PRINCIPES

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THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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Contents for October

Front Cover

Bactris militaris in Costa Rica with Mark Binder for scale. See pp. 184–193.

PRINCIPES

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Principes, 40(4), 1996, p. 175

Editorial

Costa Rica has a remarkably diverse palm flora and an excellent network of protected areas so there is every hope that much of the wonderful variety will persist. One of the rarest palms of Costa Rica is the extraordinary *Bactris militaris*. Described some 50 years ago, this splendid palm with its narrow undivided leaves has been scarcely known in cultivation. It's not surprising that such a spectacular palm should be high on every collector's desiderata list. Don Hodel and Mark Binder describe in graphic detail a sodden trip to Costa Rica during which they eventually found *Bactris militaris*, as well as a wealth of chamaedoreas and other palms. Among the chamaedoreas they saw are, believe it or not, yet two more new species! *Chamaedorea coralliformis* and *C. binderi* are described by Don in a separate paper, also in this issue.

Continuing attention on the palms of Central America, we include a paper by Carlo Morici describing a visit to an isolated limestone hill, El Yunque in Cuba, which is the type locality of *Coccothrinax yunquensis*, described in 1980 by Borhidi and Muniz, but later subsumed into the synonymy of *C. salvatoris* by Henderson, Galearno, and Bernal. Carlo provides photographs of this poorly known palm.

Palms can occasionally become naturalized—witness the extraordinary naturalization of *Archontophoenix* in Hawaii and *Nypa fruiticans* in Panama; however, such instances are rarely recorded. Thus it is particularly useful to have a clearly documented account of the naturalization of *Sabal palmetto* in western Louisiana by Gary Landry and William Reese.

We have three articles concerning palm cultivation. De Hull describes the astonishing effect of a new growth stimulant that seems to have remarkable results on palms. Sprayed on palms damaged by Hurricane Andrew, the growth stimulant appears to enhance rapid recovery. The same substance also apparently improves cold tolerance. In another paper, researchers from the college of agriculture in Riyadh, Saudi Arabia, provide a method for improving root development in date palm offshoots, giving information that may be of relevance to other palms. The third article by Jorge Mora-Urpi and Ramon Mexzon describes a very clear protocol for controlled pollination in the peach palm, again a methodology that could be applied elsewhere.

Two shorter contributions are interesting. IPS Board member, Ralph Velez, gives us an account of the palms seen in Puerto Rico. Finally Paul Tuley has written an amusing photo feature on *Raphia australis*.

Among the news you'll find what happened during the California Biennial. In lieu of a "President's Note," administrative secretary, Lynn McKamy, has provided a summary of the Directors' meeting and information about what you may anticipate in the future.

JOHN DRANSFIELD
NATALIE W. UHL

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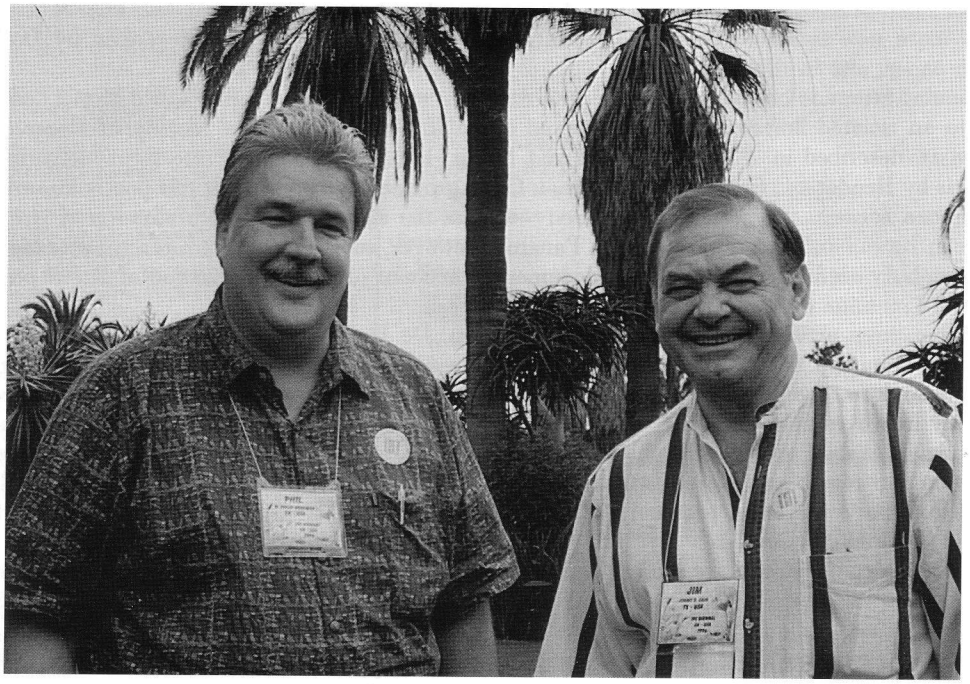
Secretarial Note

THE 1996 DIRECTORS MEETING

Twenty-three Directors of the IPS attended the August 3, 1996 of Directors' meeting in Newport, California, USA. Our new officers for 1996–1998 are Dr. Phil Bergman, President; Mr. Horace Hobbs and Ms. Cheryl Basic as Vice-Presidents. Ross Wagner was re-elected as Treasurer. The office of Secretary was split into two parts. Lynn McKamey was re-elected the Administrative Secretary and will continue to work with our editors and Allen Press to coordinate mailings of *Principes* and information to members. Out-going President, Jim Cain is now the Corresponding Secretary and will oversee

communication between our members and directors, including management of our World Wide Web page located at http://www.palms.org, which can be accessed by any of our world-wide members who have a computer, modem, and InterNet Provider.

The Seedbank was discontinued for several reasons. Since the IPS is conservation minded and must comply with the law of all lands, our ability to verify environmentally protected seed sources proved to be very difficult. Fairchild Tropical Garden and Lyon Arboretum are no longer able to donate seed to our Seedbank or assist in distribution and mailing. U.S. phytosanitary certificates are presently $25 per shipment making the operation very costly to comply with required regulations of the U.S. and many countries around the world. However, IPS members may find several private and/or commercial seed sources in the classified ads of *Principes* and soon on our WWW internet site.



Dr. Phil Bergman, President (left) and Jim Cain, Corresponding Secretary (right) for 1996–1998.

The Directors eliminated the separate dues categories for U.S. and Overseas members and created one "Regular Membership category" at $30 annually. Expenses of running our Society continue to increase—one of the most costly is for special handling and mailing of *Principes* to those who do not renew until after January 1; as a result, "back issues" must be sent by expensive First Class Mail or by slow Overseas Surface mail instead of the inexpensive "bulk mailing" to U.S. members and fairly fast "airlift delivery" to most countries. We encourage each member to renew his/her membership as soon as possible, which will help keep our mailing costs low, insure prompt delivery of journals, and hopefully prevent dues from increasing in the near future.

A new Index to *Principes* Volumes 1–40 (1956 to 1996) will be completed, printed, and mailed during 1997 as a special "member benefit." It will be an excellent reference for locating articles and palm information printed in our back issues. Extra Indexes will also be available for purchase.

The next Biennial Meeting will be held in Thailand during September 1998. Watch future issues of *Principes* for more details!

LYNN MCKAMEY
Administrative Secretary

Principes, 40(4), 1996, pp. 177–178

Sabal Palmetto Naturalized in Western Louisiana

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The cabbage palm, *Sabal palmetto*, has been discovered well-established in several localities near Lake Charles and the Calcasieu River in Calcasieu Parish, Louisiana. A group of palms, estimated at more than 200 plants (numerous seedlings, young plants, and several mature trees), occurs just east of the Calcasieu River near the base of the Interstate Highway 10 (I-10) bridge over the Calcasieu River. This population is located along an approximately ¾-mile long portion of the frontage road and an adjacent railroad north of I-10.

The largest population of *S. palmetto* occurs in a wooded area about ¼ mile directly north of I-10. Here several large specimens can be seen growing along the distant wooded shoreline. All of these groups of palms are near one another and visible from the I-10 bridge over the Calcasieu River. In addition to those in the forest and along the railroad, some palms also occur on a small elevated island in a marshland adjacent to the railroad, where they grow side by side with *Taxodium distichum*. There are no palms in the open marshy area.

Exploration of the wooded area on February 6, 1995, revealed an extensive population of tall, mature palms and numerous medium-sized juveniles. The size and height of the palms, some more than 18 feet tall, and their wide spatial distribution in the wooded area, suggest that the popualation is an old one. The tallest specimens are perhaps 30 years old, the smaller juveniles are at least six years old. Curiously, neither seedlings nor very young plants were observed throughout the woodland site, despite the fact that many of the palms were in full fruit. The Louisiana population of *S. palmetto* is documented by *Landry et al.*, 2 April 1996 (LAF).

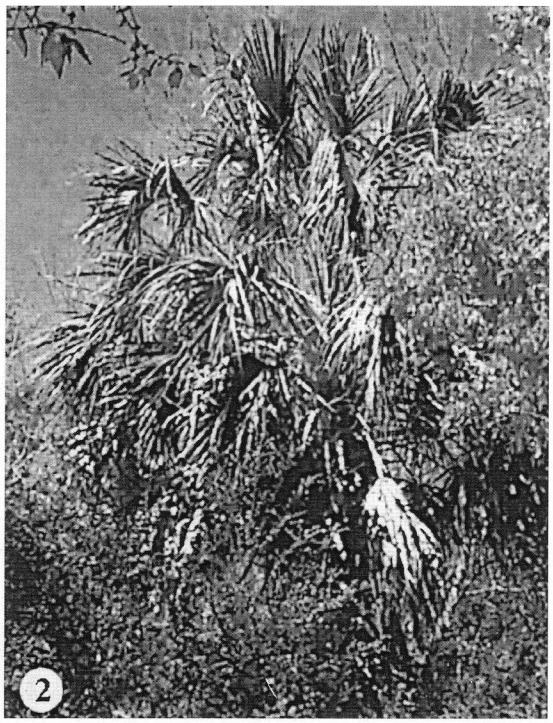
The long but narrow wooded area containing this population of cabbage palms was formerly the city dump for the community of Lake Charles. The woods are strewn with mounds of refuse, covered by several decades of leaf litter. The soil is very loose and spongy, no doubt due to successive layers of refuse. Bottles and old rubber tires are everywhere. The woodland vegetation is characteristic of a disturbed habitat. The dominant trees are *Celtis laevigata* and *Quercus nigra*. The dominant shrubs are *Ligustrum lucidum*, *L. sinense*, *Myrica cerifera*, and *Sambucus canadensis*. Most of the forest floor is sparsely vegetated. *Rubus* is not uncommon, apparently a remnant of a more open canopy.

Sabal minor, the native palmetto, appears to be absent from the woods containing *S. palmetto*, whereas only a few hundred yards farther down the road in a sandy pine forest, *S. minor* is quite common and *S. palmetto* is absent.

Another location, containing two tall, mature palms, was discovered on the southern side of I-10 at the base of the Calcasieu River bridge on the western side of the river. These palms are growing at the edge of an isolated wooded area. Cursory observations from the roadway failed to reveal additional palms at this site. The area is privately owned and has not yet been fully explored. A single juvenile palm was discovered growing along the railroad track on the west side of the Calcasieu River beneath the I-10 bridge.

Sabal palmetto was previously reported in Louisiana (Thomas and Allen 1993) from Orleans Parish (NO-*Darwin 1903*), St. Charles Parish (NO-*Montz 5166*), and Richland Parish (LAF-*Thieret 30091*). Upon examination of the last specimen we conclude that it is not *S. palmetto* but rather *S. minor*. The other two collections probably represent escapes from cultivation in the New Orleans area, which has an extensive cultivated palm flora. The range of *S. palmetto* otherwise extends from southeastern North Carolina to the Florida Panhandle; it also occurs in Cuba and the Bahamas.

The origin of the Calcasieu Parish cabbage palms is undoubtedly a large group of cultivated plants that is growing along a stretch of man-made beach on the north shore of Lake Charles on the south



1–2. Representative specimens of *Sabal palmetto* naturalized near Lake Charles, Louisiana. Scale approximately 1:67.

side of I-10. These palms were planted in the 1960s when the lakeside recreation area was developed. Ironically, the cultivated palms do not appear to be faring as well as their progeny. Over the years many of them have died and there are no volunteers at the beach site.

Dispersal of the seeds of cabbage palm can be attributed perhaps to birds, considering the one-mile distance between the cultivated palms and the established ones. The absence of very young seedlings in the forested location further suggests that predators, perhaps birds and small mammals, must consume the numerous fruits. Regardless, considering the number of adult and juvenile palms and their current distribution over such a large area, *S. palmetto* appears to be well-established in the area. However, there is little evidence to suggest that it might spread appreciably beyond its current range or have any adverse effect on the native vegetation. If left alone the cabbage palm will no doubt continue to thrive as a unique part of the local flora along the Calcasieu River.

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Principes, 40(4), 1996, pp. 179–181, 217–219

Improving Root Development on Ground and Aerial Date Palm Offshoots

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ABSTRACT

Date Palm (*Phoenix dactylifera*, L.) represents the most important fruit tree in Saudi Arabia for fruit production, ornamental, and landscape purposes. During recent years, there has been a big demand for date palm offshoots. The survival of the small aerial offshoots, which require special nursery conditions, is very low. Therefore, this investigation was carried out to study the effect of different rooting media and NAA and/or catechol on root development of small-size ground and aerial offshoots of two date palm cultivars: "Shish" and "Shahl."

Results showed that the rooting medium is an important factor in determining the extent of root formation of offshoots. The highest rooting percentages were obtained when the perlite : peat moss (3:1) medium was used followed by the woodshavings : peat moss (1:1) and perlite : peat moss (1:1) media. Sand medium is inferior as compared to the others studied. Rooting of ground offshoots was increased by NAA and/or catechol treatments. On the other hand, NAA and/or catechol treatments appeared to be essential for good root formation and development on aerial offshoots.

Date palm trees are mainly propagated through the offshoots. Ground offshoots of large sizes are usually used for this purpose. The use of small-sized and aerial (high and unrooted) offshoots is not practical due to their low survival. They are usually discarded during the separation of large-sized ones (Reuveni et al. 1972). However, these offshoots can regenerate roots and be used successfully if an inverted mist system is used (El-Hamady et al. 1992).

Auxins have been implicated in the adventitious root initiation of several plant species (Gasper and Hofinger 1989). However, there is no agreement on the effect of applied auxins on root formation of date palm offshoots. Auxin treatment was found to effectively increase rooting of date palm aerial offshoots (Gupta and Godara 1984). No such effect was found in other reports (Reuveni et al. 1972). It has been reported that besides the suitable auxin content of the plant material, there are several other rooting co-factors that occur naturally in cuttings of several plant species. These co-factors appear to act synergistically with auxins in root initiation in hard-to-root cuttings (Hess 1968, James et al. 1980, Jones and Hopgood 1979, James and Thurbon 1981). The action of these co-factors in root promotion could be, at least partly, in protecting the root-inducing, naturally occurring auxin (IAA) from destruction by the enzyme, IAA-oxidase (Donoho et al. 1962, Fadl et al. 1979). These co-factors are thought to be phenolic compounds (Hess 1968).

As far as the authors know, no information concerning the effect of phenolic compound treatment on rooting of detached date palm offshoots is available in the literature. Thus, this study was carried out for the following purposes: (1) evaluation of different rooting media on root development of small ground and aerial offshoots of the "Shishi" date palm cultivar; and (2) testing the effect of NAA and/or catechol on root formation and regeneration on small ground and aerial offshoots of the "Shahl" date palm cultivar.

Materials and Methods

This study was carried out during 1992 and 1993 in the lathhouse at the Agricultural Research Station of Deirab, College of Agriculture, King Saud University. Ground offshoots of weights ranging from 2 to 6 Kg and different weights of aerial offshoots were separated from both "Shish" and "Shahl" date palm cultivars in late spring. After separation, all offshoots were sterilized by soaking them in Bafastin solution (containing 50% Carbendazin) for 30 minutes. These offshoots were used for the following two experiments (Fig. 1).

Experiment No. 1—Evaluation of Different Rooting Media. The sterilized offshoots were planted in plastic containers (eight gallons) filled with six different rooting media as follows: 1—Woodshavings; 2—Mixture of woodshavings : peat moss (3:1 v/v); 3—Mixture of woodshavings : peat moss (1:1 v/v); 4—Mixture of perlite : peat moss (3:1 v/v); 5—Mixture of perlite : peat moss (1:1 v/v); 6—Sand.

1. Section of the general layout of the experiment in the lathhouse.

Each of the six media was represented by five ground offshoots, where each offshoot was considered as a replicate. The same media were used for the aerial offshoots, except medium number 6 was eliminated for lack of offshoots. The planted offshoots were randomly arranged in the lathhouse. The offshoots were irrigated using a simple drip irrigation system, and each offshoot received the same amount of water.

Six months later, the offshoots were dug out and the percentage rooting and the length of the longest roots were determined. Then, all the formed roots were removed and the total fresh weight for each offshoot was recorded. The small diameter roots (less than 0.5 cm) were separated and their weight was determined and the percentage that this weight represented from the total was calculated.

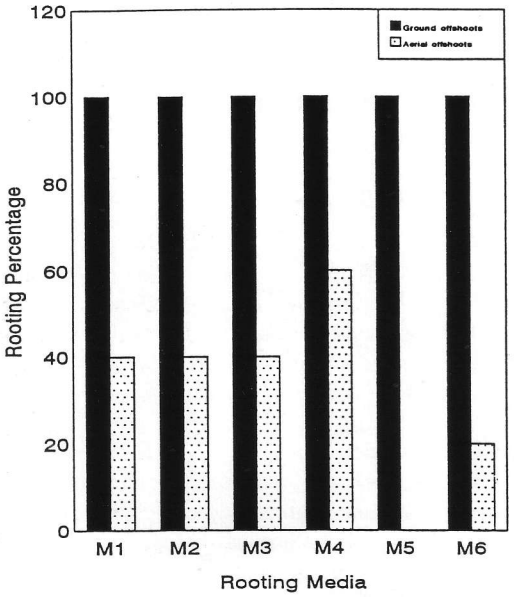
Experiment No. 2—Effect of NAA and/or Catechol Treatments. Thirty six ground offshoots and a similar number of aerial offshoots from "Shahl" cultivar were prepared as described before. These offshoots were treated basally with one of the following treatments : 1—dusting offshoot bases with rooting powder containing 8% NAA; 2—soaking offshoot bases in solution containing 25 ppm of catechol; 3—soaking offshoot bases in solution containing 50 ppm of catechol; 4—treatment No. 2 + treatment No. 1; 5—treatment No. 3 + treatment No. 1; 6—control (untreated).

The offshoots were planted in plastic containers (eight gallons) filled with a mixture of perlite : peat moss (1:1 v/v). Six offshoots from each type were used for each treatment. Each offshoot was considered as a replicate. The experiment was arranged randomly in the lathhouse, and was dug out for examination six months later. The same procedure and data taken in the first experiment were followed.

Results

Experiment No. 1—Evaluation of Different Rooting Media.

Ground Offshoots. Data in Figs. 2 and 3 indicated that root regeneration of "Shish" offshoots was achieved in all treatments. The longest roots were obtained when a mixture of woodshavings : peat moss (3:1) was used (Fig. 4). It was also found that the greatest total fresh root weight was obtained in the perlite : peat moss (3:1) media. On the other hand, the lowest total fresh root weight was obtained when sand medium was used (Fig. 5). It was also found that the ratio of the weight of the small diameter roots to the weight of the



2. Effect of rooting media on rooting percentage of "Shish" date palm cultivar ground and aerial offshoot (M1 = Woodshavings; M2 = Woodshavings : Peat Moss [3:1]; M3 = Woodshavings : Peat Moss [1:1]; M4 = Perlite : Peat Moss [3:1]; M5 = Perlite : Peat Moss [1:1]; M6 = Sand).

total roots was greatest in perlite : peat moss (1:1) or perlite : peat moss at the same ratio (Fig. 6).

Aerial Offshoots. The highest rooting percentage was obtained when the perlite : peat moss (3:1) medium was used (Figs. 2 and 7). On the other hand, lowest values were obtained in the sand medium. Longest roots were found in the woodshavings : peat moss (3:1) medium. Also, sand media had the shortest root length (Fig. 4).

It was also shown that the greatest fresh weight of the newly formed roots were in the woodshavings : peat moss (1:1) medium, followed by the perlite : peat moss (3:1). Total root fresh weight, however, was drastically reduced in the sand medium (Fig. 5). It was also evident that the highest ratio of the small diameter root weight to the total fresh root weight was obtained in the woodshavings : peat moss (1:1) followed by the woodshavings : peat moss (3:1) treatment, while the sand medium had the lowest percentage (Fig. 6).

Effect of NAA and/or Catechol Treatments. Ground offshoots.

Data of this study demonstrated that all treatments showed 100% root regeneration (Fig. 8).

(*Continued on p. 217*)

3. Effect of different rooting media on root development on ground offshoots. Media used (left to right) are : Woodshavings (WS), Woodshavings : Peat moss (3:1), Sand, Perlite : Peat moss (1:1), Woodshavings : Peat moss (1:1), and Perlite : Peat moss (1:1).

Principes, 40(4), 1996, pp. 182–183

Ducks and Raphia australis

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My regular golfing partners, the Smyths, having returned from holiday in South Africa were showing me the photographs of their travels. Among these, was a panoramic shot of the Durban Botanic Gardens, where a waterside scene and a gaggle of waterfowl had attracted their attention. Plum center in the print was a fine specimen of *Raphia australis*, apparently in flower but, as the prime concern of the photographer had been essentially zoological, the vital part at the top of the palm was obscured and part excised (Fig. 1). Having resigned myself to yet another example of "Murphy's Law," I discovered that another old colleague and his good lady, the Smiths, were due to proceed on a very similar vacation in the republic. Armed with the Smyth photograph, they were requested to make every effort to include the Durban Botanic Gardens on their itinerary and, assuming a successful arrival, to seek out the palm and to photograph the missing bit at the top. This, with the most helpful aid of a young lady on the Gardens' staff, they were able to do (Fig. 2). In fact, this may not be the same individual, but it clearly shows the impressive, erectly held compound inflorescence that is a unique feature of this species. Of the 20 or so species of *Raphia*, only the West African *R. regalis* has s similar, erect, compound inflorescence but here, it is a far more linear structure arising from a short trunk, virtually at ground level. As proof of their endeavours, the Smiths made a point of photographing the label on the palm (Fig. 3). By so doing, they have illustrated two valuable field characters for the identification of nonflowering specimens: first, the robust and persistent leaf-bases; and secondly, the contorted mat of epigeal roots arising from the trunk, hidden within the leaf-bases. Such "aerial" adventitious roots are common within the genus, but they are typically linear, more scattered, adpressed to the trunk, and markedly negatively geotropic. Within the known geographical range, the only other probable species with which *R. australis* might be confused is *R. farinifera* and this last feature could well prove to be a most useful device for separating sterile specimens in the field. Thanks are due to the Smyths and the Smiths for their efforts and for freely making available the photographs and also to the helpful member of the Durban Gardens staff.

1. *Raphia australis* in Durban Botanic Gardens, photographed by the Smyths. 2. Top of *Raphia australis* in Durban Botanic Gardens, photographed by the Smiths. 3. Bottom of *Raphia australis*, showing persistent leaf-bases and mat of epigeal roots, photographed by the Smiths.

Principes, 40(4), 1996, pp. 184–193

From Inches To Yards: Costa Rica's Simple-leaved Palms and More

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Though only 185 miles across at its widest point, and covering a mere 20,000 square miles, Costa Rica possesses geographical, cultural, and ecological diversity unmatched by countries 10 times its size. From breathtaking beaches to active volcanoes and lush rain forests, from high elevation cloud forests to dry tropical forests and mangroves, Costa Rica's ecological diversity is great enough to support tens of thousands of plant and animal species. Although home to about 9,000 species of plants, countless more are yet undiscovered. About a hundred species of palms are native to Costa Rica, and their diversity is particularly impressive.

Perhaps the most striking difference is illustrated by comparing two simple-leaved palms, *Chamaedorea minima* and *Bactris militaris*. The bifid leaves of the endangered *Chamaedorea minima* are but a few centimeters long and among the smallest in the palm family, while those of the spiny, rare *Bactris militaris* are over three meters long and among the largest. These were just two of the palms we hoped to see on our two-week trip to Costa Rica in November, 1994.

Mark had worked at the Jardín Botánico Robert y Catherine Wilson (commonly known as simply the Wilson Garden) in the summer of 1993, cleaning, labeling, and adding to their famous palm collection. Mark designed and implemented a *Chamaedorea* collection and accompanying database. The latter was designed to provide cultural information and accession data on each species added to the collection. In honor of his contributions, the Jardín's director, Luís Diego Gomez, bestowed upon Mark the title of Honorary *Chamaedorea* Curator. Prior to Mark's work there, he and Don had discussed Costa Rica's palms, particularly chamaedoreas. Don asked Mark to look for several species of *Chamaedorea* during his 10-week stay in Costa Rica that might be new to science (see accompanying article about new Costa Rican *Chamaedorea*), were thought to be extinct (*C. minima, C. stenocarpa*), or were little known in the Costa Rican forests (*C. pygmaea, C. sullivaniorum, C. tenella, C. zamorae*). Mark was successful in finding all that Don had asked, and even more. Thus, we were off to Costa Rica in late 1994 to investigate the chamaedoreas Mark had tracked down in 1993 as well as others Don wanted to see. Another object of our trip was to locate and document *Bactris militaris* at its type locality in the Golfo Dulce region of southeastern Costa Rica. Seen only once in the wild since it was discovered and named over 50 years ago, we hoped to collect leaves and flowers for several herbaria as well as seeds for botanical gardens.

We divided our two-week stay in Costa Rica in half, spending the first week in the northwest, the second week in the southeast, and a few days in between exploring around the capital San José and visiting La Selva Biological Reserve and Field Station in the Atlantic lowlands.

The Northwest

Our two objectives in the northwest were to locate simple-leaved forms of *Chamaedorea dammeriana* and a large *Chamaedorea* with nearly simple leaves, which bore a resemblance to two pinnate-leaved species, *C. selvae* from the Costa Rican Atlantic lowlands and *C. lucidifrons* known only from Panamá. Accompanying us on the first part of our trip was Gerardo Herrera, collector *extraordinaire* for the Costa Rican National Museum and Herbarium in San José.

We left San José for the north full of antici-

pation but under cloudy, threatening skies. By the time we had reached our first destination in the Tilarán mountain range, the skies had parted and it was pouring rain, a deluge that would stay with us for a good part of our two-week stay. In fact, the two weeks turned out to be one of the rainiest periods in Costa Rican history. Apparently, two tropical waves or depressions had settled over Costa Rica, one on the Atlantic and the other on the Pacific, pummeling the country with nearly nonstop rain. We had never been so sweaty, muddy, and wet; we were like pigs in the forest, wallowing in the mud and water. Despite the adverse conditions we were successful in locating the various chamaedoreas, and several added bonuses, too, although picture taking in the pouring rain required patience and a companion with an untiring, steady arm to hold the umbrella.

Our first stop was to locate the simple-leaved form of *Chamaedorea dammeriana*. Although Don had collected and photographed pinnate-leaved forms of this highly variable species in the eastern Atlantic lowlands of Costa Rica, he wanted to see the simple-leaved form since they were so striking with their compact crown of up to 15, broadly spreading, simple leaves. Unfortunately, our first stop produced no *C. dammeriana*, but we did find some unexpected treasures. Upon entering the forest the first palm we saw was the beautiful *C. amabilis* (Fig. 1). Close by grew another beautiful, dwarf, simple-leaved species, *C. pumila* (Fig. 3). Perhaps the highlight of this stop, though, was finding *C. scheryi* (Fig. 4) and *C. undulatifolia* (Fig. 2) growing side by side. Several palm researchers had raised doubts about the differences between *C. scheryi* and *C. undulatifolia*, so it was comforting for Don to find them both growing together and easily distinguishable with no intermediate forms present. Additional exploration produced the attractive *Calyptrogyne trichospadix* and *Chamaedorea deckeriana*.

We descended farther into a large valley and, as the day was drawing to a close, succeeded in locating the stunning, simple-leaved form of *Chamaedorea dammeriana* (Fig. 5). Growing with the simple-leaved form was, to our surprise, a pinnate-leaved form of the same species (Fig. 6). Here was a case where each of the two forms of the same species was so distinct that, to the untrained eye, they could easily be described as two different species. One may ask if they are so distinct why they are not considered two species. The answer is the simple-leaved nature is a variable feature. Simple and pinnate leaves are found on the same individual and there is a wide spectrum of intermediate forms between the two extremes; there are no differences between inflorescences, flowers, and fruits of the leaf forms, characters much more important in distinguishing species.

Our experience with the two leaf forms of *Chamaedorea dammeriana* set the tone and was a recurrent theme for much the remainder of our trip, especially with three other species we had yet to encounter, *C. lucidifrons*, *C. pittieri*, and *C. pygmaea*. The lesson was to learn to appreciate variability, especially that of a vegetative nature, when developing a species concept. Another lesson we learned was not to let your enthusiasm searching for palms keep you out in the field so long that you lose track of time. Nightfall quickly overcame us as we were examining and photographing *C. dammeriana*. Before we could finish our work and get back to the car it had become pitch black. You could not see your hand an inch in front of your face. Fortunately, Mark had had the foresight to carry a small pocket flashlight with him. It proved invaluable in enabling Don to spot and focus on palms for photographs and in finding our way back to the car. As we stumbled back toward the car, tripping over logs and vines, we were ever mindful of poisonous snakes, several kinds of which are most active in the early evening.

The next morning dawned cloudy and rainy as we headed farther into the Tilarán range to track down a strange and elusive chamaedorea with nearly simple, big leaves. In habit, it bore a resemblance to two pinnate-leaved species, *Chamaedorea lucidifrons* and *C. selvae*. All three are solitary, moderately tall chamaedoreas with nearly identical inflorescences, flowers, and fruits. The long-stalked inflorescences are quite conspicuous since they arise well below the leaves from bare stem. We immediately found the specimen with large, nearly simple leaves (Figs. 7 and 8), and further exploration revealed additional specimens displaying a wide degree of leaf division; some had up to seven leaflets on each side, others were simple, and, of course, like the previous day with *C. dammeriana*, there was a host of intermediate forms. Don was pretty well convinced these plants were but a variant of *C. lucidifrons*, dramatically increasing the range of this species heretofore known only from Panamá and greatly adding to its vegetative description. What remained to be seen was how the lowland *C. selvae* compared with the variable *C. lucidifrons*. Growing nearby

1. *Chamaedorea amabilis*, wet mountain rain forest, Tilarán, *Hodel et al. 1303.* 2. Leaflet margins of *Chamaedorea undulatifolia*, are strikingly undulate, wet mountain forest, Tilarán, *Hodel et al. 1305.* 3. Fruiting plant of *Chamaedorea pumila*, wet mountain rain forest, Tilarán, *Hodel et al. 1315.* 4. *Chamaedorea scheryi*, has leaflets with straight margins, wet mountain rain forest, Tilarán, *Hodel et al. 1301.*

were *Calyptrogyne trichospadix*, *Chamaedorea warscewiczii*, *C. scheryi*, the ever-present *C. pinnatifrons*, and a cycad, *Zamia skinneri*.

The final day in the northwest found us in the rain again, this time on the Pacific side of the Tilarán range at 5 000 feet elevation in wind-blown cloud forest. There we found *Chamaedorea parvifolia*, a diminutive but rather handsome species with a short, curved, mostly subsurface stem topped by a neat, compact but leafy crown of thickish, blue-green leaves (Fig. 9). The leaf litter and humus layer were 12-18 inches deep at this site, and most *C. parvifolia* had their short stems completely buried, giving the appearance of a stemless plant with leaves and inflorescences arising directly from the ground. Only a few, much older plants had visible stems with congested, prominent nodes.

We returned to San José, dropping Gerardo off at his home west of the capital. We then spent two days in San José, cleaning up, laundering clothes, and drying out. One of the days we drove over the mountains from San José to La Selva in the Atlantic lowlands to search for *Chamaedorea selvae*. Surprisingly, the day was sunny and warm, a welcomed respite from the previous days of cool, mountain rain. We marveled at the tall canopy palms, *Euterpe*, *Socratea*, and *Iriartea*, poking

5. Simple-leaved forms of *Chamaedorea dammeriana* are neat, compact plants holding many leaves, wet forest, Tilarán, *Hodel et al. 1307.* 6. Pinnate-leaved form of *Chamaedorea dammeriana* grows with simple-leaved form, wet forest, Tilarán, *Hodel et al. 1308.* Note hand and flashlight to spot subject in forest after nightfall. 7. *Chamaedorea lucidifrons* has pinnate or nearly simple leaves with large terminal lobes, wet mountain forest, Tilarán, *Hodel et al. 1319.* 8. Inflorescences of *Chamaedorea lucidifrons* are held well below the leaves, wet mountain forest, Tilarán, *Hodel et al. 1323.*

9. *Chamaedorea parvifolia* has a short stem buried in the leaf litter and topped with a compact, rosettelike crown of fairly sturdy, thickish leaves, moist cloud forest, Puntarenas, *Hodel et al. 1326*. 10. High in cloud forest in the Talamanca Mountains, and with litter-trapping, stiffly ascending leaves and a whitish crownshaft, an old specimen of *Chamaedorea pittieri* with emergent stem is not too unlike some New Caledonia or Madagascar palm, *Hodel & Binder 1332*. 11. *Chamaedorea pygmaea*, mature, fruiting plant with one-foot-long leaves, moist cloud forest, Puntarenas, *Hodel & Binder 1344*.

their majestic crown above the verdant trees as we passed through Braulio Carrillo National Park down to La Selva. A virtual cornucopia of palms, La Selva supports a wide array of genera such as *Welfia*, *Astrocaryum*, *Bactris*, *Geonoma*, *Desmoncus*, *Calyptrogyne*, *Euterpe*, *Socratea*, *Iriartea*, *Asterogyne*, *Pholidostachys*, and *Synechanthus* among others. *Chamaedorea* is little evident at La Selva although we did see the ever-present *C. pinnatifrons* and *C. tepejilote*. *C. selvae* proved more difficult to find, but after several hours of looking we finally found one fruiting specimen, and close examination confirmed Don's theory that it is but a low-elevation form of *C. lucidifrons*.

The Southeast

After our hiatus in San José, we headed to the southeastern part of Costa Rica, in the rain of course, to search for new or elusive species of *Chamaedorea* and the rare *Bactris militaris*. The southeastern part of Costa Rica held a special fascination for us. Botanically, it is a unique and mysterious region, and harbors a rich palm flora. Many palm species take on a slightly different appearance and occur at lower elevations there than where they occur farther to the north and south. Some are even endemic to the region and found nowhere else on the globe. We headquartered at the Jardín Botanico Robert y Catherine Wilson near San Vito, and made daily forays up into the Talamanca mountains, down to the Osá Peninsula and Golfo Dulce, or simply explored in forest remnants in the San Vito region.

One of our most exciting discoveries was high up in the Talamanca mountains. Don was traversing a stream in cool cloud forest when he let out an excited yell. "Mark, we have a new species of *Chamaedorea*, and it has a white crownshaft!" The key words *Chamaedorea*, new species, white

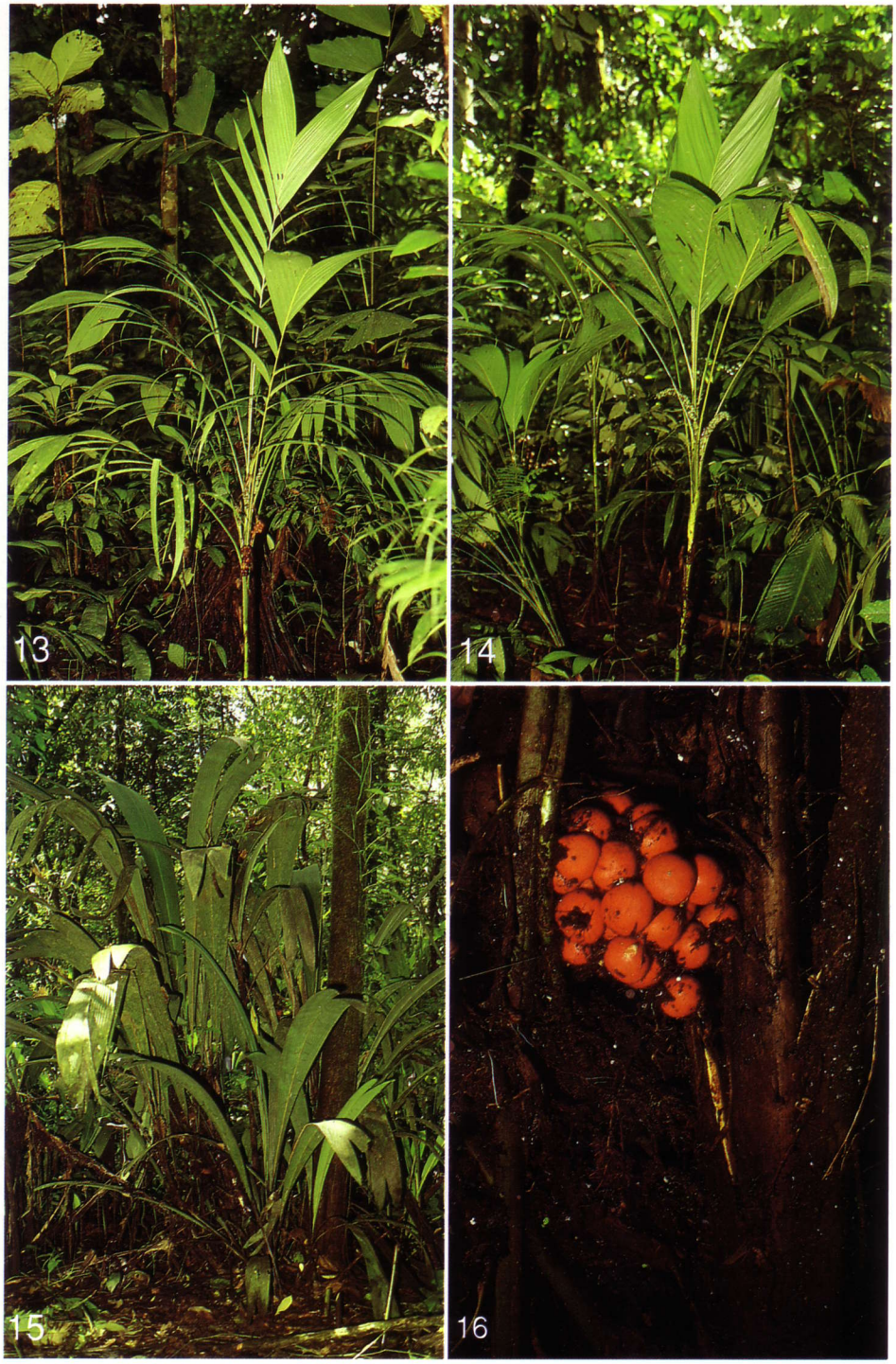
12. *Chamaedorea sullivaniorum* is rare in the lowland, Osá rain forest, *Hodel & Binder 1349.*

crownshaft brought Mark crashing through the forest on a run. Although the plant turned out to be *C. pittieri*, not a new species, it was a significant find nonetheless because it was the first known record of *C. pittieri* in Costa Rica since it was collected there nearly 100 years earlier. The six-foot-tall visible stem, whitish leafbases, and curved inflorescences had misled Don (Fig. 10). Further exploration, however, turned up plants with little or no visible stem, greenish leaf bases, and straight inflorescences, all characters of the more typical *C. pittieri* in Panamá, as well as several individuals with intermediate features. To the untrained eye, one could easily think two species exist in this instance. The experience with *C. dammeriana* still fresh in our minds, though, our appreciation for natural variability and age-induced characters in defining species took another giant leap in importance.

On another day in the Talamancas, we pursued *Chamaedorea pygmaea* and a new species closely allied to *C. allenii*. First collected in the mid 1960s, the new species has orange, rough, coral-like, nearly spiny fruits, which have attracted attention the few times it has been collected. Mark had seen and collected the spiny fruited *Chamaedorea* in 1993, so in little time we had relocated several fruiting specimens, made collections, and took photographs. Growing with the new species was the highly variable *C. pygmaea*. If there is one plant that symbolizes the great variability within some species of the genus, it must be *C. pygmaea*. At 5 500 feet elevation this species may have either simple or pinnate leaves, with blades up to four inches wide and eight inches long and inflorescences up to ten inches long (Fig. 11). At about 6 200 feet elevation, it seems to be a different species altogether. While leaves may still be either simple or pinnate, they are, on average, much larger, measuring up to one foot across, two feet long, and with inflorescences up to two and a half feet long. Viewing the ends of the spectrum independently, one with leaves and inflorescences several inches long and the other with the same organs several feet long, one would conclude they are surely different species. While some of the differences are obviously age-induced, there are abundant intermediate forms and natural variability within this species. To see the several forms together, we were reminded of the variability that makes plying the waters of palm taxonomy so difficult and perilous, especially in the south of Costa Rica.

We turned our attention to the lowland forests of the Golfo Dulce and the Osá Peninsula for a few days. Of particular interest were three simple-leaved *Chamaedorea*, *C. tenella*, *C. sullivaniorum*, and *C. zamorae*. The first two were known from other countries, the former México and the latter Panamá and Colombia, while *C. zamorae* was not known from the wild. *C. tenella* is rare in the Osá, suffering from forest clearing and disturbance for farming, cattle, and mining, and overcollecting by enthusiasts. We found it only as scattered individuals, not a good sign for the future survival of the species. Equally scarce and suffering from the same ravages was *C. sullivaniorum* (Fig. 12), a close relative of *C. pumila* and *C. minima*. All three species occur in the Golfo Dulce region but, apparently at distinct altitudinal levels, *C. minima* being the highest and *C. sullivaniorum* the lowest. The three are similar in habit, differing mainly in the number of primary nerves in the leaf blade and some floral details. A study would seem to be in order, which would investigate what effect, if any, altitude plays in the expression of these diagnostic characters.

Growing close by but in greater abundance was *Chamaedorea zamorae*, originally described and named from cultivated plants. Don was especially glad to see this species in the wild since we were able to confirm its identity and provide a known locality for it. As with some other simple-leaved chamaedoreas we had encountered on the trip, *C. zamorae* often has pinnate leaves (Figs. 13 and 14), sometimes in combination with simple leaves on the same plant! Even with pinnate leaves, though, the plant is still a dramatic sight since the terminal lobes of each leaf are broad and conspicuous. Add the large, showy, orange fruits



13. A pinnae-leaved form of *Chamaedorea zamorae* with broad terminal lobes, lowland rain forest, Osá, *Hodel & Binder 1348.* 14. A simple-leaved form of *Chamaedorea zamorae*, lowland rain forest, Osá. 15. *Bactris militaris*, with 10-foot-long, straplike, simple leaves, swampy, lowland rain forest, Golfo Dulca, *Hodel et al. 1353.* 16. Infructescence of *Bactris militaris* with red-orange, mature fruits is embedded in decaying organic matter and humus and harbors colonies of agressive, biting ants, swampy lowland rain forest, Golfo Dulce, *Hodel at al. 1353.*

packed tightly together like an ear of corn and you have one stunning palm. A short distance away was *C. matae*, perhaps nothing more than a low-elevation variant of *C. warscewiczii*. However, the unusually broad terminal leaflets distinguish *C. matae*. A simple-leaved species of *Bactris*, probably a new species, grew nearby although in no great abundance.

We devoted another day in the Golfo Dulce to tracking down the fabled *Bactris militaris*. Although named nearly 50 years ago, this spiny, giant simple-leaved palm had never been recollected and documented, and the type locality had been much disturbed for planting bananas and rice. Armed with directions and encouragement from Ken Foster, who along with Nancy Edmonson, had made the only seed collections of this rare species 10 years ago, we headed into the lowland swamps of the Golfo Dulce accompanied by Elfie Schmid, a German botanist studying in Costa Rica. As we began the first leg of our search, a grim march through an overgrown rice paddy, the sun surprisingly blazed down from above, heating the humid air well into the upper 80s. We trudged along for nearly a mile, hopping from row to row of swampy soil in a vain effort to stay dry, until reaching the end of the rice paddy. Relieved to be out of the strong sun, we plunged into a nearly impenetrable thicket of overgrown marantas, heliconias, dieffenbachias, and vines, heading for a group of taller trees and, hopefully, good forest and the elusive *Bactris*.

Unfortunately, the thick vegetation blocked our view of the trees, making navigation all but impossible. We slowed to a snail's pace, hacking and pushing through the thick vegetation for about an hour. Numerous times we crossed a stagnant, sewerlike stream winding through the swamp. Ever mindful of snakes, scorpions, and spiders, and constantly attacked by mosquitos and biting gnats, we pressed on for a group of trees that we hoped marked good forest and *Bactris militaris*. Yet each time we approached a promising group trees our hopes would be dashed when it, too, proved nothing more than the same inhospitable swamp through which we had trudged for an hour. We began to think Ken Foster's memory had failed him or forest disturbance had been so severe in the intervening 10 years that *Bactris militaris* no longer existed. Finally, dejected and exhausted, we made our way back to the rice paddy and reassessed our position.

With lessened vigor and increased despair, we reentered the swamp forest at a new location and again hacked and pushed our way through equally dense vegetation, always heading for that patch of good forest that would harbor the *Bactris* and that seemed just yards away. After a half hour of laborious travel and no sign of decent forest, let alone the *Bactris*, we once again returned to the rice paddy and decided to make one last attempt; either we would be successful or we would admit defeat and head back to the comforts of the Jardín. The latter alternative was beginning to look more like a real possibility, and a rather comfortable one at that. Moving another 200 yards along the edge of the rice paddy, though, we entered the swamp forest a third and final time and renewed our search. Our initial push into the forbidding vegetation seemed no different than the first two. Enthusiasm rapidly waning, we were just about to "throw in the towel" and admit defeat when we noticed a slight change in the forest. There were larger trees with a denser canopy, the thick undergrowth had thinned out, and there were new species of plants, including a few palms. Did we dare raise our hopes? First we saw *Astrocaryum*, then *Cryosophila*, and finally, much to our relief and joy, several magnificent clumps of *Bactris militaris*. Our three hours of tortuous trekking through inhospitable and forbidding, mosquito-infested swamp had ended. How sweet it was!

After some self congratulating and celebrating, we spent the next half hour making herbarium specimens, collecting fruits, and taking photographs. An awesome species, *Bactris militaris* forms clumps to 15 feet high and wide (Fig. 15). The enormous, 10-feet-long, simple leaves have stiff, sharp spines jutting out from the underside of the rachis and petiole. Indeed, running your finger carefully along the spines produces a plinking sound reminiscent of a music box. Although potentially showy and attractive, the infructescences, brimming with bright orange-red fruits, are usually deeply covered with fallen leaf litter and humus (Fig. 16) and harbor nests of aggressive, stinging ants, making gathering fruits a delicate operation. Fortunately, we were able to collect enough seeds to distribute worldwide, including botanical gardens in Costa Rica, Florida, California, Hawaii, and Australia among others. We also made duplicate collections of leaves, inflorescences, and fruits for herbaria in Costa Rica and the United States, the first such collections since the species was formally named and described nearly 50 years ago.

Although laden with our prized herbarium material and seeds, the return trek back through the swamp and across the rice paddy to our waiting car seemed a breeze. The fatigue faded, becoming only a distant memory, the hundreds of insect bites seemed insignificant, and the slithering creatures seemingly looming all around were somehow less threatening. It's funny how success can change one's outlook on life.

We spent our final days in the Jardín and its environs. During his sojourn at the Jardín in 1993, Mark had rediscovered *Chamaedorea stenocarpa* and *C. minima* in the wild, both thought probably to be extinct, and had brought another *Chamaedorea* to Don's attention, which turned out to be new to science. We returned to the forest remnant where Mark had found *C. minima* and the possible new species in 1993. Much to our consternation and sadness, in what had harbored healthy populations of *C. minima* just 15 months earlier, we now found destruction of all but one or two lone survivors. Cut or fallen trees and branches had crushed or covered several, while cattle, recently moved to the area, were making quick work of most of the others. For the few plants still hanging on, exposure to the sun and wind means a certain but slow death. Extensive searching revealed enough flowering and fruiting material of the other *Chamaedorea* to confirm it as new species (see accompanying article about new species of Costa Rican *Chamaedorea*). Although it, too, had suffered the ravages of forest destruction and cattle, it seemed to be faring a bit better than *C. minima*.

Although somewhat disappointed at the outcome of our search for *Chamaedorea minima*, we were not at all ready for what awaited us at the other site where Mark had found *C. stenocarpa*, a highly ornamental species valued for its diminutive stature and petite, cupped leaflets. It, like *C. minima*, was once much more common in forested areas around the Jardín. In fact, in the 1960s and 70s local peddlers would appear at the Jardín with scores of plants for sale. At one time as late as the middle 1980s the Jardín boasted collections of both species, each covering over 200 square feet and containing upwards of 200 plants. However, overcollecting, forest destruction, and even theft from the Jardín had driven this dwarf species, like *C. minima*, back into the most remote forest recesses. Where Mark had rediscovered only a handful of plants of *C. stenocarpa* only 15 months before, we found none, even after returning to the same site for a second, equally thorough search the next day. Since the forest was not disturbed, we can only surmise that these few remaining *C. stenocarpa* had fallen prey to the unscrupulous collector under the guise of "saving the species." The future for *C. minima* and *C. stenocarpa* does not look bright; both are highly sought after by collectors and both inhabit forest remnants in southeastern Costa Rica under increasing pressure from farmers, loggers, and cattle ranchers. While there are a few plants of *C. minima* left in the wild, *C. stenocarpa* may be extinct.

We spent our few remaining days in the Jardín itself, exploring its native stands of forest and admiring its fabulous collection of indigenous and exotic palms. One afternoon, in particular, we will remember for years to come. We were down the trail to the Río Jaba examining *Chamaedorea crucensis*, *C. pedunculata* (a close relative of *C. macrospadix*), and *C. brachyclada* when it clouded up rapidly and, appropriately, began to rain. Since it was near lunch time, we headed up the trail to the dormitory and lunch room. We hadn't gone very far when the skies opened and we were caught in a torrential downpour, perhaps the greatest of our lives. Our walk back quickly became a struggle as every small path, depression, or rivulet had turned into a raging torrent. The driving rain glanced and bounced off vegetation, soaking us completely under the pitiful cover provided by the wind-whipped and shrub-torn umbrellas.

After lunch and a change of clothes, the rain let up and we were out into the Jardín again, this time to admire its cultivated palms. We were particularly awestruck by the *Asterogyne martiana* and *Calyptrogyne sarapiquense*, two of Costa Rica's most stunning native palms. The rare and endangered *Hyophorbe indica* were fruiting and the *Dypsis decipiens* with their swollen trunks were certainly impressive. A fine double row of *Syagrus coronata* caught our eye, as did a group planting of a white-crownshafted *Dypsis* from Madagascar. Several *Reinhardtia* were in fruit, although those of the striking *Iguanura* and *Linospadix* were immature. We had a little time to admire some of Mark's 1993 handiwork, a group planting of *Chamaedorea minima*, before the next deluge of rain arrived.

We spent our last day in Costa Rica packing, cleaning seeds, and dropping off the duplicate herbarium material for the National Herbarium and Museum in San José. Although tired from the

hectic pace of the trip, we found time to reminisce and reflect on our experiences of the last two weeks, especially our appreciation for variability within a species, the new species we had documented, and the beauty and fragility of the Costa Rican palms, from the diminutive *Chamaedorea tenella* and *C. minima* to the spectacular and large *Bactris militaris*. Oh, did we forget to mention the rain?

Acknowledgments

Barry Hammel and Michael Grayum of the Missouri Botanical Garden provided information about palms and localities in Costa Rica. Gerardo Herrera was an admirable and helpful companion in the field. The Southern California Chapter of the International Palm Society, the Friends of the Virginia Robinson Garden, and the late Richard Palmer provided support for Hodel. To the maker of the rain, many thanks!

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CHAPTER NEWS AND EVENTS

Phytopathological Slide Collection Available to Chapters

The Gulf Coast Chapter of the IPS has purchased a set of over 200 slides from the American Phytopathology Society and donated these slides to the International Palm Society. At the August board meeting, the IPS accepted this outstanding collection of slides. The IPS agreed that the Gulf Coast Chapter be custodian of these slides, making them available on loan to IPS chapters and affiliates. If your chapter would like to make use of these phytopathological slides, please contact Maxwell Stewart of the Gulf Coast Chapter. Alternately, you can send an email to the new editors of their chapter journal, Fan and Feather, Joe Watkins ⟨jwatkins@gulftel.com⟩ or William Watkins ⟨watkinsw@aol.com⟩ expressing your group's interest.

News from the Palm Beach Chapter

It has been a hot, eventful Summer. The general meeting in July featured Paul Craft showing slides and speaking on his trips to Cuba. Joe Michael donated *Borassus flabellifer* seed to all who attended. Thank you, Joe! The August meeting had David McLean show us how we should plant palms and cycads in our gardens so they show off best. David is an instructor who teaches courses on palms and cycads at Broward Community College and is also a landscape designer.

Our September meeting was held on Saturday, the 7th at Ruth Sallenbach's home and palm garden. We were treated to a tour of hundreds of palm and cycad species, had our annual picnic, and held an auction of palms, cycads, and even a few other species of tropical plants.

The October 2 meeting featured Chris Migliaccio, an Associate Professor at the MDCC Wolfson campus, who also teaches courses at Fairchild Tropical Garden on palm horticulture. The plant auction followed the meeting, with a free palm to all who attended.

Our Fall Sale is being held October 12 and 13 at Morikami Park in Delray Beach. It is hard to believe this is already our 8th Annual Fall Sale.

PAUL CRAFT
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News from the South Florida Chapter

The South Florida Chapter held a field trip on July 20 to the University of Florida Agricultural Research and Education Center in Ft. Lauderdale. Dr. Bill Howard led the group on a tour of this extensive research collection. The Chapter also met on August 27 at Fairchild Tropical Garden for "A Photographic Tour of Palms of Cuba," by Peter Mayotte, MD. Dr. Mayotte has travelled around the world studying and photographing many species of palms.

(*Continued on p. 199*)

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Controlled Pollination of the Pejibaye Palm

JORGE MORA-URPI AND RAMON MEXZON
School of Biology, Pejibaye Program, University of Costa Rica, San Jose, Costa Rica

The study on natural pollination of the pejibaye palm (*Bactris gasipaes* Mora-Urpi and Solis 1980) provides the basis for the development of a technique for controlled pollination necessary for breeding work. The authors established the following principles, which field practice later confirmed.

1) the pollination cycle in "pejibaye" takes three days.

2) Flowers are unisexual and are found in the same inflorescence.

3) Female anthesis within the same inflorescence is simultaneous.

4) Female anthesis is easily determined because it coincides with the opening of the peduncular bract that covers the inflorescence. It generally takes place between 5 and 6 p.m., but may vary between 3 and 7 p.m.

5) Female receptivity lasts at least 24 hours.

6) Male anthesis takes place 24 hours after the opening of the peduncular bract and male flowers become detached from the inflorescence right after pollen is released.

7) From the above points it can be deduced that flowering is not completely protogynous because the period of female fertility overlaps with that of male fetility.

8) In a pejibaye plantation, there are two peaks of pollen concentration in the air. One occurs around 6 p.m. and corresponds with male anthesis; another occurs around 6:30 a.m. from pollen that remained on the inflorescence rachillas after its liberation the afternoon of the day before. On the morning of the following day the pollen is drier and easily blown by the breeze.

9) The main pollinators are the curculionid beetles *Andranthobius* (syn. *Derelomus*) *palmarum* in Central America and several species of *Phyllotrox* in the Amazon Basin. They arrive by the thousands when the peduncular bract opens and leave 24 hours later during pollen release when the male flowers are falling.

10) Wind is also a pollinating agent in a plantation, but of much lesser importance than beetles.

11) Gravity is another pollinating agent that may have some importance when there is some degree of self-compatibility present.

12) Other visiting insects may play a secondary role.

13) There is a self-incompatibility genetic system present that seems to be quantitative.

14) It is easily seen that xenogamia (cross-breeding) is highly preponderant.

15) If the inflorescence is separated from the plant shortly before the opening of the peduncular bract and its base placed in water in the laboratory, the flowering cycle continues normally to completion.

16) Pollen germinates well on 5% glucose agar in one hour and 15 minutes on the average.

17) Pollen can remain fertile when dry and cold for six months (Miranda 1986).

Protection Against Genetic Contamination

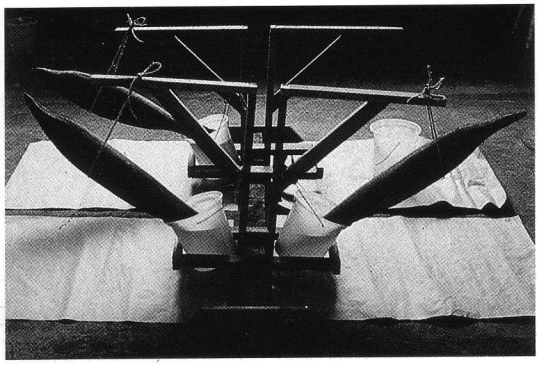
The small size of the curculionids (*Andranthobius* and *Phyllotrox*) and the large number visiting the inflorescences make it obligatory to take very strict precautions to avoid contamination with pollen transported by those insects. The protecting bags must fit tightly against the base of the peduncular bract.

Although pollen is carried for only a short distance by the wind, in a plantation the trees are close enough for this factor to have significance; protecting the inflorescences the day before their opening is essential.

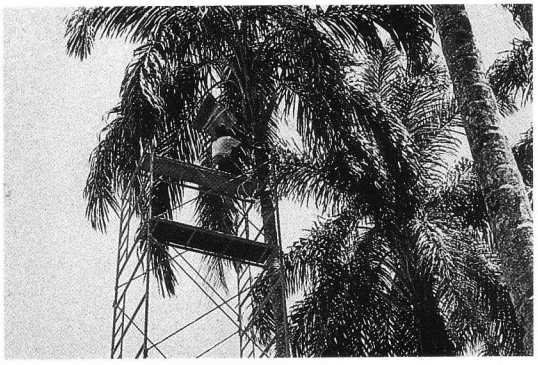
Emasculation of the male flowers is generally unnecessary because of the genetic self-incompatibility present in most plants and, in addition, the 24-hour difference between the onset of female and male fertility allows sufficient time for the germination of the hand-applied pollen, which, as mentioned, takes only one hour and a few minutes to germinate.

Pollen Collection

The pollen can be gathered from the male parent by any of the following three methods:



1. Separated inflorescences for pollen collection method.



2. Hybridizing a mature mother palm.

1) Remove the inflorescence from the tree just before it opens. Take it to the laboratory and open the peduncular bract with a knife. Separate the rachillae from the rachis and place them on kraft paper or other substrate and place in an oven at 40° (a wooden box with a light bulb inside can be easily built for this purpose). The pollen is liberated within 12 hours. This is the most practical of the three methods described here.

2) Separate the closed inflorescence from the tree right before it opens as described above. Take it to the laboratory and immediately place the base of the peduncular bract in a container with water (Fig. 1). The inflorescence will continue its normal opening cycle and release the pollen 24 hours from the onset of opening.

3) Bagging the inflorescence on the tree before it opens. This is the most impractical method because in most cases the male tree is too tall to be reached and because more pollen sticks to the paper bag, diminishing the amount collected.

Pollen Conservation

The pollen collected by any of the above methods must be cleaned of other materials such as male flowers and loose anthers. It is then placed in small vials, which are put uncovered into an hermetically covered receptacle with a drying agent such as silica gel or calcium chloride for 24 to 48 hours. The small vials are then covered (best under vacuum) and stored under refrigeration. Although pollen fertility diminshes with time, it will be usable for up to six months. Its fertility can be checked by placing in 5% glucose agar. The pollen can be left to rehydrate in a humid atmosphere before using, although this is not essential.

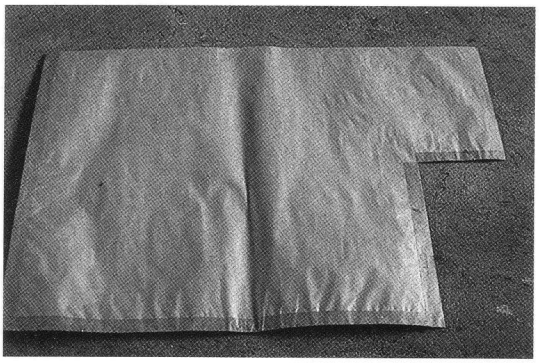
The Protecting Bag

The inflorescence-protecting bag is made of kraft paper, reinforced on its dorsal edge for rain protection with a strip of the same kind of paper 20 cm wide, bent over both sides. This same procedure is performed at the neck of the sleeve to prevent tearing at that point. Two sizes of protecting bags are generally used to accommodate the different lengths of the inflorescences: a larger bag 90 cm × 70 cm, with a sleeve (included in the 90 cm) 17 cm long with a 27 cm opening, and a smaller bag 70 cm × 45 cm with a sleeve of 17 cm × 22 cm opening. Occasionally it is necessary to use other bag dimensions to accommodate some inflorescences that are too short or too long (45 to 110 cm).

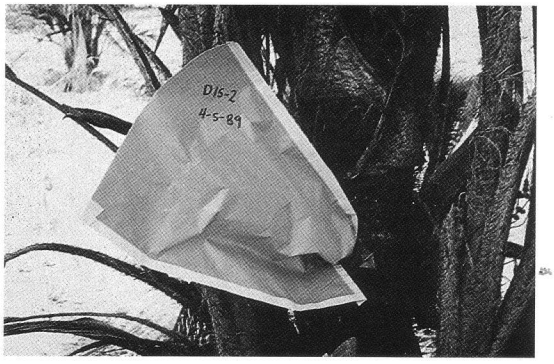
Protection of the Inflorescence

In the "utilis pejibaye" race, the unopened inflorescence when ready to open changes its position on the tree from one originally close to vertical (100° to 110°) to one close to horizontal (140° to 160°). This change occurs approximately 24 hours before anthesis. It is at this last stage that the protecting bag is placed on the still-closed peduncular bract (Figs. 2–4). This change of position may vary in other "pejibaye" races. For instance, in the "Yurimaguas" hybrid the inflorescence starts that movement several days before anthesis, and may come to a complete horizontal or even hanging position ahead of anthesis, which makes it much more difficult to predict its opening day.

Prior to the placing of the protective bag, the spines must be eliminated with a knife when present on the area in the stem that would interfere with this operation. The bag must be sprayed inside



3. Protecting bag.



4. Protected inflorescence.

with an aerosol insecticide such as propoxur 1% and a cotton washer impregnated with insecticide must be placed in the bag opening. The opening is closed tightly against the inflorescence base with a strong rubber band around it. When pollination is accomplished the bag is labelled with a pencil indicating the date of pollination and the parents. The labelling is protected by applying liquid vaseline.

Assisted Pollination

The opening of the peduncular bract varies in time according with season. If it opens after 5 p.m., the remaining daylight is too short to allow several pollinations. For this reason the hand pollinations, if possible, should be programmed for the season when flowering occurs earlier in the afternoon. In the area of Guapiles, Costa Rica, earlier flowering occurs in July and normally it coincides with the flowering peak. However, that is not the case in other regions such as San Isidro del General, Costa Rica, where the flowering time comes earlier in the day during the month of May, which corresponds with a season of low flowering. However, as mentioned, female fertility lasts for 24 hours, which allows pollinations the following day. Although the female fertility peak is reached at the time of opening of the peduncular bract, the risk of genetic contamination by the beetles is high.

The hours in which there is less chance of genetic contamination, because there is no pollen in the air and the beetles are inactive, is between 9 a.m. and 4 p.m. One pollen application is enough since all female flowers are fertile at the same time. The application can be made easily, with a small hand sprayer, through a cut made on the distal inferior corner of the protecting bag or by opening completely the distal end of the bag exposing all the inflorescence. This opening of the entire distal end of the bag must not be practiced if the procedure is done after 4 p.m. The opening is then closed with staples and sealed carefully with glued paper.

No pollen dilution with talc is used since the pollen is already diluted to above 50% by the presence of loose trichome cells from the rachillae.

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An update on Palms in Puerto Rico

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This past May–June, 1995, I had an opportunity to revisit friends and family in Puerto Rico. I was especially looking forward to this visit, because during the last Biennial to Venezuela, I had the occasion to meet Hector Rivera, a very enthusiastic Palm Society member who happens to work at the Botanical Garden in Rio Piedras, which is associated with the University of Puerto Rico. Up until now, I had never had the good fortune to get acquainted with anyone at the Botanical Gardens, either in Mayaguez or Rio Piedras, with any genuine interest in palms. Hector is relatively new to palms, but has all the enthusiasm of someone who has been bitten by the bug. He wants desperately to get the Island (Puerto Rico) to lessen its self-imposed restriction on importing seeds from outside the Island. There is real fear of Lethal Yellowing, which, to my knowledge, has not shown up there yet. One palm grower in particular, Dominique Gilormini, from Patillas, has many, many acres of dwarf coconut palms under cultivation and they are much in demand from the large hotel and industrial complex industry on the island.

On June 8, 1995, Hector picked me up from where I was staying in Bayamon, a large suburb in the San Juan area. He took me to the other side of the island in the south-east portion and there I had the opportunity to meet Dominique Gilormini. He was quite gracious and offered us some home-grown grape juice. He stated that he is growing some four varieties of dwarf coconuts. Hector and I spent a couple of hours there and decided to head back home to Bayamon. On the way we passed a large palm nursery that he had never seen before and we decided to go in and check it out. There we met Alfonso Carrero, agronomist, who was in charge of the entire operation. The farm consisted of about 1 500 acres of which about 80% was devoted to palms. What amazed me was the tremendous increase in the planting of *Syagrus romanzoffiana* (the Queen palm) and *Washingtonia robusta* (the Mexican fan palm). These palms were being used for street planting and landscaping in new shopping centers. At this nursery, mostly what we saw, beside the two most common palms in California, were *Aiphanes acanthophylla*, *Hyophorbe verschaffeltii*, *Livistona chinensis*, *Areca catechu*, *Cocos nucifera*, *Roystonea borinquena*, *Chamaerops humilis*, which on my last trip, I was informed was quite rare, *Pritchardia pacifica*, and *Dypsis cabadae*. Alfonso seemed quite interested in the Palm Society and I gave him an application to join.

The next day, Hector came by again, quite early, to take me to the largest nursery on the Island, Margo Farms. I was introduced first to Pascual Marranzini, a sales representative and then to a former Californian, Mick Parzanese. He took us on a tour of the nursery, and it was there that I saw perhaps the only specimen of *Bismarckia nobilis* on the Island. Unfortunately, Puerto Rico is light years behind Florida, California, and Hawaii, as far as the variety of species is concerned, and now they are planting Mexican fan and Queen palms. Well, they are fast and cheap. Need we say more. Howeas are also being grown for the indoor trade. That afternoon was spent in checking out several other nurseries that specialized in palms. *Cyrtostachys renda* was available in some nurseries, but was very expensive. Apparently, new species do show up on the island from time to time, but no one wants to take credit for it. I definitely get the impression that it is taboo to bring seed or palms into the Island, but it does occur. I do hope the restriction of seed importation does become officially more relaxed.

The following week on June 14, Hector once again graciously picked me up in Bayamon to take me to the Botanical Garden in Rio Piedras. We arrived at the Jardin Botanico in a short time, and there I met Henri Llogier, taxonomist, who escorted me through the Palmetum. I was particularly happy

to see that they have planted a fairly large number of an endangered Island species, *Calyptronoma rivalis*. Outside of its native habitat in San Sebastain on the outer side of the island, the only one was in the Botanical Garden in Mayaguez, and that one at this time looked as if it were dying. I was very happy to see this palm established in the Rio Piedras Botanical Garden. Ironically, I have two species of *Calyptronoma* from Cuba in my collection, but none from Puerto Rico. Three of the most impressive palms in the garden were two huge *Corypha* species. They were not yet in flower, but probably about 35 years old, a fairly large *Cyrtostachys renda* and the American oil palm, *Elaeis oleifera*, a relative of the African oil palm, but to me, more ornamental. The garden also had some *Licuala spinosa*, *L. peltata*, and *L. grandis*, which I had not seen previously. I recall also seeing representatives of *Livistona decipens*, *Attalea* sp., *Pritchardia pacifica*, *Caryota mitis*, *C. urens*, *Dypsis lutescens*, *D. cabadae*, and *Hyophorbe verschaffeltii*. They also had *Cryosophila* species available in the nursery. The gardens were, all in all, very attractive and well taken care of. To my way of thinking, the only thing lacking was an aggressive program of new introductions. Hopefully, that will change in the near future with the efforts of Hector Rivera.

That afternoon, Javier Garcia, my wife's nephew picked me up at the Botanical Garden. I was completely soaked to the skin. I was caught touring the garden without an umbrella when a downpour nailed me. By the time I got to a building, it was too late. We headed off to El Yungue, a rain forest on the island under the protection of the United States Federal Parks Service. That morning I was introduced to George Proctor, a natural resource specialist, who worked at the Botanical Garden. His primary interest is in ferns, and when I told him of a strong desire to see a particular fern in the rain forest, he told me where I could find it. That afternoon, I did. In the past, on visits to El Yunque, I just never went up far enough. This time we did, and I saw enough to thoroughly satisfy me. The only palm indigenous to the rain forest is *Prestoea montana*, and believe me, it is not endangered at all. Seeds drop every winter, and I could see them sprouting all over the place. Ferns, orchids, and bromeliads cover the trunks profusely. Although not considered a prop root palm, thick plump roots jut out from the trunks on steep hillsides to help support the palm. The palm does not have a clearly distinguishable crownshaft, but the glossiness of the fronds are especially attractive. I'm so glad that they can grow in California, although they are not at all common even in palm collections. Mine is just beginning to form a clear trunk. This palm is not seen at all in the San Juan metropolitan area. Hector had brought back a seedling to see if it will grow. It might just be too hot. The temperatures in El Yunque were decidedly comfortable, not so at sea level. The next time I go, I hope to see the Elfin Forest in El Yunque. It is at the highest elevations of about 4 000 feet. There the trees are dwarfed due to the constant winds, cooler temperatures, and higher humidity. Rainfall is in the neighborhood of 250 inches per year.

The next day we left Puerto Rico, USA to return to California, and the day after that I gave a slide presentation on the Palm Society Biennial in Venezuela to the Los Angeles International Fern Society. Hopefully, the next time I visit Puerto Rico, Hector Rivera may be well on his way to establishing a IPS Chapter on the Island, and we may begin to see mass importation of seed from the seed bank and other seed sources.

CHAPTER NEWS AND EVENTS (*Continued from p. 193*)

Pacific Northwest Chapter News

The Pacific Northwest Palm & Exotic Plant Society is in the early stages of working on producing blueprints for the city of Vancouver parks department for the planting of an exotic plant and tree boulevard along downtown's English Bay. The area already has almost 60 publicly planted palms, all donated by the palm society, and is hoping now that the city will use this blueprint and their budget to create what many palmophiles have dreamed of.

As featured on the back cover of *Hardy Palm International*, 27, the largest eucalyptus in Canada was recently discovered in a Victoria, BC, backyard. It is *E. gunni* or *Niphophila*, but we are not sure which. It completely dwarfs the houses below and looks absolutely beautiful.

The society organized a tour of club members Larry and Peggy Wick's Keats Island retreat just southwest of Vancouver. Over 60 people packed the glorious waterfront site to see a tremendously varied group of plants. Larry has spent years creating this garden, battling for soil and water on the dry sandy island. Next year the club is planning another tour of some of Seattle's finest gardens, and there are many.

Membership currently stands at 265. Upcoming meetings are scheduled for September 23 and November 25.

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News from Broward County, Florida

The Broward County Palm & Cycad Society (BCP&CS) met on July 25 to enjoy a brief travelogue of New Zealand's subtropical and temperate gardens as presented by Keith Boyer, an avid palm enthusiast and grower in New Zealand.

Afterwards, the Annual Rare Palm and Cycad Auction took place.

More than 100 "one of a kind," unusual and rare palms and cycads were auctioned. Extremely rare Vietnamese *Cycas* spp. collected by Dr. Alan Meerow were offered as well as *Neoveitchia storkii*, many lovely *Pinanga* spp. such as *P. bicolana*, and of course the *Rhopalostylis* that Keith Boyer presented in his talk. A good time was had by all.

Chapter elections were held in July, with Sandra Haller becoming the new President. For a list of all new officers, see the Membership Roster accompanying this issue of *Principes*. The Broward County Palm and Cycad Society Fall Sale was held on September 21 and 22 at Flamingo Gardens. Many Florida vendors provided an incredible array of palms and cycads for sale—from the local native species such as *Pseudophoenix sargentii* to the lovely and rare, such as *Licuala orbicularis*. In all, more than 500 species of palms and over 60 species of cycads were offered.

The September 26 meeting featured Dr. Alan Meerow, delving into the *Cycas micholitzii* complex. He spent a good deal of time during the past year with Dr. Si-Lin Yang working on the entire complex to sort out the various proposed species using electrophoresis.

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News from the Palm Beach Chapter

It has been a hot, eventful Summer. The general meeting in July featured Paul Craft showing slides and speaking on his trips to Cuba. Joe Michael donated *Borassus flabellifer* seed to all who attended. Thank you Joe!

The August meeting had David McLean show us how we should plant palms and cycads in our garden so they show off best. David is an instructor who teaches courses on palms and cycads at Broward Community College and is also a landscape designer.

Our September meeting was held on Saturday, the 7th at Ruth Sallenbach's home and palm garden. We were treated to a tour of hundreds of palm and cycad species, had our annual picnic, and held an auction of palms, cycads, and even a few other species of tropical plants.

Our Fall sale is being held October 12 and 13 this year at Morikami Park in Delray Beach. It is hard to believe this is already our 8th Annual Fall sale.

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News from the Hawaii Island Chapter

The Hawaii Island Chapter has received a second grant for our palm planting project at the Panaewa Rain Forest Zoo. The grant is for nearly $5 000. The money will be spent to buy 26 *Wodyetia bifurcata* to line the entrance to the zoo and 13 *Cyrtostachys renda* to line one of the walkways in the zoo. In addition seven *Neodypsis* (or, make that now *Dypsis) lastelliana* will be purchased to plant near the graves of two tigers, popular former zoo residents, much missed by the community.

Eighteen additional, unspecified palms will also be purchased. These will no doubt be unusual, hard-to-get varieties, which, lucky for us here, are not as hard-to-get on the Big Island as elsewhere. The grant is Kaulunani Hawaii the Beautiful Urban Forestry Grant. It is provided jointly by the State of Hawaii and the Federal Government. As required under the terms of the grant, the Hawaii Island Palm Society will match the amount of the grant with in-kind donations of plants, fertilizer, and labor (digging holes, my favorite thing).

On Monday, July 29, the Chapter was treated to a slide show and talk by Rolf Kyburz, Australian (by way of Switzerland) nurseryman, seedsman, and plant explorer. His thoughtful and thought-provoking talk focused on the continuing destruction of the world's tropical rain forests and the economic pressures that cause this. Mr. Kyburz offered suggestions for diminishing the threat; these included developing economic alternatives to the inhabitants of threatened areas. One example was teaching native inhabitants of an area in Madagascar that a particular palm was a renewable resource—selling the seed could produce a regular income. The natives then protected the palm and it was recognized as a living asset of the village. It was understood, however, that the problem of the destruction of the world's tropical rain forests is of such scope that it will not be easily solved.

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News from Louisiana

The Louisiana Chapter of the IPS met on August 2 at the home of members Kit Blue and Robert Whitney. Members were encouraged to drive by the *Phoenix* palms, donated by the chapter, planted near the entrance of the nearby Lakeview City Park on Esplanade Avenue. A palm auction and a raffle followed the meeting.

News from the Texas Chapters

The Texas Chapter of the IPS met on September 28 at the home of Horace an Cynthia Ford Hobbs, in south Houston. This meeting featured a slide presentation by Horace Hobbs on the recent IPS Biennial Meeting held in southern California. This followed the annual "Fall Members' Sale" where a wide selection of palms were available. A delicious Mexican dinner was prepared by Cynthia for all to enjoy.

The October 26 meeting will feature Alan W. Meerow, author of *Betrock's Guide to Landscape Palms*. This meeting was arranged by Grant Stephenson and will be held at his nursery, Horticultural Consultants, in west Houston. Gant has a wide variety of large, mature palms available for viewing and purchase.

Plans for further "working parties" for maintenance of the new Hobby Esplanade Palm Planting project were laid. The plants are "holding on," but have shown some stress due to the high summer temperatures. The group will also meet on November 16 at Darren Oeschler's home in Seabrook, Texas.

The South Texas Palm Society, formed early in 1996 to provide a more localized organization for deep south Texas, was made a separate affiliate chapter of the IPS at the IPS Board Meeting in August. The IPS welcomes this new chapter! See their listing in the accompanying IPS Membership Roster for further information.

The group met in September for their First Annual Palm Sale in Weslaco, then met in October in Rockport. A meeting is also scheduled at the home of Charles Vieh in San Benito on November 10th.

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European Palm Society CHAMAEROPS News

From the next issue, *Chamaerops*, the magazine of the European Palm Society, will be available with a supplement containing a translation of the text of the magazine into French, German, and Spanish. These are available to all and any EPS members at no extra cost. It will go out automatically to all members living in those countries; others should simply request the appropriate translation, if required. This is an exciting development for our society, and helps us to maintain

more credibly our European outlook. It is further hoped that this will encourage more articles from those whose lack of English has been a limiting factor. The translators work both ways!

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News from Western Australia

The Palm & Cycad Society of Western Australia (PACSOWA) met on August 19 at the Leederville Town Hall. Ken Adcock gave a potting demonstration with lots of helpful hints. He also showed how to divide and re-pot a *Rhapis* palm. John Banasiewicz gave a short talk and demonstration on how to prepare palms and cycads for display. This was very timely because of the exhibition at the Roy Edinger Hall subsequently held in September. There will also be another display and plant sale by the Society at the Dianella Shopping Centre on November 14–16.

Ten workers turned out for the Gascoyne Park July 20 workday. The Wanneroo Council has been extremely generous with mulch and a further four truckloads have been delivered. These mountains of mulch were spread, creating a massive area that can now be converted into a rain forest. More palms were planted around the BBQ which has some heavily shaded areas mixed with full sun and partly shaded areas. The comments and enthusiasm displayed by the members make the effort that has been put into the park worthwhile. The small island of palms along the side of the playground was also mulched. Another workday for continued maintenance was held on August 25.

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South African Palm Society News

The South African Palm Society (SAPS) 1996 Annual General Meeting (A.G.M.) was held in Malelane, Mpumalanga on June 14–17. Numerous nurseries and palm gardens were toured and members enjoyed the company of other palm enthusiasts.

1996 INTERNATIONAL PALM SOCIETY BIENNIAL
Orange County, California

Members from more than 25 countries traveled to the Hyatt Newporter Hotel in Orange County California to attend the 1996 International Palm Society Biennial. The six-day event featured tours of private and public gardens, and guest speaker presentations by John Dransfield, Nora Martinez, Myron Kimnach, Chuck Hubbard, Keith Boyer, Ralph Velez, Libby Besse, Rolf Kyburz, Scott Zona, Larry Noblick, Martin Gibbons, Kampon Tansacha, Poonsak Watcharakorn, Inge Hoffmann, and Don Hodel.

The Palm Collection at the Hyatt Newporter Newport Beach, California

IPS members checking into the Hyatt Newporter discovered a huge palm collection scattered throughout the extensive grounds and around the gardens, pools, and fountains. More than 100 mature *Rhopalostylis* highlight the landscaping along with many *Howea forsteriana* and *Howea belmoreana*. Other notable palms include *Acoelorraphe wrightii*, *Caryota urens*, *Rhapidophyllium hystrix*, and *Brahea armata*. Over the past few years, several "new" species have also been added, including *Ravenea* and *Dypsis*. One of the most prized palms is a *Jubaeopsis caffra*.

SCHEDULED IPS BIENNIEL ACTIVITIES:
Public Gardens

The Huntington Palm Collection
The Huntington Library, Art Collections, and Botanical Gardens
San Marino, California

The Huntington not only has one of the finest palm collections on the West Coast, but also outstanding collections of antique furnishings, rare books, and British and French art of the 18th and 19th centuries, including the world renowned Blue Boy by Gainsborough and Pinkie by Lawrence. The Botanical Garden surrounds the estate of Henry E. Huntington, an exceptional businessman who built a financial empire, which included railroad companies and real estate holdings in Southern California. In 1910, at the age of 60, Mr. Huntington retired to devote time to his book and art collections as well as to the landscaping of his 600-acre ranch. Today the Huntington covers 207 acres, of which 150 acres are botanical gardens, including an outstanding 5-acre Desert Garden and a Japanese Garden featuring a drum bridge and furnished Japanese house. The first curator of the gardens, William Hertrich, recognized Huntington's interest in tropical plants and suggested the establishment of a palm collection

suitable to Southern California's hot, dry summers and cool, dry winters on four acres of sloping ground. By 1930 Hertrich had searched for palms in Southern California, Europe, and Japan, and had accumulated about 450 specimens representing 148 species and varieties. Included in the original collection was a Canary Island date palm, which Huntington had moved from his uncle's estate on Nob Hill in San Francisco, where it had survived the 1906 earthquake and fire. The tree, which can be seen today in the northwest section of the Desert Garden, still carries scars of that great disaster. The current palm collection, located mainly in the Palm and Jungle Gardens, has approximately 60 genera and over 200 species. A microclimate has been formed where large, old trees protect small and less hardy trees. This is important since severe frosts damaged or killed many palms, particularly young specimens, in 1913, 1922, 1937, and 1949. Fine, mature specimens of cold-hardy palms include *Phoenix*, *Sabal*, *Butia*, *Jubaea*, *Washingtonia*, *Livistona*, *Trachycarpus*, *Caryota*, *Brahea*, *Syagrus*, *Howea*, and *Archontophoenix*. More recent additions include *Ravenea*, *Ceroxylon*, *Jubaeopsis*, *Dypsis*, and *Parajubaea*. Of particular note is a large *Acrocomia*.

The Los Angeles State and County Arboretum
Arcadia, California

The Los Angeles State and County Arboretum, established in 1947, occupies 127 acres in the historic Rancho Santa Anita, a fertile area whose spring-fed lake has attracted a series of owners over the years, beginning with primitive hunting and gathering Indians, and continuing through cattle-raising rancheros, American entrepreneurs, and modern-day preservationists. The arboretum's picturesque lake surrounds the historic 111-year-old Queen Anne Cottage, a national landmark, which has been the setting for numerous movies and television programs, including "Fantasy Island." The towering washingtonias adjacent to the Cottage are some of the tallest and oldest of this species in the world. The palm garden represents a fine collection of primarily cold-hardy genera: *Archontophoenix*, *Brahea*, *Chamaedorea*, *Jubaea*, *Livistona*, *Phoenix*, *Sabal*, *Syagrus*, *Trithrinax*, and *Washingtonia*. Recent additions include *Caryota*, *Dypsis*, *Howea*, and *Ravenea*. The palm gardens are also enhanced by many large cycads.

Quail Botanical Gardens
Encinitas, CA

Quail Botanical Gardens was originally the private residence of Ruth Baird Larabee who, in 1957, deeded her 25-acre estate to the County of San Diego to be used for "public purposes." She and her husband had traveled through Mexico, South America, and along the western United States coast, collecting drought-resistant plants and many of these historical plantings remain. In 1961, a group of private citizens formed the Quail Botanical Gardens Foundation, Inc. to assist the Parks and Recreation Department in the preservation of the site. The original charter of incorporation called for providing a refuge and feeding station for quail, the favorite wildlife of Mrs. Larabee. Plants are displayed in natural settings according to geographical origin. Quail Botanical Gardens has become well-known for the diversity of plantings, and includes important bamboo and hibiscus collections. In 1992 an additional 30 acres of coastal sage scrub and maritime chaparral were added and will be maintained as a native plant and wildlife preserve. The palm plantings at Quail include over 50 genera and 130 species. Palms can be found throughout the grounds, but particularly in the areas near the recently completed Mildred MacPherson Waterfall and Palm Canyon. Palm collections include *Rhopalostylus*, various *Chamaedorea* and *Pritchardia* species, *Archontophoenix alexandrae*, *Hedyscepe canterburyana*, *Arenga engleri*, *Hyphenae thebaica*, and a grouping of *Caryota ochlandra*.

The Palm Collection at Crystal Court
Costa Mesa, CA

This impressive palm collection, situated in a shopping area, has over 100 species. Particularly noteworthy are a large *Roystonea regia*, a large cluster of *Rhapis humilis*, plus *Pritchardia hillebrandii*, *Chambeyronia macrocarpa*, and *Ravenea rivularis*. Each palm is labeled with its common name, botanical name, and country of origin.

Ganna Walska Lotusland
Santa Barbara, California

In 1882, pioneer nurseryman R. Kinton Stevens established a nursery on 37 acres of land in Santa Barbara. He planted a wealth of exotic trees, palms, and other subtropical plants. Stevens was one of the first Americans to grow the sacred Indian Lotus, introducing it in the early 1890s.

His property, called Tanglewood, became a favorite destination on tours of private gardens. In 1941 the well-known Polish opera singer Mme. Ganna Walska purchased the estate and renamed it Lotusland. For her, Lotusland became a spiritual refuge—a place where she could set aside the concerns of the ordinary world. She lived there until her death at the age of 100 in 1984. Over the years, she had worked with expert horticulturalists to create a remarkable botanical and horticultural collection of mostly tropical and subtropical plants. Among them are aloes, cacti, bromeliads, ferns, palms, and four hundred cycads, including three rare South African *Encephalartus woodii.*

Ventura College
Ventura, CA

The palm collection at Ventura College was first established in 1973. There are palms planted throughout the 110 acres of the college's ground, with most of them concentrated in an area near the swimming pool. Temperatures have dropped as low as 22 degrees Fahrenheit in this area near Santa Barbara, so the emphasis has been on growing as many cold-hardy species as possible. At present there are over 200 species represented in the gardens, and palms are being added all the time by the Friends of the Ventura College Palm Garden, a group responsible for management of the collection. Among the many splendid specimens to be seen here are various species and varieties of *Coccothrinax, Pritchardia, Brahea,* and *Phoenix,* as well as *Archontophoenix, Syagrus, Caryota,* and *Ptychosperma.*

The Fullerton Arboretum
Fullerton, California

The Fullerton Arboretum, first opened to the public in 1979, is located on 26 acres of a former orange grove and is adjacent to California State University, Fullerton. The palm gardens represent a fine collection of primarily cold-hardy species. Many of the 26 genera and approximately 50 species were donated by members of the Southern California Chapter of the IPS. Palms include *Brahea brandegeei, Livistona mariae, Caryota urens, Phoenix* hybrids, and various *Sabal. Dypsis decaryi, Rhapidophyllum, Wodyetia,* and *Chambeyronia* have been added to the collection this past year. The arboretum also has several species of *Ficus,* a "Rare Fruit Grove," and a shady grove of California Redwoods (*Sequoia sempervirens*). The various gardens are picturesquely joined together by several ponds and streams.

SCHEDULED IPS BIENNIEL ACTIVITIES:
Private gardens

Garden of Loran Whitelock
Los Angeles, CA

Loran Whitelock's "Cycad Gardens" began with the purchase of land in 1962. The exotic garden is planted predominantly with cycads; however, the Whitelocks' interests also include palms, anthuriums, begonias, platyceriums, and other subtropical plants. At the present time, the collection consists of about 233 cycad species and varieties, and 65 palm species: of palms, the genus *Chamaedorea* is best represented, with about 35 species. The garden was planted in a natural way and not as a collection. The ideas for this were developed as a result of observing plants in their natural habitats during numerous collecting trips throughout the world.

Note: For other private gardens visited see the July 1996 issue of *Principes* 40(3): 159–161.

Note: All news by Jim Cain unless otherwise marked.

Principes, 40(4), 1996, pp. 204–207

Coccothrinax yunquensis

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ABSTRACT

The species discussed in this article is just an example of what sometimes happens in the world of plant taxonomy. A species is described, then rejected, then restored. Someone talks about "taxonomic dirty laundry." The usual trend is to reduce many of the old species described to forms or varieties as intraspecific diversity. Behind the controversy, the biggest problem is often that the plant is almost unknown. In this paper I briefly relate the taxonomic story of a Cuban *Coccothrinax* from its institution as a "sp. nov." to its eventual annihilation and then I tell the wonderful experience I had of going to visit it in the "flesh" in Cuba.

In 1980 Attila Borhidi, a Hungarian taxonomist and geographer, and Onaney Muñiz, a Cuban botanist, described seven new Cuban species of the genus *Coccothrinax*. A few years later a comprehensive and very technical key, "Catàlogo de las palmas de Cuba," was published by the same authors.

One of the seven new palms was *Coccothrinax yunquensis* Borhidi et Muñiz. The new *Coccothrinax* was found "in saxosis calcareis humidis cacuminis monti Yunque de Baracoa, 500 m alt. s.m. . . .", i.e., on humid calcareous rocky precipices of El Yunque; a flat-topped mountain located in the "Oriente" region of southeastern Cuba. The observation at the end of its formal description reports that it is closely related to *C. salvatoris* Leòn and annotates all the differences (see Table 1).

In 1995 a new brick-sized book appeared; *A Field Guide to the Palms of the Americas*. The authors, A Henderson, G. Galeano, and R. Bernal, fighting against the "taxonomic dirty laundry" of the past, refused hundreds of old palm names and, in the genus *Coccothrinax*, accepted only 14 specific names out of the 49 validly published existing names. *C. yunquensis* Borhidi et Muñiz was not within the group of the lucky 14; it had been actually put as part of synonymy of *C. salvatoris* because in 1991 two Northern American taxonomists, Nauman and Saunders, suggested that the two plants were very, very similar from a cladistic point of view (but not identical!).

Last summer, when the new book was being distributed, I was wandering with a friend of mine in South Cuba to collect palm seeds for the botanical garden of Rome. Ignoring the work of Nauman and Saunders and having not yet seen the new book, for me the small palm of El Yunque was still a fascinating endemic, valid species and, being around there, I decided to go for it with the key of Borhidi and Muñiz in my backpack.

El Yunque lies a few kilometers away from the warm beach of Baracoa, a very beautiful Caribbean town, which was formerly the capital of Cuba. As the area is protected by a mountain chain, it is very humid and almost hurricane-free, and the mountain is surrounded by an unbelievably thick and intriguing Caribbean rain forest.

The driveable road ends at the bottom of the mountain in a pleasant camping site for Cubans on vacation, playing loud "salsa" and roasting pork. After a picturesque crossing of nearby river with the water to our waists and cameras on our heads, we started to hike through the winding path leading upwards. The lowest slopes are sustainably cultivated with cocoa and bananas by the few natives who live there. The much steeper upper part of the mountain is totally intact.

It rained during most of the time that we took to get to the top with our local guide Antonio (one of the cocoa growers). During the astonishing walk I could appreciate some marvelous specimens of *Prestoea montana* and *Calyptronoma plumeriana*, the latter with a huge mass of cherry-red roots coming out of the base of the trunk because of the high humidity.

After almost four hours we arrived at the edge and when the thick fog allowed me to give a close look, I realized that the top of the flat-topped El Yunque was not flat at all; it is a mix of very dangerous sculptured sharp coral rock, covered by fascinating bromeliads and surrounded by mist and vertical cliffs. It is almost impossible to get around there without time and experience.

The *Coccothrinax* was right there, at the end of the path, in front of the metal plaque left by

an expedition of geographers in 1978, maybe the same one that brought the new *Coccothrinax* to the light of formal knowledge. It was smiling in the mist, loaded with bromeliads and with its silvery leaves and its creamy blooms. The plants, almost saxicolous, were growing on the most exposed outcrops of coral rock, where just such very specialized plants could thrive. At 500 m of elevation, the top of El Yunque could host a tall cloud forest like the one with *Prestoea* found slightly below, but the rock, calcareous and porous, retains very little moisture and the wind limits the height of the forest. The frequent rains and the usual fog encourage development of a curious vegetation, and a difficult walk of less than a 100 meters allowed me to enjoy an intriguing flora, which ranges from creeping *Selenicereus* sp. through a lot of colorful bromeliads and tillandsias to orchids and *Melastomataceae*.

The day spent in El Yunque was one of the least fruitful for my expedition. All the plants were happily blooming, but none of them offered a seed to my avid hands. I could anyway bring back lots of good pictures and good memories and some dried samples, now stored in the Herbarium of the University of La Laguna (TFC), Canary Islands, which showed a much smaller leaf size (see Table 1 footnote), similar to that of *C. salvatoris*.

Also Borhidi, who collected the holotype on November 26th 1978, could not get any seed as the Latin description of the *C. yunquensis* ends with the eloquent sentence "Fructus maturus non visus." As far as I know there are no cultivated specimens of this "poorly known" palm and growing *C. yunquensis* and *C. salvatoris* side by side could ultimately reveal if the characters that make the two descriptions different are a mere result of environmental influence or something that comes from DNA.

If a man shares 98% of its genes with a chimpanzee, then I suppose that a *C. yunquensis* will share 99.99999% of its genes with the *C. salvatoris*. I hope that the need of palm collectors to have that minimal percentage of DNA in their gardens, will not threaten those slender "yuraguanos" (Cuban name for small *Coccothrinax*). I wrote this article to spread the knowledge of what is left of the once extended Caribbean rain forests, not to create a demand for a new "palm product."

The story of *C. yunquensis* could be that of any number of other palms that come from the top, the base, or a particular slope of a particular mountain and have been described as endemics

Table 1. Differences in taxonomic characters of C. yunquensis *Borhidi et Muñiz and* C. salvatoris *Leòn and comparison with data obtained from my* C. yunquensis *material collected in August 1995.**

	C. salvatoris	*C. yunquensis*	*"My" yunquensis* CMR#2.20
Central leaflets	30–40 cm long and 6 cm wide	40–50 cm long and up to 4.5 cm wide	26–28 cm long and 3.9–4.5 cm wide†
Glanduliform spots on the underside of the leaf	big and pale	small and dark, opaque	small and dark: 0.05–0.1 mm in diameter
Sheath fibers	4–9 mm wide	3–4 mm wide	3.5 mm wide
Tips of free sheath fibers	obtuse	acute	acute
Partial inflorescences	bigger	shorter	—
Flower pedicels	well-developed 1–2.5 mm long	up to 1 mm long–almost subsessile fls.	0.6 to 1 mm (almost subsessile fls.)
Stamens	7–9	6–7	6–7
Filaments	connate up to half	fused until the bottom, forming a dome	fused until the bottom

* Data of *C. salvatoris* and *C. yunquensis* are from the works of Borhidi and Muñiz (1981 and 1982) "My *yunquensis*" has my field No. CMR #2.20 at the Herbarium of Universidad de La Laguna (TFC).

† The leaves collected by me in 1995 are much smaller than those of Borhidi in 1978. Leaf size in palms may vary due to age or to the rain received during leaf development. Was it due to an exceptionally dry 1994 or to a very humid 1978? The smaller size of "my" leaves would put *C. yunquensis* one step closer to *C. salvatoris*.

but afterwards cancelled as synonyms, buried, and labelled on their tombs as "poorly known."

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CHAPTER NEWS AND EVENTS (*Continued from p. 203*)

Southern California Chapter Meetings

The Southern California Chapter of the IPS met on September 21 at Ventura College, Ventura. The day began with a sale by the Friends of the Ventura College Palm Garden at the growing area. There are about 400 palms representing 200 species growing on the Ventura College campus. The meeting featured tours of Pauleen Sullivan's Baylor Avenue apartments (after the sale) and of her home and personal garden (after the meeting). Pauleen's Baylor apartments are easily recognizable by the *Roystonea* and *Veitchia* in the driveway. An educational program with a panel of palm experts answering preselected questions took place in the open area next to Guthrie Hall on the west side of the campus.

The November 16 meeting will begin at noon at the Topanga Canyon (Malibu area) estate of Leland Lai and will feature the fourth annual Concoction Auction. Leland has aggressively planted palms for the past three years, including the relocation of the principal portion of the Dick Palmer collection from Pasadena. Leland will give a brief presentation explaining how he developed the collection, advocating the therapeutic value of plants, landscaping, and a garden from his own perspective.

Townsville Palm & Cycad Symposium

A Palm & Cycad Symposium will be held in Townsville, Queensland, Australia, on October 11–13. This event is jointly organized by the Palm & Cycad Societies of Australia (PACSOA), the North Queensland Palm Society (NQPS), and The Friends of the Palmetum. It will be held at Tumbetin Lodge, The Palmetum; Douglas; and at Brothers Leagues Club, Hervey's Range Road, Thuringowa.

The program will feature lectures by international palm and cycad specialists, tours of The Palmetum and selected private palm and cycad gardens, and the Annual Palmetum Plant Sale. Associated social events include an afternoon tea Saturday afternoon, a banquet and lecture by Don Hodel on Saturday night, and a BBQ at Lorraine and Frank Tooth's residence on Sunday, followed by additional lectures by Michael Ferrero and Don Hodel. Other lecturers include Dr. Roy Osborne, David Jones, and John Dowe.

Late registration is A$85 per person including all above events. Registration inquiries should be addressed to Joe Schmidt [61-(077)-891578], general inquiries to Lorraine Tooth [61-(018)-771470], and Townsville accommodation inquiries to Jill Whaley [61-(077)-745866] or Kerry Robertson [61-(077)-251350.

More News from the North Queensland Palm Society

The North Queensland Palm Society met on June 3 for a presentation on Tassel Ferns by Owen Rawlins—covering propagation through to the end result. There were a number of plants available for sale.

The Queen's Birthday Weekend Palm celebration was held on June 8–9. This included a number of visitors from Cairns, Mackay, and Rockhampton. The events began on Saturday with an afternoon visit to the home and garden of Jessie Roberts in Kirwan. Many nice palms, ferns, and cycads

(*Continued on p. 211*)

1. The flat-topped mountain, El Yunque, Cuba, with its cloud cap. 2. Cloud forest at the summit of El Yunque, habitat of *Coccothrinax yunquensis*. 3. *Coccothrinax yunquensis* growing in the mist. 4. Specimen of *Coccothrinax yunquensis* ready for the plant press. 5. Inflorescence of *Coccothrinax yunquensis*.

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Facilitation of Hurricane Recovery in Miami

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Major tropical storms can leave a path of destruction in their wake from which the vegetative recovery can be extremely difficult or even impossible. We relearned this lesson in Miami three years ago as we watched our cherished collections attempt to withstand the force of Hurricane Andrew, a Category IV wind of destruction. Wind gusts of over 150 miles per hour (240 km/hr) can destroy even hurricane-resistant trees such as royal palms, coconut palms, and live oaks, let alone the more fragile specimens that provide daily pleasure to their owners.

I would like to report on one badly damaged private garden in Miami, and its remarkable recovery. I have had the extreme good fortune over the past 20 years, as I followed a career as an agricultural extension agent, and as a grower of palms and cycads from around the world, to be able to observe plant growth under all forms of care and culture in this subtropical environment. My work as well as my abiding interest in and love of plants has helped educate me in virtually all aspects of plant health, care, well-being, as well as disease, and neglect. During the course of the six years that I have observed the garden of Dr. D. Michael Bitz, I have always been impressed with its good management; however, over the last two years I have seen a phenomenal improvement in all of his plants. While less damaged gardens have struggled to regain their former allure, this garden with the benefit of the use of a new biological catalyst has clearly surpassed its previous stature.

The soils of South Florida are calcareous and unfortunately provide plants with little to no native nutrition and, even worse, have minimal ability to hold nutrients. Although this garden is large for a private urban garden, space restraints and horticultural enthusiasm have necessitated very dense plantings with large palms planted in clusters spaced no greater than 3–5 feet. To achieve optimal results, this garden had availed itself of 3–5 tons of organic turkey manure for fertilization prior to the last two years. During the last two years, however, major changes in their standard cultural practices have occurred. Using monthly foliant sprayings of Ecosane, an enzymic activated stabilized biologic catalyst, they have progressively decreased their fertilization practices to the point that there has been no ground application for over nine months. Ecosane is at the forefront of biologic plant growth stimulants designed to enhance the populations of microorganisms within the plants' environment whose byproducts directly benefit the plant. The enzymic action provides increased bioavailability of nutrients to the plant. This further enhances the plants' tolerance to normal stresses such as varied watering, temperature fluctuations, and soil pH.

In this garden, hundreds of species of plants have been treated with universally positive effects, and in no case has a deleterious result been observed. Ecosane has undergone extensive laboratory testing and was found not to be toxic, even having been used on water plants without any adverse effects on sensitive tropical fish.

While the growth rates of plants in the ground have exceeded those in containers, comparison of containerized plants is dramatic. Seedlings grown by this author from the same accessions and grown in identical media and conditions as those of this garden but without application of Ecosane have consistently shown a growth rate of half of those grown with Ecosane. The plant growth in the ground has been nothing less than remarkable. In less than two years, caryotas with a height of five feet have grown to greater than 35 feet with a diameter of 35 inches at six feet in height. Arengas have also matured to 24 to 35 feet in height from five feet in less than three years with vetchias showing a 4–5 fold increase in mass over a two and a half year period. Over the same time period,

1–4. Commercial nursery results. Substantial increased growth rates were noted in multiple types of plants. The following figures show randomly selected plants from hundreds of treated and untreated plants. The test period was 7 weeks with foliar sprays of Ecosane every two weeks. 1. *Cycas* (top left). 2. Calamondin (top right). 3. *Spathiphyllum* (bottom left). 4. Majesty palm (bottom right).

Syagrus species have progressed from five feet to over 25 ft in height with an average girth of three feet six inches at six feet. *Wodyetia* palms planted a year previously have grown from four to 18 rings in the year; in fact four additional rings have occurred in the last six weeks since work on this paper began. Peach palms have grown from six feet to 40 feet in two and a half years. Two *Normanbya* have doubled in size within a year. *Corypha* palms have shown the equivalent of 15 years of growth in less than two and a half years. *Ptychosperma* species are maturing to seed in less than two years. As a general rule, 3–5 years of growth are achieved in one year, with an apparent cumulative effect with continued usage.

While cycads have shown similar growth acceleration, they have also demonstrated markedly increased blooming. *Encephalartos manikensis* has grown from three feet to nine feet in leaf height in approximately 14 months. Many cycas species have grown from 2–3 feet leaf height to 3–4 feet of wood and a leaf height of 6–14 feet in 2–3 years. A colony of *Encephalartos ferox* has grown from three feet to almost six feet within the last two years. These plants are now showing the second set of blooms within an eight-month time period.

Similar effects have been seen with flowering trees, aroids, tropical bamboo, tropical fruits, and succulents. Not only has there been an increase in growth rate, but the health and vigor of individual plants has improved, consistent with a gen-

5. Cold tolerance. The areca palms in the above photo shown in a commercial nursery of hundreds of areca palms grown side by side under identical conditions, except half of the plants had been treated with Ecosane and half had not. Following a temperature drop to 35°F a uniform finding of greater cold tolerance was noted in the treated palms.

eral enhancement of the plants' ability to utilize available nutrition. In-depth examination of both containerized and planted specimens shows consistently increased root masses, measurably thicker leaves, and improved waxiness with a much darker green coloration. As an additional indicator of increased robustness in the treated plants markedly greater numbers of inflorescenses have been noted, with more blooms and greater seed production. Many plants a third of the age normally needed for bloom production are noted to be producing fertile seed; indeed, seeds have been produced on palms and flowering trees that have not previously been seen to produce in this environment.

The results seen in the tropical and semitropical materials are consistent with that seen in agronomic crops. Testing in crops as diverse as sugarcane, corn, cucurbits, tomatoes, watermelon, beans, and tobacco has demostrated improvements ranging from 20 to 50%. Early testing on tree crops such as citrus and mangoes has demonstrated substantial benefits. The use of Ecosane on this garden was a "side interest." The driving focus of its development was to enhance the ability of the farmer to deal with the changing face of agriculture, in particular the stresses of less fertilizer usage, and less usage of insecticides and pesticides.

Following the hurricane and the massive recovery efforts it soon became apparent that this garden was recovering better than others and with time the differences have become more and more obvious. During this period of repair, we were first impressed with the rapid growth of the new plants from seedlings to young stock; however, further observation has revealed a far greater than normal capacity of the existing traumatized plants to not only survive the insult of Hurricane Andrew but also to continue to grow and flourish.

The multiple cold spells that visited South Florida this winter have revealed another significant difference in this garden. While the cold weather has caused damage to both native and imported

flora, the plants in this garden have shown minimal damage and have continued their growth. This was also seen in a nursery study of over a thousand plants. (Figs. 1–4).

In an attempt to understand all that I was seeing, an in-depth evaluation of all variables has caused me to conclude that Ecosane has played the major role in benefitting this garden. In summary, the following characteristics have been noted with the use of Ecosane: increased growth rates; increased root mass; increased leaf size; increased production shown by greater numbers of seeds, larger seeds, more flowers produced per inflorescence, more inflorescences, more frequent flowering, increased fruit production; minimal plant disease (including sooty mold, anthracnose, and leaf miner); minimal pest damage without chemical applications; rapid recovery from transplant shock; and increased cold tolerance (Fig. 5).

Ecosane represents a new concept that will allow people to enjoy a mature garden in a shortened time period.

CHAPTER NEWS AND EVENTS (*Continued from p. 206*)

were features—including a *Wodyetia* in seed! The evening meal was held at Brothers Leagues Club.

Sunday morning began with a series of lectures at the Tooth's residence. Included were the Department of Environment and Heritage Code of Practices—taking and use of protected Australian plants (do's and don'ts of buying and selling, collection, permits, etc.). Michael Ten Lohuis also spoke on the "Genetic Engineering" of plants. The day ended with a BBQ at Peter and Kerry Robertson's home in Mount Louisa. Numerous plants were available for sale from Marissa White of Rare Exotic Palms, Cycads and Plants and from Jill Goetze.

News from Southern Queensland Branch, PACSOA

The Southern Queensland Group (SQG) of PACSOA met on June 16 at Stan and Jane Walkley's place in Burpengary, north of Brisbane. A tremendous number of palms and cycads were viewed by all. The group met again on July 15 at United Church, New Farm.

The SQ Group also met on September 2 at Uniting Church in New Farm to hear Ken Hill, who spoke on the new cycads from Southeast Asia. A giant foxtail palm, *Wodyetia bifurcata*, purchased by the SQG was in the raffle, along with many other palms and cycads donated by members. The neighboring groups, Gold Coast-Tweed and Sunshine Coast branches, were also invited by the SQG to this presentation.

The IPS would like to congratulate Cheryl Basic of the Southern Queensland Group, who was recently elected President of PACSOA and, separately, Vice President of the International Palm Society.

News from the Sunshine Coast Branch

Readers are advised that the local branch president, Leo Gamble, has produced a nice presentation on "Palms for the Sunshine Coast" on the internet. To view this document, go to URL: http://www.future.net.au/aasunzine/palms.htm and check it out.

The Sunshine Coast met on June 3 for a talk by Roy Osborne on "Sex, Species and Cycads." The Branch also met on August 5 in Nambour. The theme for the meeting was propagation of palms and cycads from seeds, with palm seeds being the raffle prize.

News from Gold Coast Tweed Branch, PACSOA

The Gold Coast Tweed Palm and Cycad Society of Australia held an outing on June 9 to The Channon in northern New South Wales. The group also met on August 25 at the home of Jennifer and Warwick Laurie in Mudgeeraba. The local branch newsletter has been featuring various palm articles gathered from the many currently available on the World Wide Web of the internet.

News from the Sydney Chapter

The Sydney Branch met on July 16 and featured Ken Hill's presentation on the 1996 Cycad Conference in China. Ken is Senior Botanist, Royal Botanic Gardens of Sydney.

The November issue of *Principes Minor* plans to feature the genus *Pritchardia*. Please send contributions to Peter Kristensen in Gymea Bay.

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Two New Species of Chamaedorea from Costa Rica

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Since publication of a monograph of *Chamaedorea* (Hodel 1992a) and additional new species (Hodel 1992b, 1995, Hodel et al. 1995), field work in Costa Rica has enabled me to name and describe two additional species.

Chamaedorea coralliformis Hodel **sp. nov.** (Figs. 1–3).

Subgeneris *Stephanostachydis* Klotzsch, floribus masculis contiguis. *C. allenii* L. H. Bailey affinis sed fructibus aurantiacis echinulatis coralliformibus differt. Typus: Costa Rica, Puntarenas, *Hodel & Binder 1345* (Holotypus BH; isotypus CR).

Solitary, erect, to 3 m tall (Fig. 1). Stem 1–1.5 cm diam., green, ringed, internodes to 10 cm long. Leaves 5, spreading, pinnate, occasionally simple; sheath to 20 cm long, becoming obliquely long-open and splitting deeply opposite the petiole, tubular only near base, arranged ± in a triangular fashion, longitudinally striate with heavy raised yellowish (in life) costa extending from abaxial surface of petiole; petiole to 30 cm long, flat or slightly grooved adaxially, rounded and yellow-banded abaxially; rachis to 30 cm long, angled adaxially, rounded abaxially; up to 6 pinnae per side, lower middle longest, these to 25 × 4 cm, thin-papery, falcate, slightly sigmoid, acuminate, 5–10 prominently nerved, terminal pinnae 13 × 7 cm, 13–15 nerved, basal pinnae 20 × 3 cm. Inflorescences 3–4, inter- or infrafoliar in flower (Fig. 2), infrafoliar in fruit, spicate, spreading; pistillate to 45 cm long, curved; peduncle to 38 cm long, 1 cm wide at base, 3 mm diam. at apex, swollen and orange in fruit in life; rachis or flower-bearing portion 8 cm long; bracts 4–5, prophyll attached 5 mm above base, 5 cm long, bifid, acute, 2nd bract attached 1.5 cm above base, 12 cm long, 3rd attached 5.5 cm above base, 30 cm long, 4th attached 12.5 cm above base, 22 cm long, bracts 2–4 obliquely open, acute, all thin-papery, longitudinally nerved; staminate inflorescence still enclosed in bracts, peduncle 9 cm long; rachis or flower-bearing portion 21 cm long, probably pendulous; bracts as in pistillate, prophyll 5 cm long, 2nd bract 12 cm long, 3rd 26 cm long, 4th 23 cm long. Staminate flowers in bud in dense spirals, angled from mutual pressure, 1.5 × 1 mm, oblong, flat-topped, cream-colored (*Hammel 18606*), leaving superficial elliptic scars 2 × 0.8 mm; calyx a high thin membranous sheathing tube nearly as tall as petals, sepal tips triangular, inflexed over petals, sepals connate to ⅝ their height; petals valvate, thin, tips triangular; stamens 1.25 mm high, anthers 1 mm long, oblong, bilobed, filaments 0.75 mm long, dorsifixed in middle; pistillode 1.5 mm tall, just exceeding stamens; pistillate flowers contiguous or nearly so, leaving superficial oval scars 1.5 × 1 mm; calyx cupular, 0.75 mm high, sepals imbricate nearly to apex, truncate; petals imbricate, thickened, and expanded in fruit, 3–4 × 3–4 mm; style short or lacking, stigma lobes trifid, recurved, pointed. Fruits 9–10 × 5 mm, ± obovoid but corn-kernel-shaped and angled from mutual pressure, greenish changing to orange when soft ripe (Fig. 3), aging black; epicarp in apical region densely and sharply wrinkled, giving surface a nearly spiny appearance and texture.

Distribution: COSTA RICA. Puntarenas. San José. Wet forest and cloud forest of the Río General and Río Cotón basins; 1 700–2 300 m elevation.

Specimens Examined: COSTA RICA. Puntarenas: Las Alturas de Cotón *Hodel & Binder 1345* (holotype BH; isotype CR), *1345A* (BH, CR); *Binder s. n.* (USJ); Río Coto Brus near Cotón, *Croat 26665* (MO). San José: Cantón de Pérez Zeledón *Hammel & Hammel 18529* (MO); *Hammel 18606* (MO); *Tomlinson s. n.* (BH).

The epithet is from the Latin *coralliformis*, meaning corallike, and refers to the fruits. *Chamaedorea coralliformis* is very close to *C. allenii* from Panamá and Colombia. The latter species

1. Adult plant of *Chamaedorea coralliformis, Hodel & Binder 1345* (holotype), cloud forest, Las Alturas de Cotón, Puntarenas, Costa Rica. 2. Newly emerging staminate inflorescences of *Chamaedorea coralliformis, Hodel & Binder 1345A*, cloud forest, Las Alturas de Cotón, Puntarenas, Costa Rica. 3. Nearly mature fruits of *Chamaedorea coralliformis, Hodel & Binder 1345* (holotype). Note spiny, corallike nature.

differs in its black fruits with a rough rather than spinylike surface and bright yellow staminate flowers. The rough fruit surface in *C. allenii* is due to minute, solitary, cone-shape protuberances while the spinylike fruit surface of *C. coralliformis* results from series of dense, sharp, ridgelike wrinkles. In the key to subgenus *Stephanostachys* (Hodel 1992a, p. 234), *C. coralliformis* would key out next to *C. allenii* and *C. crucensis*. Differences of the former were discussed above. The latter differs in its smooth, black fruits and staminate sepals free nearly to the base.

4. Adult plant of *Chamaedorea binderi, Hodel & Binder 1340* (holotype), moist rain forest, Fila Las Cruces, Putarenas, Costa Rica. 5. Old staminate inflorescence of *Chamaedorea binderi, Hodel & Binder 1339*, moist rain forest, Fila Las Cruces, Puntarenas, Costa Rica. 6. Pistillate flowers and fruits of *Chamaedorea binderi, Hodel & Binder 1340* (holotype).

Chamaedorea binderi Hodel **sp. nov.** (Figs. 4–6).

Subgeneris *Chamaedoropsi* Oerst. inflorescentiis masculis solitariis, floribus masculis solitariis petalis patentibus apicaliter pertinens. *C. brachycladae* H. Wendl. affinis sed habitu, foliis et inflorescentiis minoribus, pinnis paucioribus minoribus flavivirentibus recitis, inflorescentia feminea reclusiori, rachillis gracilioribus distantibus, fructibus majoribus differt. Typus: Costa Rica, Puntarenas, *Hodel & Binder 1340* (Holotypus BH, isotypus CR).

Solitary, erect, to 50 cm tall (Fig. 4). Stem short, nearly lacking, subterranean or buried in leaf litter, prominently ringed, nodes congested, internodes 3–5 mm long. Leaves 3–4, ascending, pinnate; sheath 8 cm long, obliquely open apically, splitting deeply opposite petiole, tubular near base, longitudinally striate; petiole 15 cm long, grooved adaxially, rounded and green abaxially; rachis 28 cm long, angled adaxially, rounded abaxially; pinnae 20 per side, to 9 × 1.5 cm, decreasing progressively toward apex and there 4.5 × 0.8 cm, basal pinnae 6 × 0.8 cm, all pinnae straight, acuminate to long-acuminate, lower margin decurrent on rachis, midrib and 2 submarginal nerves conspicuous adaxially but only midrib whitish, others green, abaxially 5-nerved, midrib and 2 submarginals whitish, 1 nerve each between midrib and submarginal green to whitish. Inflorescences arising from base, long-pedunculate, arcuate; staminate inflorescence with peduncle (Fig. 5) 28 cm long; bracts 8, prophyll 5 mm long, 2nd bract 1 cm long, 3rd 2 cm long, 4th and 5th 5 cm long, 6th–8th 7 cm long, thin-papery, longitudinally nerved, lower 6 bifid, acute, upper 2 acuminate; rachis 5 cm long, 4 mm diam., narrowing toward tip; up to 60 rachillae, to 5 cm long, slender, filiform, undulate apically, diverging from rachis at right angles; pistillate inflorescence (Fig. 6) similar to staminate, peduncle 18 cm long; bracts as in staminate but smaller; rachis 8 cm long, 1–2 mm diam., slender; up to 30 rachillae, to 5 cm long, slender, filiform, diverging from rachis at right angles. Staminate flowers not seen; pistillate flowers (Fig. 6) remote, scattered, 4–6 mm distant, 2 × 1.5 mm, superficial; calyx cupular, 0.5–0.75 mm high, membranous, sepals connate nearly to apex, acute; petals 2 × 2 mm, imbricate nearly to apex, acute; pistil 1.9 × 1 mm, ovary ovoid, style exserted 0.5 mm above ovary, slender, stigma lobes long, slender, pointed, only slightly recurved; staminodes conspicuous, toothlike. Fruits 6–8 mm diam., globose, black (Fig. 6). Eophyll pinnate.

Distribution: COSTA RICA. Puntarenas. San José. Moist to wet forest on the Pacific slope, 1 140–1 900 m elevation.

Specimens Examined: COSTA RICA. Puntarenas: Fila Las Cruces, *Hodel & Binder 1339* (BH, CR), *1340* (holotype BH; isotype CR); *Maas & McAlpin 1387* (U); Jardín Botánico Robert y Catherine Wilson, ridge west of Río Jaba, *Grayum 9280* (MO). San José: Fila Aguabuena, Candelaria, *Chavarria et al. 107* (CR).

The epithet honors Mark Binder of Los Angeles, California, who brought this species to my attention, assisted in collecting the type, and did exemplary work with the palm collection, chamaedoreas in particular, at the Jardín Botánico Robert y Catherine Wilson. *Chamaedorea binderi* is very close to *C. brachyclada* with which it has been confused. *C. brachyclada* differs in its much larger (2–4 times as large) habit, leaves, and inflorescences, more numerous, larger, dark green, conspicuously falcate pinnae, more compact pistillate inflorescence with more numerous and thicker, close-set rachillae, and smaller fruits. The two species grow sympatrically in forest remants not too far from the Jardín Botánico Robert y Catherine Wilson near San Vito in southeastern Costa Rica. That there are no intermediate forms lends credence to their validity as distinct species. *C. binderi*, along with *C. brachyclada*, *C. stenocarpa*, *C. scheryi*, *C. undulatifolia*, and *C. pygmaea*, belongs to a natural subgroup of species characterized by its essentially stemless habit, pinnate leaves with lower margins decurrent on the rachis, and long-pedunculate inflorescences arising from the base (Hodel and Uhl 1990).

In the key to subgenus *Chamaedoropsis* (Hodel 1992a, p. 124), *Chamaedorea binderi* would key out next to *C. brachyclada* and *C. stenocarpa*. Differences of the former were discussed above. The latter differs in its spicate or forked pistillate inflorescence.

Acknowledgments

Barry Hammel and Michael Grayum of the Missouri Botanical Garden provided information about palms and localities in Costa Rica. Gerardo Herrera and Mark Binder were admirable companions in the field and instrumental in helping to track down palms quickly. The Southern California Chapter of the International Palm Society, the

Friends of the Virginia Robinson Garden, and the late Richard Palmer provided support for my field work in Costa Rica.

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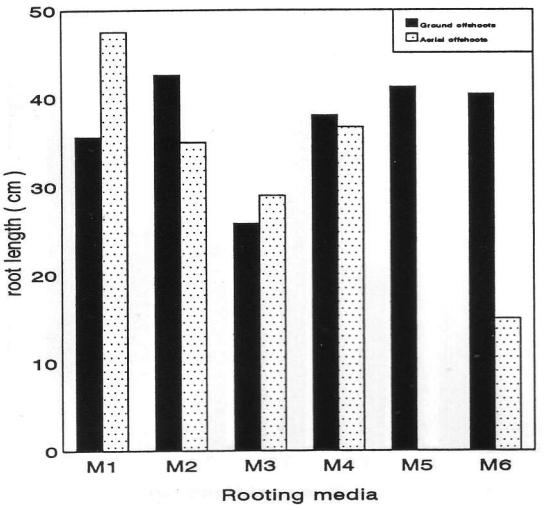
(*Continued from p. 181*)



4. Effect of rooting media on length of longest root of "Shish" date palm cultivar ground and aerial offshoots (M1 = Woodshavings; M2 = Woodshavings : Peat Moss [3:1]; M3 = Woodshavings : Peat Moss [1:1]; M4 = Perlite : Peat Moss [3:1]; M5 = Perlite : Peat Moss [1:1]; M6 = Sand).

The greatest root length was achieved in the control and the 50 ppm catechol treatments (Fig. 9). It was also found that the largest fresh root weight was obtained in the control and the NAA + 50 ppm catechol treatments (Fig. 10).

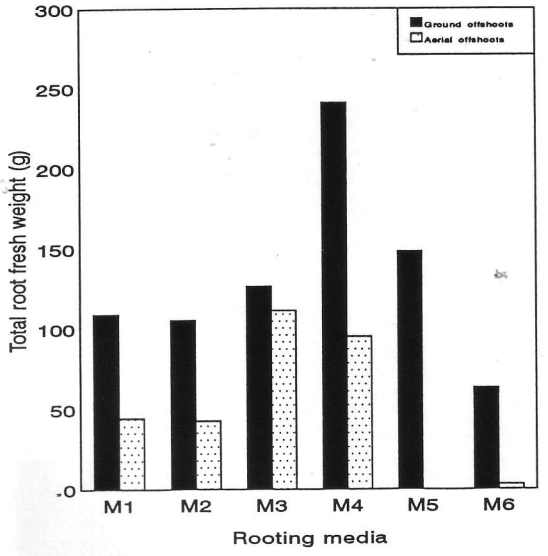
When the ratio of the weight of the small root diameter: total roots weight was considered, it became evident that the NAA + 50 ppm catechol treatment was the best followed by the 25 ppm catechol treatment (Fig. 11).

Aerial Offshoots. Data showed that the highest rooting percentage was achieved in the NAA treatment. This was followed by those offshoots treated with NAA + 50 ppm catechol. The rooting percentage of the catechol treated offshoots was either equal (in the 25 ppm) or lower (in the 50 ppm) than the control (Fig. 8).

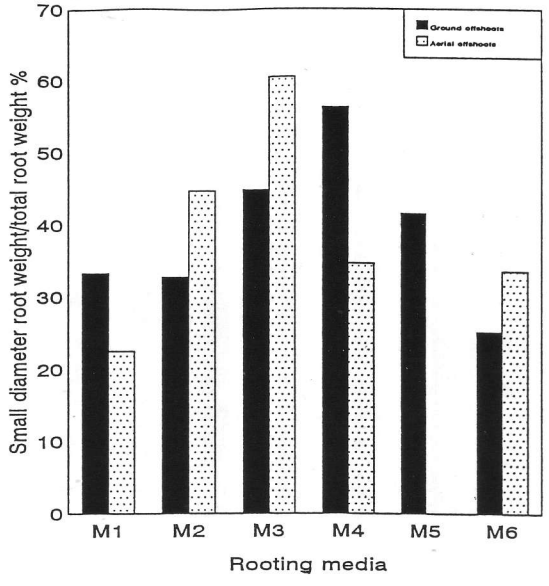
Longest roots were obtained in the 25 ppm and 50 ppm catechol treatments. On the other hand, shortest roots were obtained in the control (Fig. 9).

Total fresh weight of the newly formed adventitious roots was greatest in the NAA treatment, followed by the 50 ppm catechol and the NAA + 25 ppm catechol treatments in decreasing order. The lowest root fresh weight was obtained in the untreated offshoots (Fig. 10).

Highest small-diameter root percentages were obtained in the 50 ppm catechol and NAA + 25 ppm catechol treatments in an increasing order. Lower values were obtained in the control, NAA

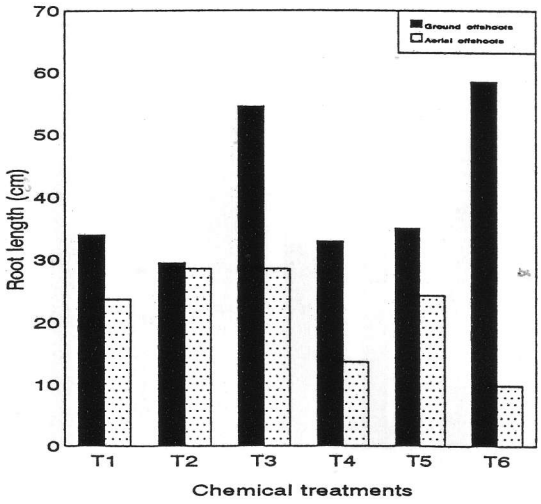


5. Effect of rooting media on total root fresh weight of "Shish" date palm cultivar ground and aerial offshoots (M1 = Woodshavings; M2 = Woodshavings : Peat Moss [3:1]; M3 = Woodshavings : Peat Moss [1:1]; M4 = Perlite : Peat Moss [3:1]; M5 = Perlite : Peat Moss [1:1]; M6 = Sand).



6. Effect of rooting media on small diameter root weight/total root weight of "Shish" date palm cultivar ground aerial offshoots (M1 = Woodshavings; M2 = Woodshavings : Peat Moss [3:1]; M3 = Woodshavings : Peat Moss [1:1]; M4 = Perlite : Peat Moss [3:1]; M5 = Perlite : Peat Moss [1:1]; M6 = Sand).

7. Comparison between root development of "Shish date palm aerial offshoots in sand or Perlite : Peat moss (3:1) media.

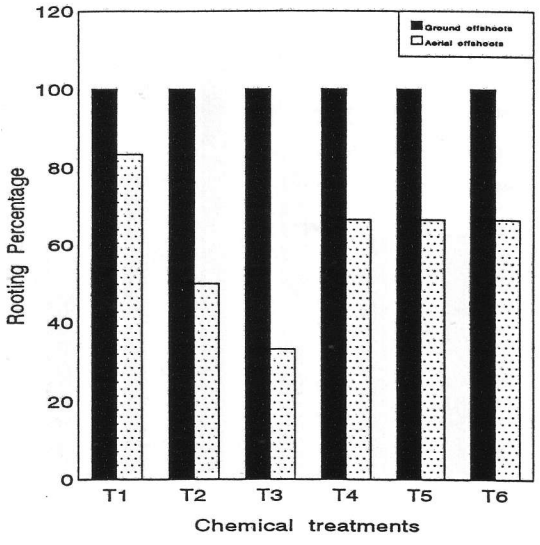


9. Effect NAA and/or catechol treatments on length of longest root of "Shahl" date palm cultivar ground and aerial offshoots (T1 = NAA; T2 = 25 ppm catechol; T3 = 50 ppm catechol; T4 = NAA + 25 ppm catechol; T5 = NAA + 50 ppm catechol; T6 = control).

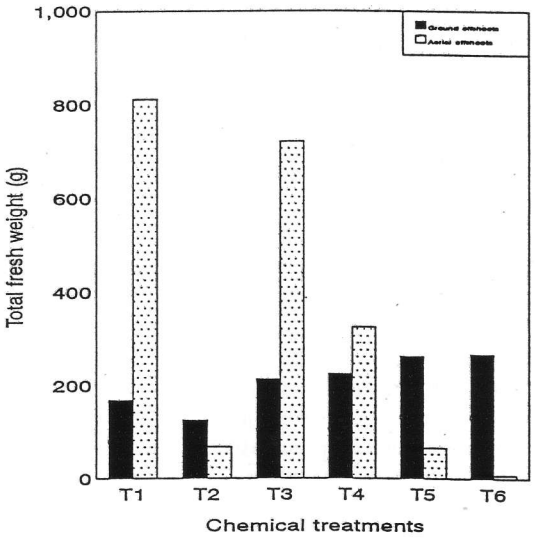
+ 50 ppm, or NAA + 25 ppm catechol treatments (Fig. 11).

Discussion

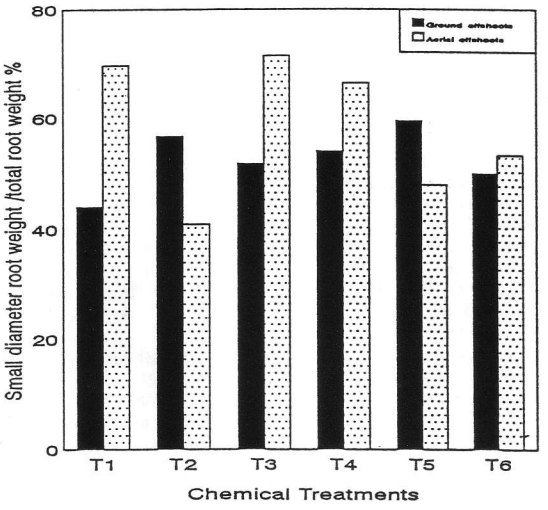
Rooting medium is an important factor in determining the extent of adventitious root formation



8. Effect of NAA and/or catechol treatments on rooting percentage of "Shahl" date palm cultivar ground and aerial offshoots (T1 = NAA; T2 = 25 ppm catechol; T3 = 50 ppm catechol; T4 = NAA + 25 ppm catechol; T5 = NAA + 50 ppm catechol; T6 = control).



10. Effect NAA and/or catechol treatments on root total fresh weight of "Shahl" date palm cultivar ground and aerial offshoots (T1 = NAA; T2 = 25 ppm catechol; T3 = 50 ppm catechol; T4 = NAA + 25 ppm catechol; T5 = NAA + 50 ppm catechol; T6 = control).



11. Effect NAA and/or catechol treatments on small root percentage of "Shahl" date palm cultivar ground and aerial offshoots (T1 = NAA; T2 = 25 ppm catechol; T3 = 50 ppm catechol; T4 = NAA + 25 ppm catechol; T5 = NAA + 50 pmm catechol; T6 = control).

in many plant species (Hartmann et al. 1990). This was shown to be also true for root formation and development in date palm offshoots. The sand medium was found to be inferior to other media mixtures evaluated in this study.

It is expected that as the small-diameter roots form a high percentage of the total formed roots, the absorption capacity of the root system will increase (El-Hamady et al. 1992). Thus, a greater small-diameter root percentage is expected to increase offshoot survival chances. The highest percentages were obtained in the perlite : peat moss (3:1) followed by the woodshaving : peat moss (1:1) and perlite : peat moss (1:1), and the lowest in the sand medium. As a rooting medium sand is inferior to the other ones studied. Both rooting percentage as well as all studied root characters were inferior in the sand medium. Total fresh root weight in the sand medium was rather low so that continued survival was doubtful.

A small rooting percentage was increased over the control by use of NAA and/or catechol, which might give some support for application of such a treatment.

On the other hand, NAA and/or catechol treatments appeared to be essential for good root development on aerial offshoots. However, no synergistic effect was evident in this respect as indicated for other plant species (Hess 1968, James et al. 1980, Jones and Hopgood 1979, James and Thurbon 1981). Auxin treatments were reported to be effective in inducing root formation on aerial offshoots whereas IBA treatment was found to be effective in increasing rooting of high offshoots (Gupta and Godara 1984), which is in agreement with the results of this study. However, other workers did not find such an effect (Reuveni et al. 1972).

The following conclusions could be obtained from this study : (1) The use of rooting media other than sand is recommended since it improved the rooting percentage in aerial offshoots. Moreover, root quality in both ground and aerial offshoots was also better when the other studied media were used. (2) Treating aerial offshoots with NAA and/or catechol seems to be required for attaining good rooting. Thus, these treatments might be recommended.

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Coccothrinax yunquensis on El Yunque, a limestone mountain in southeastern Cuba. See pp. 204–207.