals meeting informally and how those six, at Warren's instigation, organized the Northern California Chapter of the IPS and elected its first officers. That was 20 years ago.

After the formal remarks and a short business meeting, a palm auction was held which raised $639 for our treasury.

On Saturday, November 10, the chapter held its last meeting of 1990 at the Lakeside Garden Center in Oakland. The meeting began with an informal tour of the palmetum, which at 10 years is beginning to show some mature palm specimens. The *Parajubaea coccoides* have set fruit for the first time; caryotas require a step ladder for pruning; and the hybrid *Phoenix canariensis* × *reclinata* would fill most suburban back yards. John Leupold entertained with an account of his recent trip to Madagascar, the Seychelles, and Lord Howe Island, accompanied by excellent slides of these islands and their most famous palm natives: *Lodoicea maldivica* and *Howea forsteriana*. An auction was then held, which raised $326 for the chapter treasury.

Southern California Chapter Hosts IPS Directors Meeting

The International Palm Society held their annual Board of Directors meeting in San Diego on June 21–22, as guests of the Southern California Chapter. The board meeting was attended by 15 IPS board members from Alabama, California, Florida, Hawaii, and Texas, as well as one member of the Advisory Council and other IPS member observers, from as far away as Florida. Although the board members from Australia couldn't attend, two of them did telephone with their comments on several issues for consideration by the Board.

The Board of Directors took the opportunity to name to the Advisory Council, long time palm enthusiast, Teddy Buehler, from Florida, who usually attends the Board's meetings and has been a tremendous supporter of the IPS for many, many years. The Advisory Council of the IPS is made up of former Presidents of the Society, and is to "further consist of such other members as will have rendered outstanding service in the Society." Teddy now has the honor of being the first member elected to the Advisory Council who has not served the IPS in the capacity of President. Teddy and her daughter were at the meeting when this action was taken. Thanks again to Teddy for all her hard work over the years.

Other actions taken by the Board of Directors will be summarized in a separate article to be printed in *Principes*.

In addition to the formal directors meetings, the group was hosted and fêted impeccably by Phil Bergman and the numerous Southern California volunteers who assisted him with arrangements. Member Bill Evans, owner of the Catamaran and Bahia Hotels on Mission Bay, made the Catamaran Hotel accommodations available to out of town guests at excellent rates. Garden tours were provided by: Ed and Priscilla Moore on Friday morning, Jerry Hunter and Rancho Soledad Nursery early Friday afternoon, and Jim and Lise Wright late Friday afternoon and evening. Excellent meals were served at all of the Friday events, with Jerry Hunter donating the luncheon barbeque, wine, beer, and soft drinks. All gardens were much enjoyed by the Board and accompanying guests. The Board of Directors met all day Saturday, followed by an impromptu dinner arranged by Jim Wright at the Souplantation. Sunday was free time for those able to stay around and enjoy the lovely San Diego area.

Obituary: Hans Hoffmann

Hans Hoffmann, 62, of San Leandro, California, died at home, May 30th of cancer after a brief illness. He is survived by his wife Inge.

For many years he had been very active in the Northern California Chapter of the International Palm Society. He served as President and Vice President and contributed many hours of labor toward establishing the Lakeside Palmetum in Oakland, California. Hans was well known for his dedication in helping any Palm Society members who were visiting Northern California. His hospitality was second to none! Many times a year, whenever an International Palm Society member visited Hans, he would stop working and take them on a tour of palm gardens of Northern and Southern California. He worked countless hours cleaning palm seeds and helping his wife Inge send out seeds for the Society Seed Bank. He took early retirement in 1991, not knowing he had cancer, but looking forward to spending more time on palm related matters. We will miss you Hans!

PAULEEN SULLIVAN

Back Cover

Chamaedorea stricta Standl. & Steyerm. grows in dense, mountain forests on the wet Pacific slope of Volcan Tajumulco in western Guatemala, *Hodel & Castillo 995*. Essentially an acaulescent species, it has a very short, subterranean stem buried in the leaf litter of the forest floor. Its thick, leathery, dark green, simple leaves with a slight bluish cast remind one of those of *C. metallica*; in fact, it could be likened to a giant, trunkless form of this latter species. Although originally thought to be endemic to Guatemala, botanists have found *C. stricta* in Costa Rica, Panama, and Mexico. Photo by Donald R. Hodel.