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THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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PRINCIPES

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Principes, 41(1), 1997, p. 3

Editorial

We introduce 1997 with articles that are international in origin and wide-ranging in scope. The oil palm, the date palm, and the coconut are considered the major cultigens in the palm family. Two of them are featured in this issue. Many years of extensive breeding have led to the need for a broadened genetic base for the oil palm in Malaysia. O. Rohani and colleagues discuss methods for germinating seeds designated for the oil palm germplasm collection in Malaysia. Since the needed seeds are gathered in different countries and must undergo long quarantine periods, efficient methods of germination are critical.

Another article by Michael Otier discusses the production of dates in the United Arab Emirates. This union is modernizing and expanding the propagation and cultivation of *Phoenix dactylifera* and may become a global center for date production. A fascinating part of the article are the comments on the many varieties and uses of dates and their cultivation, which has been relatively unchanged for centuries, in the Al-Ain oasis. A different sort of study on the date palm is given by M. E. Mohamed who reports abnormal patterns in a particular cultivar, suggesting that it would be a valuable subject for developmental investigations.

Palms dominate the landscape in the Dominican Republic and their multiple uses there are discussed and beautifully portrayed by Oscar Horst. Palm use in the Old World is also represented by a discussion of the economically important rattans of Central Sulawesi. This carefully done study offers hope that villagers can manage harvesting on public lands, although the issues related to conservation are complex indeed.

Anyone planting palms must consider the susceptibility of desired species to lethal yellowing. F. W. Howard and N. A. Harrison provide us with an example of a field test as shown by two species of *Veitchia* in Florida. Also of interest to growers is a contribution by M. Daquinta and collaborators on a method of vegetative reproduction in *Rhapis excelsa*.

The Royal Botanic Gardens in the attractive city of Melbourne, the state capital of Victoria, Australia is celebrating its 150th anniversary. The garden is not well known and Mark Wuschke has provided an introduction to its climate, history, great lawns, lakes, and rainforest. Some 40 species of palms can be seen; among other attractions there is a formally named "Palm Lawn."

As we prepared this issue the mail brought a copy of *Palms: Their Conservation and Sustained Utilization*, an elegant publication, the result of more than a decade of work by 30 palm specialists around the globe. In a special contribution for *Principes*, the editor, Dennis Johnson, explains this plan and how we should use it.

You'll find many news items about the varied activities of our farflung chapters.

We conclude by wishing a Happy New Year to all members.

NATALIE W. UHL
JOHN DRANSFIELD

Principes, 41(1), 1997, pp. 3–4

Note from the President

Greetings and Happy New Year! I had the privilege this past August of being elected as your new President. I wish to thank all of you for this honor. As many of you may not know me personally, I would first like to tell you a little about myself. I have been in the I.P.S. for about 20 years and am a previous President of the Southern California Chapter. I have been on the Board of Directors for over six years and have previously served as your Vice President. I am an emergency physician in San Diego, California, and have a family with three children. I have also operated a palm and cycad nursery since 1977.

I am a great supporter of the International Palm Society and am particularly proud of its efforts to

expand as an international group. This has probably been one of the most exciting things about the I.P.S. Every time I get a new *Membership Roster,* I love to check on new Members from around the world. We presently number over 3,000 member subscribers from 85 countries around the world! My goal is that we expand in this area and form even more Chapters worldwide.

However, continued growth and expansion mean that Members must receive what they need and want from our group. It is my job to see that all members receive value from their dues, as well as enjoyment. In the past few years we have made tremendous efforts to make *Principes* more interesting, both in terms of content and larger color format. The addition of more interior color photographs has been part of this effort. We have attempted to add more horticultural and travel-related articles, while maintaining the position of *Principes* in the scientific community. This requires your participation. Please feel free to submit articles to the Editor on your palm experiences, observations, or travels. You will find that there is satisfaction in having your articles published and you, in fact, may be the "expert," especially where growing and horticulture are discussed.

You have recently received an updated IPS *Membership Roster.* This publication is a necessity when you travel or want to communicate with palm friends throughout the world. The comprehensive *Index to Principes* will soon be forthcoming as well. For those studying a particular subject or species, this will prove invaluable. For newer Members we offer back issues of *Principes* for sale so that you can do your studying or research from home. You will find that articles in *Principes* typically give far more information on species than one can find in available texts. On occasion such articles were made possible by grants directly from our Endowment Fund. Our Bookstore offers to members publications that are often not available elsewhere. Another new service is our presence on the Internet. This offers quick, diverse information on palms and an inexpensive way to communicate with others about topics of concern or questions.

One of the best aspects of values from your membership is your simultaneous membership in an Affiliated Chapter of the I.P.S. We actively recruit and aid in the formation of local Chapters and Affiliates. These Chapters help you expand your palm knowledge and make new friends with shared interests. In my local Chapter, we hold meetings six times a year. They are great fun and I strongly suggest that you invite your friends to your local Chapter meetings. You may wish to join Chapters in other parts of the world. For anyone wishing to form a new Affiliated Chapter, please feel free to contact me.

I do want to keep the communication lines fully open between you and any of us on the Board of Directors. I want to know what you feel are needed and wanted. My personal phone number, fax number, and Email address are listed on the inside cover of this journal. Together we can continue to create a group that is enjoyable, satisfying, and rewarding. Thank you for your participation and support.

PHIL BERGMAN
President, IPS

Principes, 41(1), 1997, p. 4

Palms of the Amazon

A tour, by river boat, from Manaus in Brazil up the Rio Negro to see the rich palm flora of the central Amazon region (including *Barcella, Manicaria, Leopoldinia, Mauritia, Mauritiella, Euterpe, Bactris, Desmoncus, Geonoma, Astrocaryum, Attalea, Syagrus, Hyospathe, Socratea, Iriartella,* and *Oenocarpus*). Dates: 4–15 August 1997. Leader: Dr. Andrew Henderson. For more information contact the Institute of Systematic Botany, New York Botanical Garden, at 718 817 8628.

Principes, 41(1), 1997, pp. 5–11

Seed Characteristics of African Accessions of Oil Palm (*Elaeis guineensis*)

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ABSTRACT

The germination percentage of shell-less *pisifera* and thin-shelled *tenera* seeds is extremely low. Recently oil palm seeds were collected in Tanzania, Senegal, Sierra Leone, Gambia, and Guinea to broaden the genetic base. The *pisifera* seeds were germinated in vitro while the *tenera seeds* were germinated using both in vitro and in vivo methods. Current study shows that it was possible to establish more accessions from Gambia, Guinea, and Senegal using the in vitro method. In the case of the Sierra Leone collections, more accessions were established by the in vivo method.

The Malaysian Agricultural and Development Institute (MARDI) initiated its first oil palm (*Elaeis guineensis* Jacq.) germplasm collection in 1973 (Rajanaidu and Rao 1987). Since 1979 these responsibilities have been carried out by the Palm Oil Research Institute of Malaysia (PORIM). These collections are essential to the oil palm industry to broaden the genetic base of current breeding materials, which had eroded through years of extensive breeding and selections (Rajanaidu 1985*a*, 1987) and also for germplasm conservation (Hardon 1985). Now, PORIM has the world's largest oil palm germplasm repository involving about 400 ha of land planted with 60,000 seedlings from Africa and Latin America. The oil palm plantations will benefit from these collections when new genes are incorporated into existing breeding materials (Rosenquist et al. 1988, Rajanaidu and Rao 1987). Other oil palm genotypes with desirable traits such as short trunk or high unsaturation oil were also collected (Rajanaidu 1985*b*, Rajanaidu et al. 1989). Some exotic palm species such as *Bactris gasipaes* (Pejibaye), *Oenocarpus* spp. and others with potential economic value were also included in the collections (Rajanaidu et al. 1991).

A review of practical applications of embryo culture technique was made by Raghavan (1977). One of the applications is the culture of zygotic embryos to rescue them from hybrid genetic crosses (Mott 1984, Dunwell 1986). Yuri (1987) used embryo culture to propagate wine palm, which normally germinates poorly by the conventional method. This technique has also been applied to overcome poor germination of *pisifera* seeds and stored seeds (Rohani and Paranjothy 1985, Paranjothy et al. 1989). Sterile conditions have also been used to store *pisifera* kernels; germination (%) after 60 days of storage was still high (Nwankwo and Kirkorian 1983). The embryo culture method involves removing the embryos from the surrounding endosperm tissue and culturing them on agar nutrient media supplemented with growth substances either in the absence (Jones and Dethan 1973) or presence (Rohani and Paranjothy 1985) of activated charcoal, or on a basal nutrient medium devoid of growth substances but solidified with Gelrite (Paranjothy et al. 1989). Embryo rescue technique is now being used routinely to germinate seed germplasms in vitro. This method was also used to germinate mantled fruits in vitro to study the meiotic transmission of abnormal characteristics in oil palm (Paranjothy et al. 1993).

In mid 1993 and early 1994, PORIM officers carried out an expedition to collect *tenera* and *pisifera* germplasm in Africa. A major proportion of the germplasm seeds was germinated in vivo using the method described by Hartley (1988) and about 20 seeds per accession were subjected to embryo culture. This paper describes the preparation of the African seed materials before and after they were dispatched to Malaysia, germination using in vitro and in vivo methods, and seed characteristics. Comparison between the two methods for

establishing plant collections from seed is discussed.

Materials and Methods

Seed Collection. Tenera fruits were collected from Gambia, Guinea, Senegal, and Sierra Leone. Approximately 64,000 seeds were collected from 266 accessions. The fruits were depericarped at the collecting centers to remove the nuts. The nuts were washed, dried, and packed before they were transported to the International Mycological Institute, Surrey, London, UK, for quarantine. After one to three months the seeds were dispatched to the Malaysian Phytosanitary Department (MPD) for further quarantine and inspection against pests and diseases (Rajanaidu 1994). Only 'clean' seed consignments were released to PORIM. Of 266 accessions, 260 were finally released by the Phytosanitary Department. The Senegal and Gambian seeds were prospected in July 1993 and Guinean and Sierra Leone in April/May 1994. The embryos were cultured in September 1994, 14 months after collection of the Senegal and Gambian seed, and five months after collection of the Guinean and Sierra Leone seed.

Shell-less *pisifera* fruits were collected in Sierra Leone and Tanzania in May and July 1994, respectively. Since they could not be stored for long periods special arrangement had been made to dispatch this fruit form to Malaysia in the shortest time possible. *Pisifera* fruits were manually dehusked and the kernels obtained were treated with fungicide. They were dispatched to the MPD for further inspection before they were released to PORIM. Embryo culture was carried out after two weeks of storage.

Seed Germination by the Embryo Culture Method. The basal medium was made up of MS (Murashige and Skoog 1962) macro- and micronutrients, Y3 vitamins (Eeuwens 1976), 0.1 g/L inositol, 0.1 g/L glutamine, 0.1 g/L arginine, 0.1 g/L asparagine, and 3% sucrose. The medium was solidified by adding 0.15% Gelrite. The pH of the medium was adjusted to 5.7. Ten ml of medium were dispensed into 25 × 150 ml tubes. The media were autoclaved at 121°C for 15 minutes.

Seedlings attaining a shoot height of ≥3 cm were transferred to 10 ml of rooting medium containing 6% sucrose, 5–9 × 10^{-5} M α-naphthalene-acetic acid, and 0.15% activated charcoal.

The cultures were incubated in the light room with a photoperiod of 12 hours and the room temperature was maintained at 28° ± 1°C (Paranjothy et al. 1989).

Kernel Preparation. Tenera seeds were placed in clear plastic bags and the shells were broken with a hammer. The kernels were picked out with a pair of clean forceps and placed in 250-ml conical flasks, one accession per flask. Partially broken kernels were also utilized as long as the operculum remained intact and the embryo was not damaged or exposed. On reaching PORIM (10 days after collection), *pisifera* seeds were further dehusked and the kernel surfaces were scraped clean with a scalpel blade. The kernels were washed several times with distilled water before transferring them to petri dishes lined with filter paper to absorb excess water and were then air-dried overnight. The drying was necessary because the residual oil in the mesocarp tissues and the exposed oily endosperm surfaces made the kernels slippery and difficult to hold during embryo excision.

Surface Sterilization. All sterile manipulations were carried out in the laminar air flow cabinets. The surgical instruments, glassware, water and 4 × 8 cm polypropylene sheets were sterilized before use. The sterile petri dishes (25 × 150 mm) were all lined with two layers of sterile filter paper.

The kernels were transferred to sterile conical flasks and immersed in water completely. The flasks were shaken manually for one to two minutes before decanting the water into another container for disposal. The washing was repeated seven times and 0.05% Tween 20 was added to the last washing. This was followed by washing twice with 0.1% of mercuric chloride ($HgCl_2$) and 0.05% Tween 20 solution for 5 minutes each. The kernels were then rinsed with water five times at two minute intervals, followed by soaking in water for 10 minutes with occasional shaking. The above rinsing steps were repeated. After decanting the water, the kernels were transferred to sterile petri dishes.

Embryo Cultures. The opercular membrane was flipped open with the tip of a blade to expose the embryo base. The germ end was turned downwards and with a soft tapping on the kernel with a scalpel or spatula the embryo slipped free onto the polypropylene sheet. Sometimes, a small excision on the endospermic tissues was needed to help free the embryo. The embryos were lifted individually with a warm, sterile spatula or a pair of forceps and transferred to a culture tubes. Only uninfected and undamaged embryos were used. After eight weeks of culture, the number of embryos

Table 1. Establishment of seedlings derived from in vitro *and* in vivo *germination methods.*

			In vitro				*In vivo*			
No.	Germplasm regions	Seed+ type	No. of seeds/ accession	Total no. embryos cultured	Total no. established	% established	No. of seeds/ accession	Total no. sown	No. germinated	% germinated
1.	Tanzania	P	19–125	81	9	11.1	—	—	—	—
2.	Sierra Leone	P	60	34	7	20.6	—	—	—	—
3.	Gambia	T	17–21	644	301	46.7	10–390*	14415	14	0.1
4.	Guinea	T	8–11	574	177	30.8	77–286	13183	974	7.4
5.	Senegal	T	19-40**	1788	836	46.8	130–442	27178	586	2.2
6.	Sierra Leone	T	9–11	497	93	18.7	87–362	9319	1572	16.9
	Total			3618	1407	38.9		60095	3146	5.2

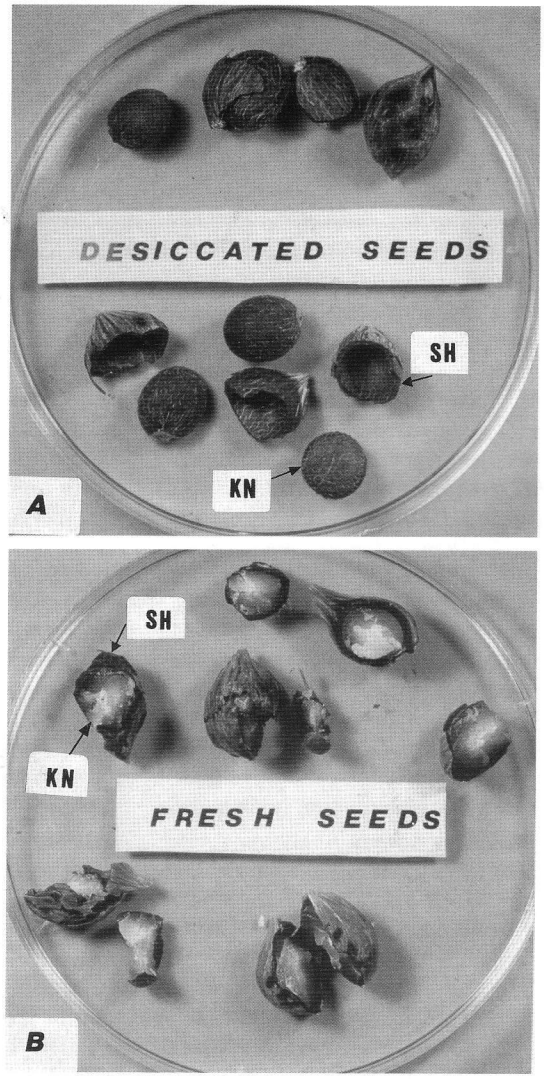
+ P = *pisifera*, T = *tenera*.
* Eight accessions with ≤30 seeds.
** One accession with 40 seeds, others 19–21 seeds per accession.

developing into a shoot or both a shoot and a root was determined as the germination success.

Establishment of Seedlings in Soil. Seedlings with well-developed root systems were transferred to 10 × 17.5 cm perforated polybags containing sand and soil mixtures (1:1). They were hardened in outside enclosures with 80% shade and watered daily (Fig. 1).

Seed Germination by the Conventional Method. Conventional seed germination was carried out at PORIM Research Station, Kluang. The seeds were incubated in the heating chamber at 40°C for 60 days followed by soaking the seeds in water for 4–5 days. After soaking, the seeds were placed in plastic bags and incubated at the ambient temperature for 10 days. The number of seeds producing both plumule and radical were scored to determine germination percentage.

1. Four-month-old germplasm seedlings in prenursery.

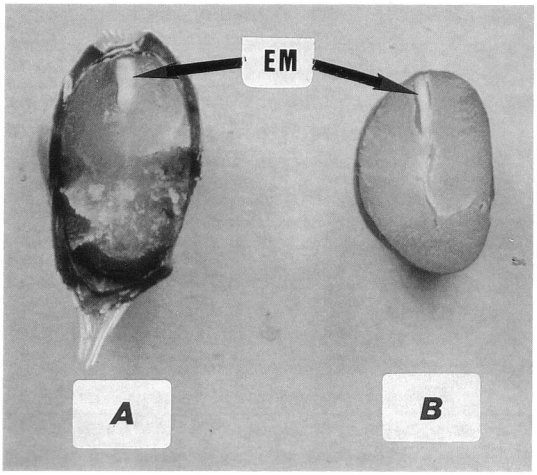


2. (A) Desiccated seeds—the shells (SH) broken to release whole kernels (KN). (B) Fresh seeds—the shells (SH) broken together with the kernels (KN).

Disposal of Materials. Shell remnants, infected seeds and embryos, and those damaged from severe desiccation were autoclaved for 45 minutes before they were discarded.

Observations and Discussion

Tenera seeds were received, fully dehusked with shells intact. About 60,000 germplasm seeds were germinated in vivo and approximately 3,600 seeds were germinated using the in vitro method (Table 1). Stored seeds were normally slightly desiccated and it was easier to break the shells compared to fresh seeds (Fig. 2). It was also observed that embryos in desiccated seeds shrank slightly (Fig. 3), and this made it easier for them to slide through the opercular opening by tapping the kernel gently with a spatula. Severely desiccated embryos were very brittle and broke easily; thus, they were never cultured.



3. Longitudinal sections of (A) fresh seed and (B) stored seed (desiccated). The embryos (EM) in the desiccated seed shrank slightly.

Shell-less *pisifera* seeds are more vulnerable to desiccation and to bacterial and fungal infections (Nwankwo and Krikorian 1983, Hartley 1988). Therefore, they are seldom stored, but are cultured soon after they are harvested.

Seed Characteristics. Pisifera seeds are known to have limited viability (Paranjothy et al. 1989) and this contributes to poor germination in vivo compared to *duras* or *teneras.* A large number of the seeds are parthenocarpic (embryo-less). Table 2 shows that parthenocarpy occurred in $\geq$33% of *pisifera* seeds and in $<$2% of *tenera* seeds. Previous study showed that the percentage parthenocarpy of 10 P $\times$ P crosses varied from 4 to 97% (Rohani and Paranjothy 1985). This study also showed that a high fertility rate did not always guarantee a high rate of germination. Besides parthenocarpy, seed dormancy could also cause poor germination.

Another characteristic observed was multiple kernels, i.e., having more than one kernel per seed. In these collections the percentage of multiple kernels in *tenera* seeds ranged from 2.8 to 4.9 (Table 2). Not all accessions had multiple ker-

Table 2. Observation on seeds of different fruit forms from different germplasm regions.

No.	Germplasm regions	Seed* type	Total seed examined	Multiple kernels		Parthenocarpic		Infected	
				No.	%	No.	%	No.	%
1.	Tanzania	P	324	0	0	219	67.6	7	2.2
2.	Sierra Leone	P	60	0	0	20	33.3	4	6.7
3.	Gambia	T	716	35	4.9	12	1.7	96	13.4
4.	Guinea	T	600	22	3.7	3	0.5	44	7.3
5.	Senegal	T	2027	79	3.9	26	1.3	291	14.4
6.	Sierra Leone	T	539	15	2.8	2	0.4	57	10.6
	Total		4266	151	3.5	282	6.6	499	11.7

* P = *pisifera*; T = *tenera*.

nels. Table 3 shows that about 36% (highest) of Guinean accessions have multiple kernels and 13% (lowest) in Sierra Leone's. At least one Sierra Leone accession and three from Senegal had multiple kernels in >41% of the fruits. Three Gambian and two Guinean accessions had multiple kernels in 21–40% of the fruits. Generally <20% of fruits had multiple kernels per accession. It is common to obtain multiple kernels in some seed types such as *duras* or *teneras* (Corley and Gray 1976, Hartley 1988). Multiple kernels in *pisifera* have not been observed to date, although a number of P × P seeds were examined in the past.

Comparison Between in Vitro and in Vivo Germination Techniques. Compared to conventional seed germination techniques, the embryo excision and rescue technique is both labor intensive and requires special skills. The conventional method can handle several thousand seeds at a cheaper cost and seeds germinate in a short time. Seedlings derived from embryo cultures require rooting, transplanting, and hardening in a prenursery, all of which takes about seven months, while in vivo germination requires about three months.

In dealing with valuable genetic seeds, it is of utmost importance to ensure the survival of some of the accessions. Since germplasm seeds have undergone prolonged storage during transit, it is impossible to predict their success rate. There are several factors that could affect the germination success of the seeds in vivo. These are moisture content, temperature (Hussey 1958, 1959, Hartley 1988), and storage duration. Thus, germination by other methods may be necessary to serve as a back-up in case of poor germination using the conventional germination method. This is well demonstrated in Gambian seeds (Table 1) where only 0.1% of a total of 10415 seeds using in vivo methods established successfully compared to a higher rate using the embryo rescue technique (46.7% of a total of 644 seeds).

The establishment of seedlings from each accession in the collection is crucial. Each accession represents seed materials obtained from palms growing in different climatic and soil conditions. Table 4 indicates that the embryo rescue method produced a higher (%) of successful accessions than the conventional method with the exception of Sierra Leone. Although the germination of seed embryos of Sierra Leone in vitro and in vivo was identical (17–19%, Table 1), the in vivo method was better for salvaging accessions (93%) than the in vitro method (65%, Table 4). Embryos that did not germinate in vitro either pro-

Table 3. Tenera *accessions with multiple kernels from various germplasm regions.*

No.	Germplasm regions	No. of accessions					
		Total	With multiple kernels	%	Fruits with multiple kernels		
					≤20%	21–40%	≥41%
1.	Gambia	60	11	18	8	3	0
2.	Guinea	36	13	36	11	2	0
3.	Senegal	100	29	29	26	0	3
4.	Sierra Leone	54	7	13	6	0	1

Table 4. Establishment of tenera *accessions by* in vitro *and* in vivo *methods.*

No.	Germplasm regions	*In vitro*			*In vivo*		
		Total no. of accessions	Successful accessions		Total no. of accessions	No. of Successful accessions	
			No.	%		No.	%
1.	Gambia	36	35	97	44**	3	7
2.	Guinea	60	52	87	60	44	73
3.	Senegal	102*	98	98	102	47	46
4.	Sierra Leone	54	35	65	54	50	93
	Total	252	220	87	260	144	55

* Two accessions were 100% contaminated and therefore were not cultured.
** The number of seeds from eight accessions were ≤30, therefore they were not supplied to the tissue culture laboratory.

duced haustoria only, which later became necrotic, or remained dormant. The dormant embryos did not show any evidence of infection even after keeping the cultures for about eight weeks.

Conclusions

Of the two methods used to germinate stored germplasm seeds, the embryo rescue technique, in general, maintains a higher percentage of successful accessions than the in vivo method. The in vitro technique is also useful to germinate shell-less *pisifera* seeds, which normally germinate poorly in vivo. The in vitro method does not require a large number of samples but does require specially trained skills. Because all the seeds are examined before embryo excision the in vitro technique can identify some causes of poor germination in vivo, such as parthenocarpy, bacterial and fungal infection, and damaged embryos. The success of the in vitro method demonstrates the value of this technique as a complementary approach to in vivo germination for the establishment of oil palm germplasm collections.

Acknowledgments

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Fellowships and Internships Announced by the Smithsonian

The Smithsonian Institution has announced its programs for research in 1997. In Biological Sciences, some of the fields covered include evolutionary biology, natural history, systematics, and tropical biology. For applications and/or information, write: Smithsonian Institution, Office of Fellowships and Grants, 955 L'Enfant Plaza, Suite 7000, Washington, D.C. 20560, or e-mail: siofg@sivm.si.edu.

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The International Palm Society provides an entire suite of InterNet services for members who have a computer, a modem, and a link to the InterNet. It appears that a large segment of IPS membership now has some access to the InterNet with this segment growing all the time.

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Principes, 41(1), 1997, pp. 12–14

Susceptibility of Palms to Lethal Yellowing: Two Species of Veitchia

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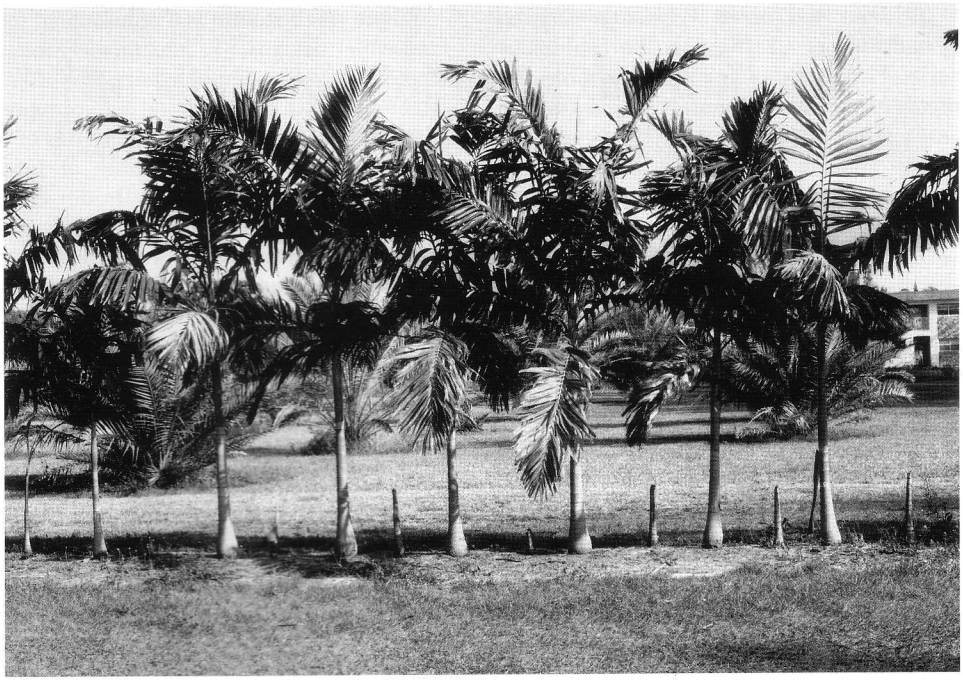
ABSTRACT

Approaches to determining the resistance of palm species and varieties to lethal yellowing (LY) disease are discussed. The field test approach is illustrated with an example: the results of a field test in Florida to compare the susceptibility to lethal yellowing (LY) of two species of *Veitchia* palms were that 91.9% of *V. merrillii* (Beccari) H. E. Moore and 19.3% of *V. montgomeryana* H. E. Moore contracted LY. Thus, *V. merrillii* is apparently highly susceptible and *V. montgomeryana* moderately susceptible to LY.

In southern Florida and areas of the Caribbean Region affected by lethal yellowing (LY), the landscape can be protected from the devastating effects of this disease by planting only disease-resistant palms. However, it is difficult to obtain information on resistance and susceptibility of palms to LY. The traditional method of screening for resistance is to plant palms where the disease is present with the idea that they will eventually be exposed to it; that is, that insect vectors carrying the pathogen will feed on the palms. If the palms are susceptible, an infection will develop; if resistant, the palms will not develop the disease. Of course, the experimenters have little or no control over parameters such as the number of infected palms in the area, the population levels of insect vectors, the percentage of inoculative vectors capable of infecting palms, their feeding rate, etc. A minimum of 20 palms is considered by some researchers to be necessary to adequately test a species. Of course, palm species of known susceptibility should be included in the test for comparison. Thus, field testing for LY resistance requires large experimental plots, and is usually a lengthy process, perhaps taking years to obtain results. Resistant varieties of coconut (*Cocos nucifera* L.), notably the 'Malayan dwarf' varieties and the 'Maypan' hybrid, were discovered by field testing in Jamaica (Harries 1973).

Testing young palm seedlings by intense exposure to LY-infected insect vectors would seem to be a way of expediting determinations of relative resistance levels. The feasibility of such a method was demonstrated (Howard et al. 1984), but was found to be highly labor-intensive and with unpredictable results, again because there is no method of controlling parameters such as those mentioned above.

What we know about the resistance or susceptibility of palm species other than coconut is based mostly on observations of survivorship of palms in areas affected by LY, especially in Florida, where a relatively high diversity of ornamental palms is present. To obtain such information, two approaches were used: (1) Estimates of the degree of susceptibility of 386 species of palms were derived from observations in Fairchild Tropical Garden during the LY epidemic that started in the early 1970s (Howard et al. 1979). (2) The palm species known to be susceptible to LY were rated as highly, moderately, or slightly susceptible according to a consensus of several LY researchers who had made observations throughout the LY-affected area of Florida. Palm species that were ubiquitous in the region and had never been known to contract LY were considered highly resistant (Howard and Barrant 1989). The advantage of the first approach was that a large number of species were included in the observations. However, the considerable variability in the numbers of individuals representing different species, planting densities, amount of shade, ages, heights, and other factors, would have affected the susceptibility of different species and thus compromised these estimates. The second approach had the advantage that it concentrated on the popular species, thus the large numbers of individuals of each species included in the observations would have somewhat compensated for their variability in age and other factors.



1. Experimental planting of *Veitchia merrillii* alternating in the same row with *V. montgomeryana*. Most *V. montgomeryana* survived, while most *V. merrillii* died and only the stumps are visible in the photograph.

To obtain more precise data on resistance/susceptibility of palms, field trials of popular and promising species are being conducted at the Fort Lauderdale Research & Education Center. The present is a report of results of a field trial of two species of *Veitchia*.

Methods

The palms were grown from seed from two local sources. Seeds of *V. merrillii* (Beccari) H. E. Moore were obtained from the Baxter Gentry Estate on Sugarloaf Key. The source of seeds of the second species was a palm in Fort Lauderdale, which Dr. Scott Zona of Fairchild Tropical Garden identified as *Veitchia montgomeryana* H. E. Moore from material that we mailed him. The palms were grown in containers for two years and then planted in the field in 1992 at the Fort Lauderdale Research & Education Center, with the two species alternating in a single row. Forty of each of these species were planted, but after losses the first year due to "transplanting failure" there were 37 *V. merrillii* and 36 *V. montgomeryana* remaining. The planting was adjacent to a large planting of coconut palms and other susceptible palms. Lethal yellowing had been present in this planting during most of the 1980s, had disappeared after 1989, and began to infect palms again in early 1993.

The palms were examined several times per week for disease symptoms. Leaf samples were taken from symptomatic palms and assessed for infection by the LY pathogen. For this purpose, deoxyribonucleic acids (DNA) were extracted from each sample and tested by the polymerase chain reaction (PCR) using a pair of oligoprimers that selectively amplify DNA of the LY pathogen only (Harrison et al. 1994). Unequivocal detection of the pathogen in leaf samples from all symptomatic palms was achieved by this means, thereby confirming earlier tentative diagnoses of LY in these palms on the basis of symptoms.

The experiment was terminated in April 1996, at which time considerable numbers of one species had died from LY and no new cases had appeared in this planting for more than a year.

Results

The first cases of LY in the experimental planting were in June 1993. As of January 1996, 34 *V.*

merrillii (91.9%) and seven *V. montgomeryana* (19.3%) had died of LY (Fig. 1). We could thus characterize *V. merrillii* as highly susceptible and *V. montgomeryana* as moderately susceptible to LY. These ratings agree with those based on Meerow's (1992) general observations. Susceptibility rates of these same species would probably vary under different conditions. Also, within species there is normally some variability in any trait, including disease resistance. However, both species of *Veitchia* can be assumed to be represented in Florida by narrow gene pools. Given the wide difference in their susceptibility in our experiment, we would expect *V. merrillii* to be the more susceptible of these two species, regardless of the seed source in Florida or the conditions under which the palms are grown.

In spite of its well-known high susceptibility to LY, *V. merrillii* is still widely grown as an ornamental in southern Florida. It is attractive and its small stature at maturity makes it compatible with many landscaping schemes. Because it is relatively inexpensive and fast-growing, palms lost to LY can be easily replaced. However, we recommend against planting this palm in areas that are affected or threatened by LY, because all available evidence indicates that the rate of spread of LY increases with the density of susceptible palms in the area. In other words, large numbers of susceptible palms encourage epiphytotics.

The susceptibility of *V. montgomeryana* should not discourage a limited use of this palm in special plantings, e.g., botanical collections. About 80% of the palms of this species survived in our trial planting. The parent palm from which the seeds of this species were obtained is one of two palms about 18 years old and 10 m tall in 1996 that survived in an area of Fort Lauderdale that has been affected by LY since the 1970s.

Where small stature is a requirement for certain landscape designs, *V. montgomeryana*, with a "typical height" more than twice that of *V. merrillii* (Meerow 1992) would not be an appropriate substitute for it. The ornamental qualities of *V. montgomeryana* are more like those of *Carpentaria acuminata* (H. Wendland & Drude) Beccari and to a lesser extent *Archontophoenix alexandrae* (F. Mueller) H. Wendland & Drude. Both of the latter species have been grown widely in southern Florida and no cases of LY have been reported in either species.

Acknowledgments

We thank Jim DeFilippis for technical assistance and Drs. Timothy Broschat and Alan Meerow for reviewing the manuscript. Thanks also to Mr. Baxter Gentry for providing seeds of *V. merrillii* and Dr. Scott Zona for identifying *V. montgomeryana*. This is Florida Agricultural Experiment Station Journal Series No. R-05112.

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The Utility of Palms in the Cultural Landscape of the Dominican Republic

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No other order of plant life [palms] contributes so much to the tropical landscape or finds so many uses among tropical peoples.
O. F. Cook, 1939

One cannot journey across the landscape of the Dominican Republic without developing an awareness of the widespread presence of palms. This observation has been similarly noted in past centuries by travelers making their way across the unchartered interior of this island nation (Hazard 1873). Literally scores of hills and low ranges, streams and arroyos, shoreline features, and small settlements and towns bear the names of local palms giving further testimony to their widespread presence. In spite of the dominance of palms on the landscape, however, the casual observer is not likely to be aware of the variety of ways in which they contribute to the livelihood and enter into the vernacular of native inhabitants.

Some years ago, I was given the responsibility of preparing a field guide entitled, "Exploration of the Dominican Landscape." Given the dominance of palms in the Dominican countryside, it was considered appropriate that a section in the field guide be devoted to the utility of palms. Beginning in 1987, I undertook a number of field reconnaissances for the purpose of fulfilling that objective. These surveys provided a wealth of information on the various ways in which palms are used by Dominicans.

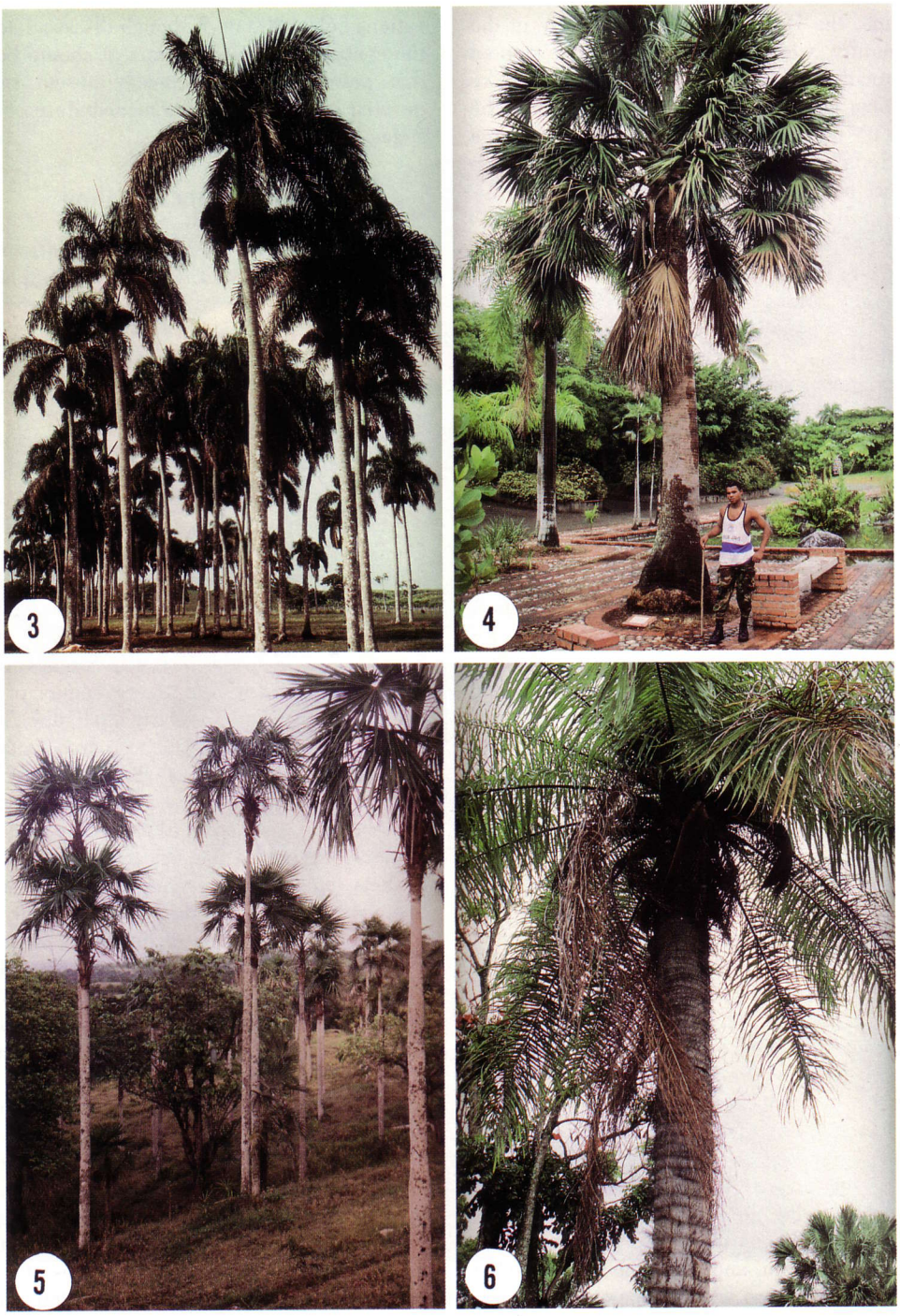
It was found that palms are widely used in the construction of houses, in fencing and landscaping, and in the crafting of a wide range of woven products intended for domestic use and the tourist trade. Although it was known that the coconut and African oil palms, both introduced from the Old World, were cultivated as sources of food, the extent to which endemic species served as sources of food and animal feed was unexpected. Neither was the role of palms in the processing of agricultural commodities fully appreciated.

The image of grace and beauty imparted by palms has enhanced their utility in less material ways. Coconut palms that follow the Atlantic and Caribbean shorelines of the Dominican Republic convey visions of a tropical paradise (Fig. 1). This has contributed significantly to the attractiveness of shoreline resorts. The esteem with which the stately native royal palm is regarded by Dominicans is revealed in its appearance as a national symbol. The fronds of the royal palm appear on the coat of arms of the nation as well as on those of a number of its provinces and the national university. The tree and/or its fronds are impressed upon Dominican coins and postage (Fig. 2). In 1930, the royal palm was selected as the symbol of the Partido Dominicano founded by the long-term dictator, Rafael Leonidas Trujillo. As an aside, numerous Dominican *dichos* (sayings) incorporating words and phrases drawn from palms or their products are commonplace.

Common Palms of Utility

In terms of utility, the more common of the native palms in the Dominican Republic are (1) the royal palm (*Roystonea boringuena*), which is known as the *palma real, palma de yaguas,* or most commonly simply as *palma* (Fig. 3); (2) the sabal palms (*Sabal domingensis* and *Sabal causiarum*), referred to as *palma cana* or *cana* (Zona 1990) (Fig. 4) and (3) the silver thatch (*Coccothrinax argentea*) and (*Thrinax* spp.), which are called *guano, guanito,* or *guano de escoba* (Fig. 5). Less commonly utilized native palms are the *cacheo* (*Pseudophoenix vinifera*), the *yarey* (*Copernicia berteroana*), the *guanito* (*Coccothrinax spissa*) (Fig. 7), *palma manacla* or *manacla* (*Prestoea montana*), and *corozo* (*Acrocomia aculeata Bailey*) (Fig. 6). The coconut palm (*Cocos nucifera*) and African oil palm (*Elaeis guineensis*), of Old World origin, are known respectively as *cocotero* or *coco* and *palma Africana.* The former was intro-

1. A roadside sign in the northern Dominican tourist resort of Sosua, advertising available lodging—"You are now entering the world of palms." (March 6, 1992). 2. Palms on Dominican stamps—as a party symbol, on the national coat of arms, on stamps featuring tourism.



3. Grove of royal palms (*Roystonea boringuena*) in a pasture 19 km east of Higüey. (June 24, 1994). 4. Sabal palm (*Sabal domingensis* Becc.) in the Jardín Botánico Nacional "Dr. Rafael M. Moscosco," Santo Domingo. (June 29, 1994). 5. Silver thatch palm (*Coccothrinax argentata*), known as "guano," "guanito," or "guano de escoba," growing on rolling terrain near El Guanal, 3 km west of Santiago Rodríguez. (Sept. 19, 1991). 6. The corozo palm (*Acrocomia aculeata*) in the Jardín Botánico Nacional "Dr. Rafael M. Moscosco," Santo Domingo. (June 29, 1994).

duced into the Dominican Republic early in the 16th century, while the latter has been planted commercially only within recent decades. Unlike the coconut palm, which is widely distributed, the African oil palm is largely restricted to two large plantations in the oriente of the Dominican Republic (near Bayaguana and at El Valle, to the south of Sabana de la Mar).

The royal, the sabal, and the silver thatch palms may grow to heights in excess of 60 feet (Fig. 9). Whereas the trunks of the royal and sabal palms may acquire diameters in excess of one and one-half feet, the silver thatch rarely exceeds a basal diameter of six inches. The heights and diameters of the trunks of the coconut and African oil palms approximate that of the royal and sabal palms. The coconut palm, unlike the columnar upright trunks of the royal, sabal, silver thatch, and African oil palms, is commonly characterized by a gracefully curving trunk (Fig. 8).

The distribution of palms is largely dictated by physical considerations. The more important palms of utility tend to require sites endowed with better soils and a readier supply of moisture. Consequently, these species occur with less frequency in the Dominican west and southwest, regions in which thinner soils and greater aridity predominate.

The coconut, royal, and sabal palms may frequently be encountered growing in common association; however, the coconut palm is more likely to be planted within proximity of the coast, particularly along the Atlantic shorelines of northeastern Dominican Republic. Royal palms are said to generally require deeper soils and a greater availability of moisture than the sabal palm (Bennett and Allison 1928). Whereas they note that sabal palms in Cuba prevail in regions of limestone soils, Uhl and Dransfield (1987) cite that the sabal palm is commonly found in regions where parent material consists of highly ultrabasic rocks such as serpentines. In the Dominican Republic, it appears that the sabal palm may be found thriving in regions with either type of parent material. The silver thatch palm tends to be found in more sterile, rocky terrain, and along the faces of relict sea cliffs. At only two widely separated sites was it found to be growing in association with royal and sabal palms (Fig. 9).

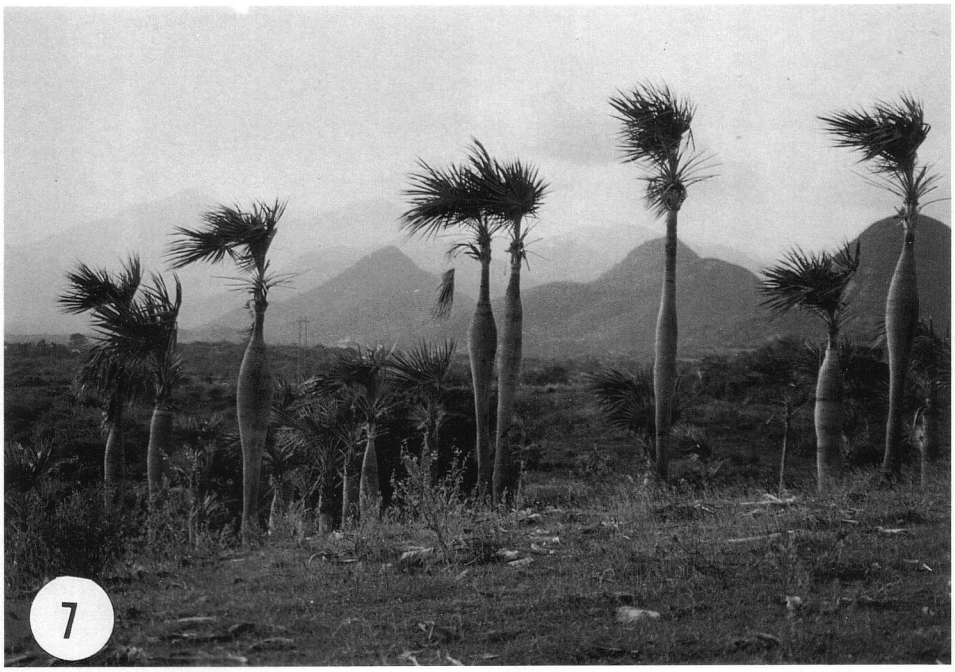
Of the palms of lesser utility, most tend to be found in the southern and southwestern provinces of the Dominican Republic. With the exception of the manacla palm, all others tend be found at elevations below 800 m. Although disassociated from the control of physical factors, it should be noted that palms are conspicuously absent in areas devoted exclusively to the monoculture of rice or sugar.

The Utility of Palms

A range of products derived from various palms provide an important source of supplemental income for Dominican rural "campesinos" (see Hartshorn 1981, Zanoni 1986, 1991; Uhl and Dransfield 1987). The fronds of the sabal and silver thatch palms are collected on a small scale by campesinos and handcrafted into a variety of products for domestic use and for sale to tourists (Figs. 11, 12). Leaves are processed within households into panniers (*árganas*), which are used in pairs as saddlebags to haul cargo on burros and horses (Antonini 1971) (Fig. 13). Also manufactured is the *petaca*, a crude box formerly much used in the transport of charcoal, small shoulder sacks (*macutos*) used in the coffee harvest, as well as other bags for carrying goods (Fig. 14). *Serones* are made for baling tobacco. Roadside vendors of broom heads (*escobas*) in the vicinity of Higüey, Santiago Rodríguez (Sabaneta), Jarabacoa, and Azua signal the local presence of the sabal and silver thatch palms (Fig. 16). The leaves of the sabal palm are made into an assortment of baskets (e.g., *cestas de pan*) used to hold, store, or carry goods, as well as baskets (*moises*) for carrying infants. These baskets have also found their way into the tourist trade (Fig. 19). Leaves of the sabal palm (cana) may be woven into seats for chairs (Moscoso 1945). Leaves of the silver thatch palm (guano) may be woven into sacks that are employed in the processing of bitter cassava. In this instance, the sack is filled with shredded cassava, which is then squeezed between wooden planks to force out the poisonous juices.

In rural communities, the leaflets of the sabal palm are made into cordage ("ripio") utilized as lashing in house construction and for tying goods for transport (Fig. 17). Antonini also notes the use of palm cordage in wrapping bundles of tobacco. Fronds of cana are also interlaid in tobacco piled for curing and have been seen being used to reduce the drift of sand at seashore resorts (Fig. 18). Hollowed trunks of the sabal palm have been seen used as beehives (*colmenas de abejas*) (Fig. 31).

The heart of the royal palm (*palmito* or *yema*)



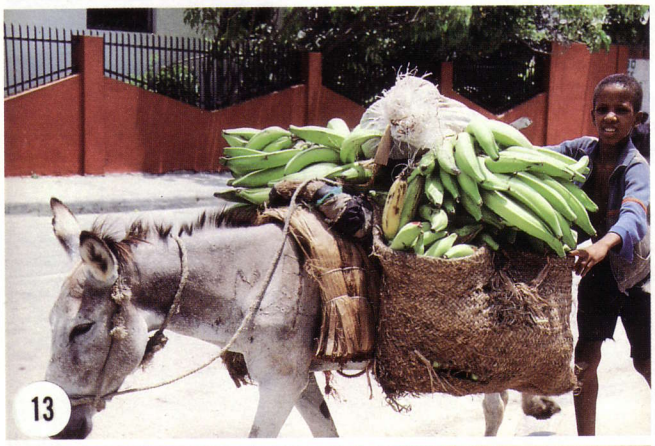
7. The "guano" palm (*Coccothrinax spissa* Bailey), 2 km east of Bani. (Aug. 20, 1992). 3. The coconut palm (*Cocos nucifera*), northern shoreline of the Samaná Peninsula, northeastern Dominican Republic. (June 21, 1991).

9. Mixed stand of palms—royal palm (*Roystonea boringuena*) in left foreground, sabal palm (*Sabal domingensis*) in right foreground, silver thatch palm (*Coccothrinax argentata, Thrinax* spp.) in background, 7 km west of Santiago Rodríguez. (Sept. 19, 1991). 10. A partially desiccated leaf sheath ("yagua") hanging down from the top of a royal palm (*Roystonea hispaniolana*). To the left and right of the leaf sheath may be seen two elongated flower bracts that project at sharp angles from the trunk of the palm. Once dried, the bract of flower sheath ("yaguita") is utilized by peasants for a variety of purposes. (Casa Santa Maria, Higüey, Feb. 24, 1992).

is eaten in salads and may be prepared with eggs or meat. The small oily purple-colored seed (*palmiche*) of the royal palm serves as a feed for chickens and hogs (Fig. 10). The medula within the trunk of the cachéo palm may be extracted and processed into a fermented drink.

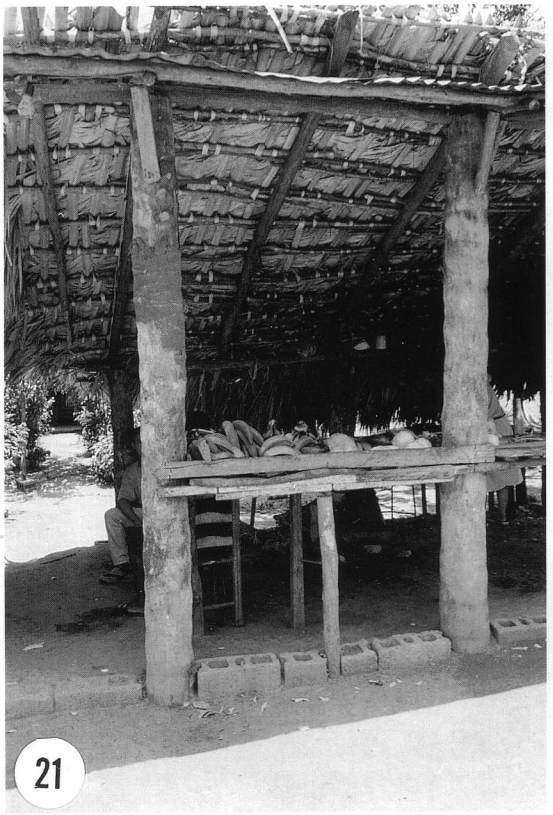
The flower bract or sheath (*yaguita* or *yaguacil*) of the royal palm has been seen used as a mold (*moldes de yagua*) in the manufacture of confections (raspadura) of *dulce de leche* in Bonao, Higüey, Puerto Plata, and San Juan, and *dulce de naranja agria,* especially in Dajabón. It is also used as a mold in the manufacture of *andullo,* a tightly compressed cured tobacco primarily used by older rural inhabitants. The *yaguita* may even be used for carrying products (Fig. 15).

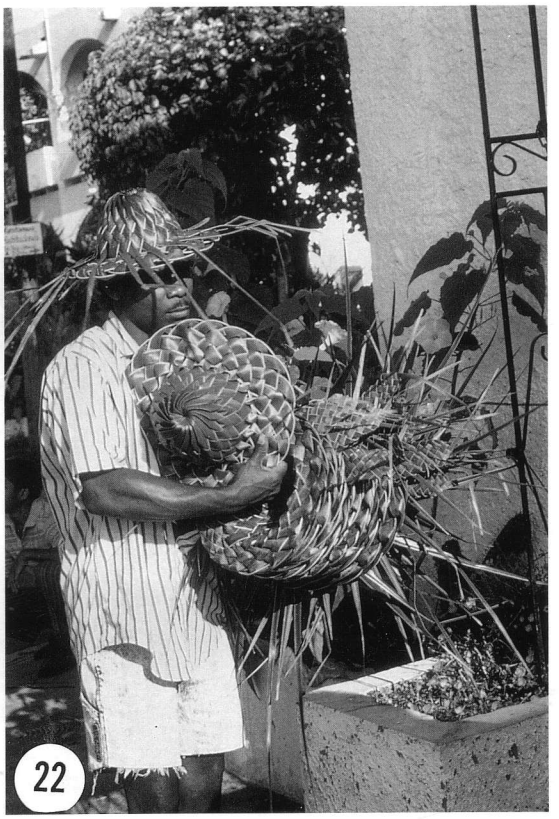
Coconut palms provide a cornucopia of products of utility. The trunks of these are used as pilings, chopping blocks, gate posts, and as columns to support roof structures (Fig. 21). The leaflets of the fronds may be woven into hats or seats for chairs (Fig. 22). Fences of thatched coconut fronds are used to enclose house and animal compounds. From immature or green coconuts, frequently seen heaped along roadsides, a refreshing drink may be extracted for passersby. The mature coconut meat (*masa*) is widely used in confections (*majarete, funde, coquitos*). The shell (*jícara*) of the coconut is utilized to fire ovens for drying copra, and may also be used as a fuel in households or to fire ovens in bakeries. It may also be used as a container or scoop. The outer husk of the fruit, known as coir (*paja*), may be used for padding. Coconut oil products ranked as the eighth most important Dominican export in 1986 (República Dominicana 1991). In the Samaná Peninsula the tree also



11. Leaves of the sabal palm (*Sabal domingensis*) at the bodega of Franklin Nuñez Olivo, 14.5 km south of Imbert. (June 29, 1991). 12. Leaves of "guano" used in making broom heads ("escobas") at the bodega of Hipólito Ramírez, 8 km north of Jarabacoa. (July 3, 1991). 13. Plantains ("platanos") being transported in panniers ("árganas"), used in pairs as saddlebags. (Neiba, July 5, 1991). 14. Offered for sale at the plaza in Comendador are bundles of leaves harvested from the silver thatch palms ("guano"). Below the bundles is a carrying bag ("macuto"). To the right are panniers ("árganas"), used to transport the leaves to market. Both the "macuto" and the "árganas" were woven from the leaves of the guano palms. (June 27, 1994). 15. Mangos being transported in flower sheath ("yaguita") of the royal palm, 2 km southwest of Azua Vieja. (June 26, 1994).

16. Roadside vendor selling small onions ("cebollines"), broom heads ("escobas"), and mortars and pestles ("pilónes con manos") made of guayacán (*Guaiacum officinale*), 26 km west of Baní. (Feb. 28, 1992). 17. Cording (ripio) made of the leaflets of the sabal palm used for tying bundles of goods, in this instance stalks of sugar cane. (Cabral, Feb. 29, 1992). 18. Fronds of the sabal palm used as windbreaks to block sand from drifting across walkway. (Club Med, Punta Cana, June 24, 1994). 19. Luz Jiménez with hand crafted baskets made of the leaves of the sabal palm ("cana") in El Guanal, 3 km west of Santiago Rodriguez. (Sept. 19, 1991). 20. "Yaguas" bound in bundles of 25 for sale at roadside bodega. Carretera Duarte at Burende, 9 km north of La Vega. (June 29, 1994).





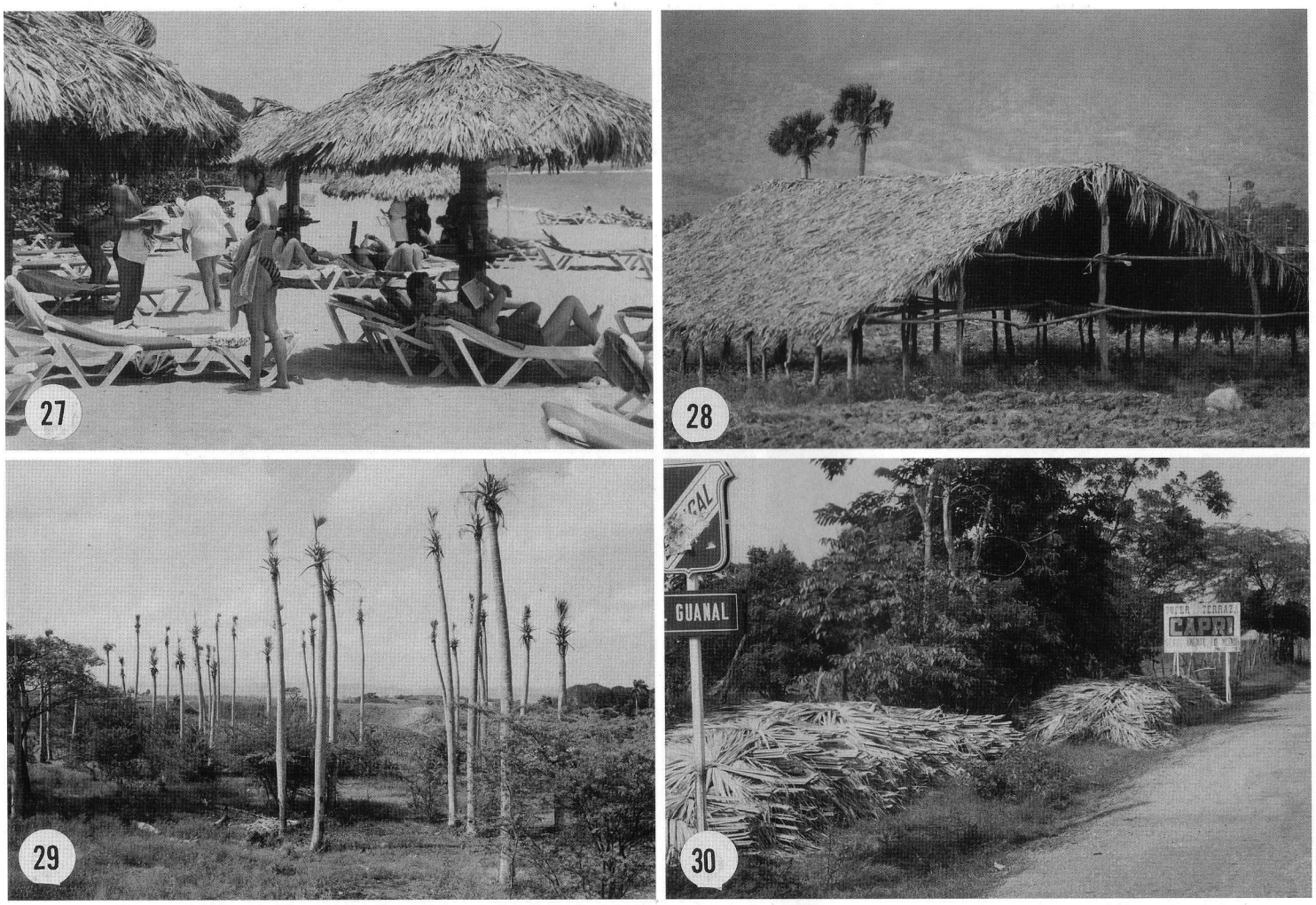
21. Posts cut from trunks of coconut palms being used as roof supports for roadside vegetable stall; leaves of "cana" used to provide roofing, 18 km north of Jarabacoa. (July 1, 1994). 22. Street vendor ("ambulante") selling hats made of leaves of obtained from the coconut palm (*Cocos nucifera*). (Samaná, Feb. 22, 1993).

serves importantly as shade for plantings of cacao. Importantly, former coconut plantations have greatly enhanced the appearance of tourist resorts that have been established at such sites along the Atlantic and Caribbean shorelines of the nation.

Nowhere is the contribution of palms more evident than in the construction of vernacular housing, outbuildings, and other structures. The leaf sheaths (*yaguas*) of royal palms and the fronds of the sabal and much less frequently the cacheo palm serve importantly as roofing material (Fig. 23). The yaguas may also be employed as siding in the construction of houses (Fig. 24). From the trunks of the royal palm and, to a lesser degree, the manacla palm, are hewn strips of wood (tablas de palma) used in the siding of structures. Used less frequently in the construction of house walls and small utility buildings are the fronds (*prendas*) of coconut palms which are resorted to by families with minimal resources. The ribs of the leaves of the coconut palm may be used as laths in the wall construction of houses. Partitions in the interior of structures may also be made of mats woven of the leaflets of the sabal palm.

Fortunately, the 1981 Dominican census of housing provides a gauge as to the contribution of palms in the construction of housing. At that time, 13% of urban and 51% of rural dwellings in the Dominican Republic were reported to have exterior walls made of lumber (*tablas*) obtained from palms (República Dominicana 1991). In addition to dwellings, lumber from palms may also be utilized in the walls of warehouses and other utility buildings. Whereas under 1% of urban housing was roofed with palm leaves (cana), 18% of rural houses were covered with thatch obtained from the sabal palm (Fig. 25) with another 15% utilizing the *yaguas* (Fig. 26) obtained from the royal palm. From this data one may surmise the monetary value of the contribution of palms. However, in the absence of data on other forms of construction or on handicrafts in which raw materials obtained

23. "Yagua" from the royal palm used as roofing for rustic pole frame structure, La Cantera, 3.2 km west of Río San Juan. (June 20, 1991). 24. House constructed with wall of "yagua" obtained from the royal palm and roof of leaves of "cana," 8 km south of Dajabón. (June 30, 1994). 25. House with thatched roof of leaves of "cana" obtained from the sabal palm. Front wall constructed of "cayuco," (a cactus) on left, of "tejamanil" (in center), and "tabla de palma" (on right), 12 km east of Monte Cristi. (Sept. 23, 1992). 26. House roofed with leaf sheaths of "yagua" secured with poles tied to roof frame with "ripio;" house is sided with "tabla de palma," Yanu, 29 km northeast of Higüey. (June 25, 1989).



27. Seashore shelters roofed with leaves of "cana" mounted on posts cut from the trunks of coconut palms, Atlantic shoreline at Playa Dorada (Puerto Plata). (June 17, 1991). 28. Open tobacco drying shed ("rancho") roofed with leaves of "cana," Central Cibao, 18 km west of Santiago. (June 30, 1994). 29. Sabal palms cropped of their fronds, Central Cibao, 11 km west of Santiago. (Feb. 17, 1992). 30. Harvested leaves of the sabal palm piled along roadside awaiting transport, El Guanal, 3 km west of Santiago Rodríguez. (Sept. 19, 1991).

31. Beehives made of sections of trunks of sabal palms at home of Paulino Almonte Santo 13 km west of Río San Juan. (May 9, 1988). 32. Transportation of leaves of "cana," by horse, in the Cibao. (June 21, 1987).

from palms are used, it is impossible to provide a fuller assessment of the contribution that palms make to the rural economy of the nation.

At shoreline resorts, bathers may be seen lounging under shelters thatched from the leaves of the sabal palm (Fig. 27). Open-air restaurants, dance halls, and bars are universally covered with thatched roofs of cana intended to enhance the attractiveness of these structures. Commonly seen in the central Cibao are clusters of open-air sheds (ranchos) roofed with cana that are used for drying tobacco (Fig. 28).

The tops of sabal palms, shorn of their leaves, frequently appear against the horizon (Fig. 29). The harvested leaves may be observed in *bodegas* or stacked up along the roadsides awaiting transport (Fig. 30), commonly by pickups, although occasionally by horses (Fig. 32). In 1967, Antonini reported that a "caballo" (50 leaves) of dried cana leaves were sold at prices varying between RD$0.30 and RD$1 (US$0.15 and US$0.50), depending upon the size and quality of the leaves and the time of the year. By 1991 the price of a *caballo* of leaves had increased to RD$50.00 (US$4.00). A minimum of 500 leaves, at a cost of RD$500 (US$40), is required to roof a small house (10 × 16 feet in dimension).

As noted previously, materials for both roofing and siding may be obtained from the royal palm. The leaf sheaths (*yagua*) of the royal palm are normally sold in a bundle of 25 (Fig. 20). The price per bundle in 1991 was RD$45 (US$3.60). Approximately 200 yaguas, costing RD$375 (US$30), are required to roof a small house. A bundle (*paquete*) of siding containing 12 strips of lumber (*tabla de palma*) measuring three varas in length (±10 feet) is priced at RD$125.00 (US$10.00). Approximately 15 bundles costing RD$1875 (US$150) would be needed in the construction of a small dwelling.

On the basis of Dominican housing stock in 1981, a conservative estimate of the value of raw materials supplied by palms for house construction would come to the sum of RD$740 million (US$59 million), based on current prices. It should be further noted that these figures do not include the value of raw materials obtained from palms that are used in the construction of other types of buildings (i.e., stores, warehouses, outbuildings, etc.) or in the manufacture of food or crafted products. Additionally, there is the income derived from the export of coconut and African palm products (a sum of RD$204 million or US$17 million in 1986). Finally, no intrinsic value is assigned to immaterial benefits provided by palms such as the provision of shade for groves of cacao or their enhancement of the value of ocean shoreline properties.

Conclusion

Aside from sketchy data provided in government censuses on the use of native palms in house construction or on the export value of coconut oil products, there is limited information on the material and esthetic value that can be attributed to palms in the Dominican Republic. Yet, it is evident that palms are an important natural resource. This is all the more meaningful for those residing in rural areas because it is largely within these regions of the nation that the products of palms are harvested and transformed into houses, shelters, food, and crafts. As for the future, it is clear that rural as well as urban dwellers are increasingly demonstrating a preference for houses made of concrete blocks and corrugated metal as opposed to lumber and thatch derived from palms. The bases for this choice are complex, but bear significantly upon preference for more commodious housing. It is also evident that many items once derived from materials obtained from palms are being substituted by bags, cartons, boxes, and other containers made of paper, wood, and plastics. The rapid increase in population and concomitant requirements, particularly housing, will continue to place a demand on resources obtained from palms; however, in the longer term it is likely that given environmental considerations and changing styles in house construction, palms will come to serve less importantly as a resource in the Dominican Republic. One has only to look at the neighboring islands of Jamaica or Puerto Rico to be assured of that conclusion.

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CHAPTER NEWS AND EVENTS

News from the Sunshine Coast Branch, PACSOA

The Sunshine Coast Group of PACSOA met on October 7 at the Nambour Band Hall, Nambour to hear Tony Huntington's slide slow and lecture on his recent visit to New Guinea, where he lived in a native village for several weeks. The raffle prize was a New Guinea palm.

News from Gold Coast Tweed Branch, PACSOA

The Gold Coast Tweed Palm and Cycad Society of Australia held an outing on October 13 to two nurseries in the Sunshine Coast hinterland. The outing began with a stop at Palm Fascinations nursery on Petrie Creek Road in Nambour.

South African Palm Society News

The South African Palm Society held a slide show on October 8, at the lecture room of the Durban Botanical Gardens, about the palms of the Sir Seewoosagur Ramgoolam Botanic Gardens (formerly Pamplemousses) in Mauritius and Valle de Mai in the Seychelles.

Also discussed was the SAPS 97 Congress to be held July 12–14, 1997 in the Durban area. SAPS also decided to proceed with a rare palm and cycad sale in conjunction with the cycad society. SAPS is negotiating with the parks department for a suitable location.

Work on the Palmetum is progressing well. For those not familiar with the SAPS Palmetum, it is a 7-hectare site located in the subtropical Transvaal Lowfeld near Hectorspruit. Groups of palms have been planted that were donated by members of the SAPS.

PETER WUNDERLIN
Vice President
South African Palm Society

(*Continued on p. 47*)

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Phoenix dactylifera in the United Arab Emirates

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From the manicured date palm orchards among the golden hills of California to the oases in the Al-Hasa region of Saudi Arabia, *Phoenix dactylifera* has a well-established presence in traditional and hi-tech commercial settings. The United Arab Emirates is rapidly raising the degree of international recognition of this region as a future standard-bearer in the cultivation of *Phoenix dactylifera.* With particular zeal the U.A.E. is promoting higher quality date harvests via scientific research and aid to farmers.

The United Arab Emirates was founded in 1971. At that time, there were about 1.5 million date palms in the region. Slightly more than two decades later, generous government subsidies and technical assistance to date palm farmers have enabled *Phoenix dactylifera* to proliferate to ca. 18 million date palms (MAF 1994). The U.A.E. government has an active agenda to increase the number of date palms in the region. Together with research projects that are in progress at the Ministry of Agriculture and Fisheries and other institutes, the United Arab Emirates could soon become a global center for the cultivation and propagation of *Phoenix dactylifera.*

The trend in the U.A.E. is to modernize date palm operations, but some traditional sectors of date palm cultivation will remain intact. One domain is the conservation of water sources for irrigation by maintaining *falajes,* which are traditional and environmentally friendly irrigation systems. Another area is the preservation of some major oases, like the Al-Ain oasis in Abu Dhabi.

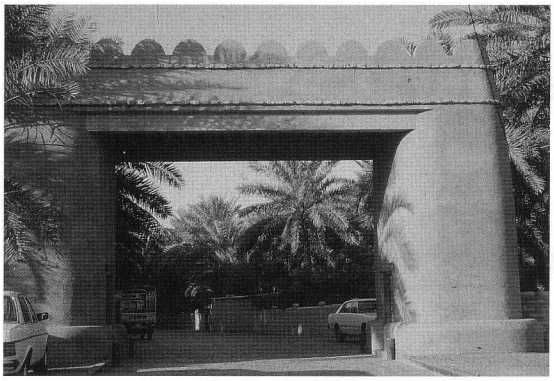
With a location of 55.5° longitude and 24.4° latitude, Al-Ain lies 165 km inland from coastal Abu Dhabi, the capital of the United Arab Emirates. The areas of Al-Ain borders Oman, and it is a three-hour drive from the fringe of the expansive Rub Al-Khali desert, i.e., the Empty Quarter. The United Arab Emirates University's Faculty of Agricultural Sciences, which is the region's hub for research into the propagation and cultivation of *Phoenix dactylifera,* is also located in Al-Ain.

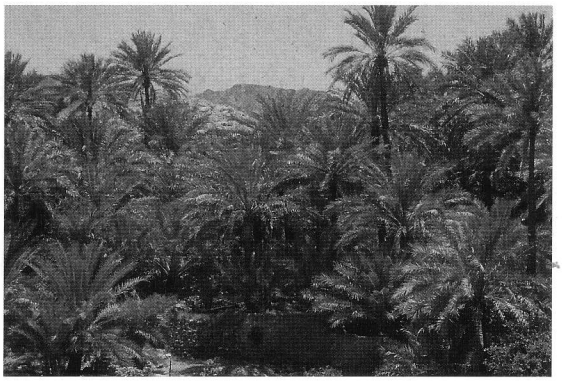
Although the Al-Ain region has some *falajes,* its more mountainous neighbor, Oman, has a larger network of *falajal* irrigation. The typical sources of water for *falajes* are subterranean water tables from which water seeps to the surface along valley river beds and the rainwater reservoirs inside mountains. Horizontal drilling into a mountain accesses its water reserves and an irrigation system that may be several kilometers long is constructed to hydrate date plantations at lower levels by the gravity flow of the water. As long as rain replenishes the mountain's water reserves, the farmer always has a reliable water source.

In contrast, wells that have been established through vertical drilling require pumps to raise the water to the surface. In the long term, pumps might extract water more quickly than it can be naturally restored and lower the water table below the reach of the palm's root system. Some of the abandoned date plantations are testimony to this event. Oman's government is keenly aware of the advantages of *falajes.* Consequently, the Ministry of Water and Electricity there has formed a Department of *Falajes,* which maintains a few hundred *falajal* irrigation systems (Fig. 8).

The Al-Ain oasis represents a site that operates in the same traditional manner as it has for centuries. Although urban development has encroached on this oasis of cultivated date palms, ca. 4 km^2 remain preserved. Its close proximity to the city offers the city dwellers who visit it a respite from the busy urban life. The oasis presents visitors a glimpse into the culture of the community that inhabits it.

The residents of the oasis live in a seemingly planned community. Upon entering the oasis through a lintel-style gate (Fig. 1), one finds a network of cobblestone roads meandering through the oasis which occasionally branch off to provide





1. The entrance to Al-Ain oasis. 2. A date palm plantation, Kitna, Oman.

access lanes to the gates of privately owned date farms. Old-fashioned mud-brick walls line the roads and define farm boundaries. Sprawling palm fronds of 5–10 m high date trees shade the road, which provide the pedestrians with a welcome relief from the baking summer daytime temperatures that average 110°–120°F (Figs. 2, 3).

The irrigation systems in the oasis not only supply water to the date palms, but they also provide local bathing areas. The dammed sections of the irrigation system create bathing pools that are accessible from the road. These discreetly located areas allow residents to cool or bathe themselves in clear, clean irrigation water. Although the inhabitants of the oasis lead a provincial lifestyle, their community is within walking distance of the city center.

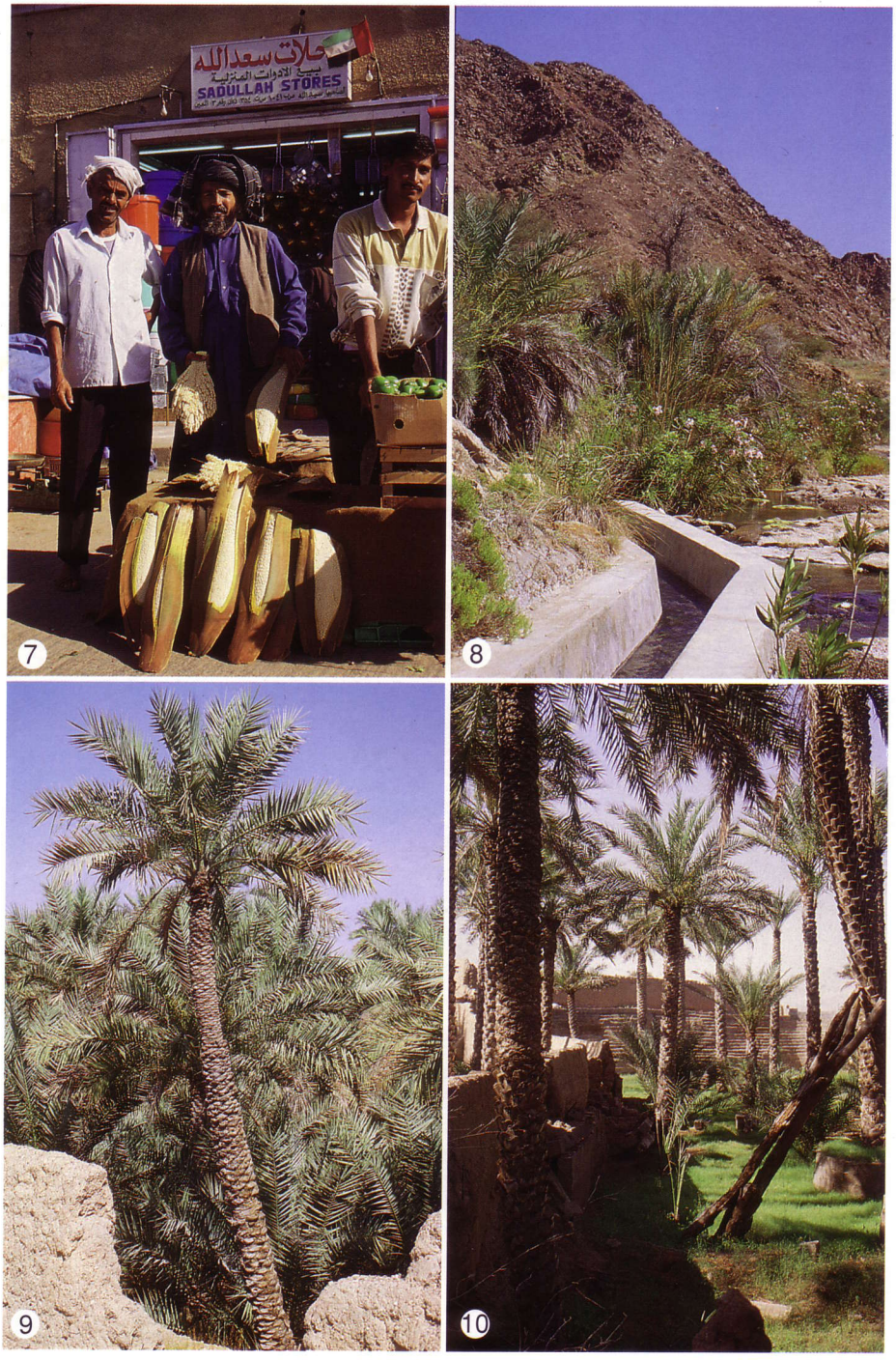
Upon exiting the oasis, it is a mere five-minute walk to Al-Ain's most popular outside vegetable and fruit market. It is hardly surprising that besides the typical fare of fresh vegetables and fruit, dates are also available. Vendors offer an astonishing plethora of date varieties. Local Al-Ain favorites are Khalas, Barhi, Faradh, Raziz, and Shishi. Additional Emirati dates like Hilali, Khasab, Lulu, and others are among the commercially available dates in the United Arab Emirates.

Not all the dates that are found in the market are locally grown. Consumer preference and targeted usage of the dates are factors that contribute to date imports. Certain preferred date varieties grow outside the Emirates. The Deglet Noor, which is a worldwide favorite, is primarily grown in Tunisia and Algeria. Moreover, climatic conditions outside the U.A.E. are more suitable for the cultivation of particular varieties. Usually, the U.A.E. has hot, humid summers. Most dates that are used in confectionery require dry summer weather. All of these factors contribute to annual date imports.

The date stalls at the market attract customers with enticing aromas and an array of colors, which range from golden-yellow to chocolate-brown to red. And these dates are available for longer periods now. The use of naphthalene acetic acid to delay ripening and etheral to promote early ripening have extended the date season. Customers can buy dates in various stages of ripeness, which range from khalal to jubseh.

The date season begins with the arrival of fresh dates in the khalal stage at the marketplace. These yellow or rose-colored dates were crunchy and slightly astringent. The kimri stage precedes khalal, but these young, green-colored dates with their high tannin content are insufficiently mature to market. In the next stage of ripeness, i.e., rutab and tamar, the Khalas date is the Emirate's favorite. This translucent-amber to chocolate-colored date with its ample, soft flesh and small pit is the queen of Emirati dates. The Khalas is best enjoyed with a cup of coffee and it is often offered to hotel guests at the reception desk. Typically, rutab dates are brown or black and are fully-ripened dates. Amazingly, some varieties, like Barhi, can simultaneously share the rutab and khalal stage. This results in a date that is half-brown and half-yellow with a respective sweet and astringent taste. Tamar represents an advanced stage of ripeness, similar to the raisin-state of a grape. A reduced moisture content of 15–20% in this stage concentrates minerals and vitamins. Customers have preferences for particular dates at a certain stage in ripeness and they must be familiar with them since different dates vary in the time they

3. The setting in Al-Ain oasis. 4. Emergence holes of the palm-stem borer. 5. Damage from a palm-stem borer. 6. An inflorescence trader.



7. Inflorescence traders. 8. Falaj, Mahda, Oman. 9. Hamasa oasis, Bureimi, Oman. 10. Another view of Hamasa oasis, Bureimi, Oman.

remain in a stage or skip certain stages of ripeness altogether (FAO 1962).

In the jubseh stage, which is colloquially known as balah jaff in the Emirates, the date is mummified and has a sandy-beige color. "Concentrated sweetness" best describes the gustatory experience of eating one of these dates. The word "jubseh" is derived from the arabic word for gypsum. True to its etymological source, it is rock-hard. Dates in this stage can be eaten dry or soaked in water first to soften them. Eating a date in the jubseh stage is reminiscent of the jarring experience of eating jaw-breaker candy. In Saudi Arabia, jubseh dates are selected based on their city of origin, such as jubseh Medina or jubseh Najran.

Jubseh dates are especially rich in minerals and are the Arab equivalents to hi-energy bars. Portable and nutritious, jubseh dates quickly restore nutrients that are lost during the performance of physically demanding activities. Women sometimes eat jubseh or other dates to replenish their strength following childbirth. Jubseh dates are also valued since they can be stored for years and serve as a valuable source of nutrients when the date season has passed. The date stalls at Al-Ain's outside market offer a plentiful variety of dates to satisfy customers' preferences. Certainly, the flurry of activity of vendors and buyers negotiating purchases reflects the importance of dates as a food staple in the Emirates.

Each year, between mid-February and early April, farm workers set up stalls beside the date vendors to enjoy some brisk business with the trade of male date palm inflorescences. In addition to customers who visit the stalls to purchase inflorescences for pollinating date palms, some residents visit the stalls to indulge themselves in a seasonal treat. Men will occasionally crumble an inflorescence and mix it with crushed, dried fish, which are also available from nearby vendors. They eat this concoction and purport to benefit from increased energy and a strengthened libido. Dr. Haffar, Associate Professor of Agricultural Engineering at the United Arab University's Faculty of Agricultural Sciences in Al-Ain, readily shared his insight into these local practices and other facets of the inflorescence trade. He frequents the vegetable market at this time of year to collect specimens of inflorescences for his pollen research at the university.

Residents who have their own date gardens and local farmers often require a source of pollen. The inflorescence trade at the market helps to satisfy this demand. Date farm workers begin to inspect inflorescences from male trees soon after sunrise. The inflorescences must be harvested before they open. Upon opening, they release a burst of pollen which benefits nearby female date trees, but renders them useless for the inflorescence trade at the market. The workers test the inflorescences for ripeness by squeezing the end of the prophyll. When the tip crackles this indicates the prophyll will swell and open later in the afternoon and is ready to be collected for the morning market. By seven or eight a.m., the inflorescence traders (Figs. 6, 7) are at the marketplace. To display the closed bunches of flowers for inspection, the vendors make length-wise, parallel cuts down the spathe, then peel back this wooden tab. Besides scrutinizing the condition of the closed flowers, the buyers also smell the inflorescence to detect the particular aroma that indicates a fresh, ripe inflorescence. The inflorescence trade concludes by eleven o'clock in the morning. The farmers require sufficient time to return to their date palm orchards and pollinate before the flowers fully open and eject their pollen. Although the market provides a limited supply of pollen, the general demand for pollen has risen so greatly that alternative sources of viable pollen are necessary to sustain the increase of date production in the region.

Pollen collection has emerged as a significant element in establishing pollen reserves, especially for use in artificial pollination. The Ministry of Agriculture and Fisheries has established Pollen Extraction and Distribution Centers in the United Arab Emirates with its main lab for date palms located in Hamraniyyah, in the Emirate of Ras Al-Khaima. These facilities collected, store, and distribute pollen to farmers.

Khodrey and *Sikkah* are the typical male offshoots in the U.A.E. whose inflorescences are used as a main source of pollen. Vacuum collectors and vibratory shaking methods are used for pollen extraction, although the latter is more predominant. In the vibratory shaking process, the prophyll covering the inflorescence is removed and the inflorescence is hung up to dry for 2–3 days in humidity- and temperature-controlled open rooms. Afterwards, the inflorescences are placed inside a vibrating shaker for pollen extraction.

The vibrating shaker generally yields 10–20 g of pollen per inflorescence, depending on the cultivar. One "super" inflorescence Dr. Haffar viewed during a visit to a local farm weighed 8 kg. This mega-inflorescence had the potential to produce

40 g of pollen, which would have been sufficient to pollinate 25–30 date bunches.

The drying time of the flowers along with the intensity and duration of vibratory shaking all influence the optimum extraction of pollen. Since increased moisture holds pollen grains together and requires a longer shaking period, properly dried flowers more readily release pollen. On the other hand, prolonged shaking of adequately dried flowers causes too much debris, e.g., bits of inflorescence, to mix with the pollen, which reduces the amount of usable pollen.

Staff members from the U.A.E. University's Faculty of Agricultural Sciences have conducted experiments to investigate the most suitable combination of drying time of the flowers, together with the intensity and duration of vibratory shaking to maximize pollen extraction from a number of date palm cultivars (Haffar et al. 1995). This university team's research is contributing significantly to making vibratory shaking an effective means of pollen extraction. A readily available source of pollen will enhance mechanized pollination and help increase date production in the United Arab Emirates.

Since the number of date palms has greatly increased, there is an insufficient pool of skilled workers to pollinate manually the date palms. The Ministry of Agriculture and Fisheries and the U.A.E. University's Faculty of Agricultural Sciences have worked intensively to develop and improve mechanized means of pollination. As a result, hand dusters are available to pollinate palms 4–5 m high, while power dusters can be used for date palms up to 10 m. Maximum efficiency in pollinating the date palms is attained by dusting them 3–6 times with a mixture of fresh pollen and free-flowing wheat flour at a ratio of 10:1. Mechanized pollen extraction and pollination are a few components of a national program for integrated date palm mechanization systems.

The Ministry of Agriculture and Fisheries, each Emirate's Department of Agriculture, and municipalities promote date cultivation by providing a core of basic services that range from land preparation, which includes sand dune removal and land leveling, to crop establishment, harvesting, postharvest management, and crop maintenance/management. Pest control, which lies within the rubric of crop management, offers some challenges in maintaining the health of *Phoenix dactylifera.* The most obvious damage by an especially harmful pest can be readily observed during a walk through the local oases. Date palm trunks with round, insect-emergence holes, which appear to have been excavated by ravenous woodpeckers, are telltale signs of the palm-stem borer, *Pseudophilus testaceus* (FAO 1982) (Figs. 4, 5). This beetle is one of the primary pests in this region that can have an adverse impact on the cultivation of *Phoenix dactylifera.* Researchers at the U.A.E. University are investigating pest control and numerous other issues that are related to the cultivation and propagation of *Phoenix dactylifera* in the United Arab Emirates.

The U.A.E. University's support of research in the cultivation of *Phoenix dactylifera* is highlighted by a generous grant it awarded to the Faculty of Agricultural Sciences for The Date Palm Project. This U.S. $160,000 grant is being allocated over four years to advance research into a myriad of projects, such as: using dates as animal feed for camels and fish; date palm protection from disease and pests; utilizing dates to manufacture jam and syrup; studying the water requirements of date palms; and investigating cultural practices and production issues of *Phoenix dactylifera,* which range from the effect of low temperature on the storage capability of dates to chemical fertilization and its effect on the productivity and fruit characteristics of date palm cultivars. The holistic benefit from the research that is conducted in The Date Palm Project should be reflected in an economically efficient approach to improving the cultivation/propagation of *Phoenix dactylifera* and the increased productivity of date palms.

The Ministry of Agriculture and Fisheries has also mobilized its resources to promote date palm propagation. In 1989, the Ministry of Agriculture and Fisheries in collaboration with the U.A.E. University established the Al-Ain Date Palm Development Research Unit. Originally, the Tissue Culture Laboratory there had the capacity to produce 120,000 date palm plantlets per year. As a result of their success in tissue culture technique and the rising demand for vast quantities of superior date palm cultivars throughout the Emirates, the facilities were expanded in 1994, and currently have the lab capacity to propagate 1,000,000 plantlets, annually.

Clonal propagation at the tissue culture lab is performed by organogenesis (Rhiss and Almai 1977, Poulain et al. 1979, Rhiss et al. 1979). This method of propagation, which has the benefit of producing mutation-free clones, has become the preferred date palm tissue culture method in the

Emirates. Primarily, the date palm tissue culture lab propagates popular cultivars, such as Khalas, Barhi, Khanazi, Khadravi, and even Sultana and Nabtat Saif, which are elite cultivars from Saudi Arabia.

Dr. Rhiss, Director of the Date Palm Development Research Unit, recently gave the author a tour of the tissue culture lab and reviewed the stages of clonal propagation by organogenesis. The explants that are cultured in organogenesis are obtained from the date palm heart. Then, the palm heart is dissected and the apical tip and surrounding tissue are cut into 20–30 sections of 2 mm^3. These explants are cultured in vitro in a solid medium that contains nutrients and growth hormones, which are modified for each particular stage in the process. In the first stage, which occurs in a dark room, the sections of explant are cultured to produce and multiply organogenesitic tissue. This initial step takes 8–12 months, depending on the cultivar. Not all of the explants produce tissue and these are discarded.

Stages 2 through 4 take place in fluorescent-lighted and temperature-controlled growth chambers, which are maintained at 28°–30°C. Stage 2, and each subsequent stage, takes one month to complete. In the second stage, the organogenesitic tissue is cultivated to produce and multiply buds. The tissue that is cultured from the initial 20–30 sections is sufficient to produce 10,000 buds. With a 2.5× rate of multiplication, these buds, in turn, will multiply to 25,000 buds. Generally, 15,000 of these buds continue to stage 3, while 10,000 buds are retained for additional multiplication. Surprisingly, as long as the nutrients and growth hormones are replenished each month, the buds can be used to reproduce for as long as five years.

Bud elongation occurs in stage 3. When the buds elongate to 10–12 cm, they are ready for stage 4, which results in root formation. Upon completion of this final stage in the lab, the combined length of the root and leaf is ca. 14 cm and the plantlets are ready to be transplanted. Acclimatization of the newly transplanted plantlets follows in growth tunnels, which are regulated to provide an environment with 80% humidity and a temperature of 28°–30°C. After one month, the plantlets are transferred to a humidity-controlled greenhouse. Once the plantlets have acclimatized, their cultivation can continue outside.

Presently, the national rate of date consumption in the U.A.E. has outstripped the country's resources of date palms to satisfy it. The Al-Ain Tissue Culture Laboratory is a good example of the country's effort to increase its stock of date palms. In the future, clonal propagation of premium cultivars should help meet the consumer's demand for this food staple.

Since its founding 25 years ago, the U.A.E. has made noteworthy progress in the areas of date palm research, technology transfer to farmers, and date palm propagation and cultivation. The international date palm community should surely benefit from the body of scientific information that will be generated from ongoing projects. In the near future, the United Arab Emirates could very well position itself to become a worldwide center for the cultivation and propagation of *Phoenix dactylifera* (Figs. 9, 10).

Acknowledgments

The author would like to thank Dr. Imad Haffar and Dr. Hameed Al-Juburi at the U.A.E. University's Faculty of Agricultural Sciences for sharing their research and personal experiences with *Phoenix dactylifera.* Appreciation is also extended to Dr. Ali Rhiss for the tour of the Al-Ain Tissue Culture Laboratory and his comments on organogenesis.

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The Royal Botanic Gardens Melbourne—150 Years

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This year marks the 150th anniversary of the founding of the Royal Botanic Gardens, Melbourne, Australia. This magnificent park ranks as one of the finest public gardens in the world, attracting more than a million visitors every year. In this compact area of 39 hectares (87 acres) are 12,200 species of plants, from the tallest trees to the smallest perennials. The park has much to offer the visitor—a superb scientific collection, with unusual and exotic plants from all over the world. It can be seen as a classical Victorian garden, complete with rose gardens, ornamental lakes, and swans. It is a beautiful landscaped park, perfect for picnics or simply walking around in, to enjoy the beauty of nature.

Palms are prominent throughout, as feature plantings and numerous scattered individuals. While there is not the large number of species found in other botanical gardens such as in Townsville or Brisbane, the Melbourne collection is impressive all the same. Around 40 species are grown, mainly from cooler temperate areas, but with some surprising exceptions. The age of the gardens combined with the mild climate have allowed some specimens to grow to enormous size. In parts of the park, some stands of palms are self-reproducing, re-creating a near natural setting.

A botanical garden has many aims: education, to teach of the great diversity of the earth's flora; conservation, to grow rare species for their protection, and raise awareness of their condition; utility, to grow plants useful to man; and aesthetics—to grow plants because they are beautiful or unusual. The gardens' founders had all these in mind when planning began more than a century and a half ago.

Note: Some background information was drawn from Joan Law-Smith's "The Royal Botanic Gardens Melbourne," Maud Gibson Trust, 1984.

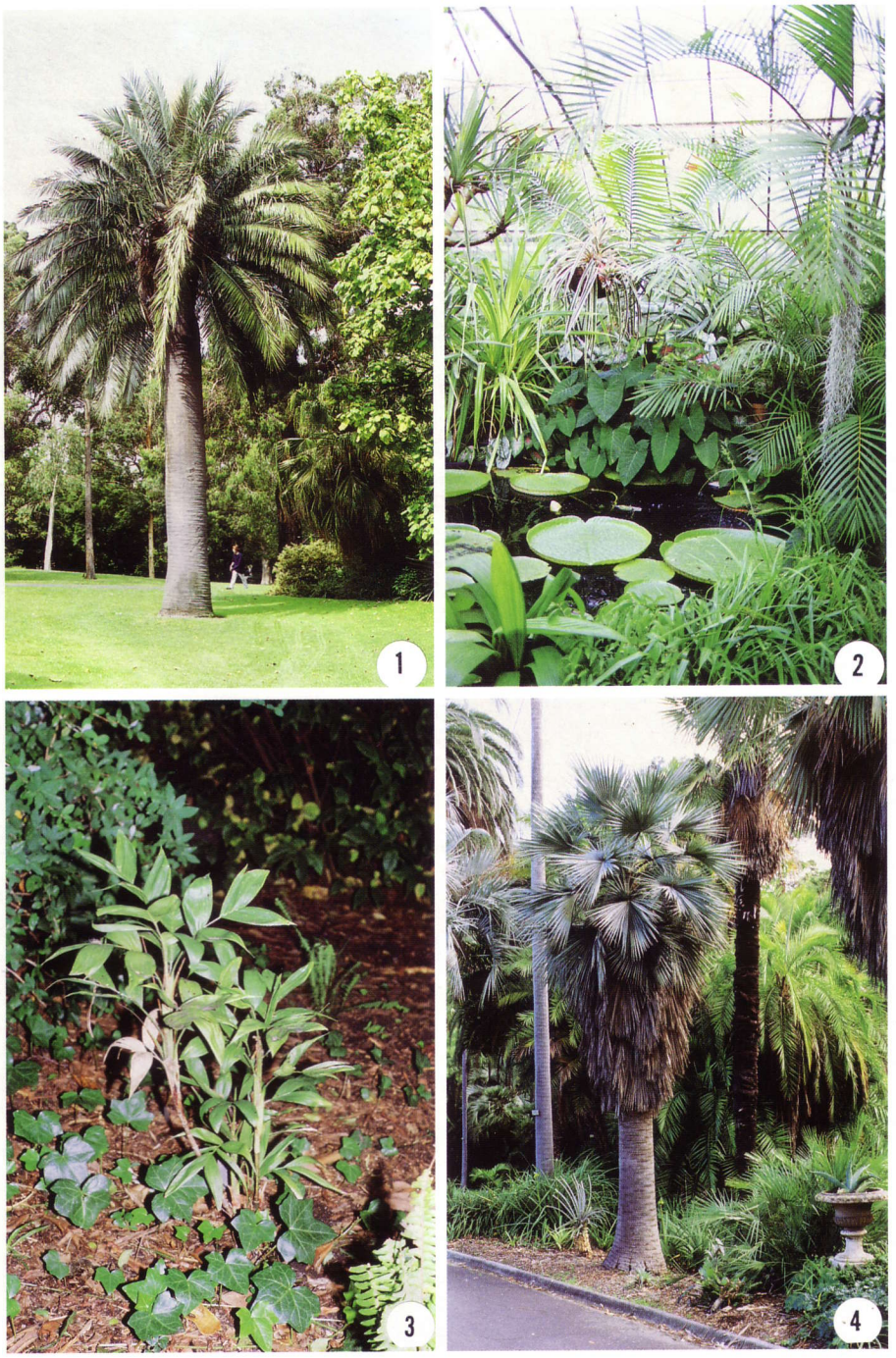
Location—Climate—History

Melbourne is the most southerly city on the Australian continent; at 38°S it is as far from the equator as San Francisco, or Norfolk, Virginia. Occasional extremes of temperature are experienced. In January, hot dry winds from the interior can drive temperatures to 42°C (108°F). This can change very abruptly, as cold fronts push through bringing cool, damp, windy weather from the Southern Ocean. July is the coldest month, with winter days seldom rising above 14°C (57°F) and nights occasionally falling to near freezing. Frost is virtually unknown, as the gardens are within a mile of the sea. Rainfall is 650 mm (26″) annually, spread fairly evenly throughout the year. Overall the conditions are very favorable to the gardener, and our city is a very green one.

Melbourne, the state capital of Victoria, was founded in 1835 as a free colony, to extend Britain's claim over the newly settled continent. It has since grown to a modern city of three million people. Despite its size, it is an attractive city, due in part to the mild climate, the preservation of many charming Victorian buildings, and the large network of inner city parks of which the Botanic Gardens are the centerpiece.

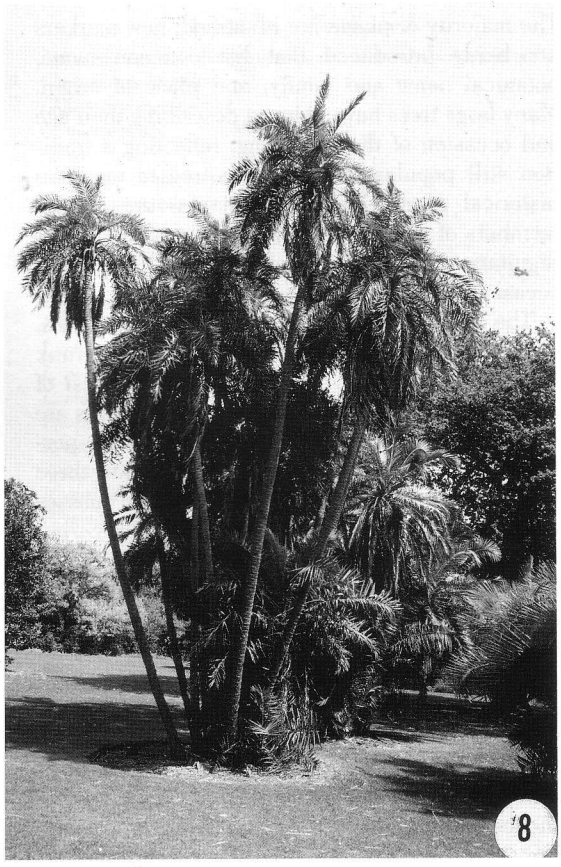
Much credit is due to the city founders who began the park system within a decade of the city's founding. On February 25, 1846 the dedication ceremony took place at the chosen site on the south bank of the Yarra river, almost opposite the city center. The area was originally scrub and swampland, dominated by the indigenous River Red Gum, some of which are still standing.

Baron Ferdinand von Mueller, Director from 1857 to 1873, is acknowledged as the father of the gardens. A government botanist and energetic collector, he described many Australian species, including palms, and is honored with species of *Livistona* and *Calamus* named after him. Mueller's focus was science and education. His exotic intro-



1. This massive *Jubaea chilensis*, planted in 1903, has a truck circumference of 3.1 m. 2. Inside the glasshouse, *Dypsis lutescens* leans over a pond filled with the giant Amazonian lily pad. 3. *Linospadix palmeriana*, normally found only in lowland tropical rainforests of Queensland. 4. *Brahea armata* in corner of the Palm Lawn.

5. The Palm Lawn: *Hedyscepe* grows beneath a mixture of *Phoenix, Livistona, Sabal,* and *Butia* species. 6. The Fern Gully: a temperate rainforest recreated with stunning effect. Shade-loving palms and ferns dominate.



7. Grey-headed flying foxes roosting in the crown of a Bangalow palm, much to its distress. 8. A large clump of *Phoenix reclinata*, this one planted in 1903 by Lord Tennyson. Many species of the genus are grown, they thrive in the relatively dry Melbourne climate.

ductions are numerous, the most notable being the conifer collection, many individuals of which survive today as his living legacy.

He also founded the National Herbarium, an important center for botanical studies. This houses a library and more than a million pressed dried specimens. Australian native plants predominate, notable among these are historical collections by Sir Joseph Banks and others in the epic voyage of the *Endeavour* under Captain James Cook.

Mueller was succeeded as director from 1873 to 1909 by William Guilfoyle, a brilliant landscaper, who made the gardens what they are today, a classic combination of beauty, elegance, and science. He rejected the then-popular concept that a botanical garden should be divided up as in rooms of a mansion. His emphasis was on scenic vistas; he introduced sweeping lawns, ringed by curving garden beds, ornamental lakes, stands of tall trees with a network of winding pathways. Towering avenues of elms and oaks are his legacy; he was also the first to introduce major plantings of palms.

The Gardens Today

A free visitor's map shows the park divided into 10 great lawns, bounded by stands of forest, gardens beds, with four separate lakes, formed from old billabongs (lagoons) of the nearby Yarra river. On entering the main gate, the visitor passes the National Herbarium. The building has been recently modernized and now houses an information center, auditorium, gift shop, and a free plant identification service. Just beyond it, is the Western Lawn, a large formal garden with many mature palm specimens nearly a century old. Accurate, informative identification of plants greatly enhances the enjoyment of any botanical garden.

The majority of plants are identified; new markers are being introduced that list common name, botanical name and family, and place of origin. Many large trees have plaques describing their age and occasion of their planting, reflecting a tradition still popular of planting a tree to mark an historical event. Among the names are several members of visiting royalty, politicians, and other dignitaries. Palms were often planted on these occasions (Fig. 8).

The largest palm is a massive *Jubaea chilensis,* over 12 m tall (Fig. 1). Planted in 1903, its trunk exceeds 3 m around, and may be the stoutest of all palms. Around April the large yellow fruits are scattered about the lawn, the nuts inside are perfect miniature coconuts (right down to the three "eyes"). Nearby are *Butia capitata,* with masses of edible sweet-smelling fruits, and *Trachycarpus fortunei,* that toughest of all palms. A tall *Livistona decipiens* seems out of place at this latitude; the species is found only in a narrow coastal strip of Queensland, nearly 2,000 km farther north.

As one progresses farther into the park, specialty gardens of great variety attract the visitor; space permits mentioning only a few. Lovers of flowers will always find something in season, be it summer roses and hibiscus, spring magnolias and rhododendrons, or winter camellias; at certain spots the ground is a carpet of petals. Along one winding path is the Victorian Herb Garden. The rule against picking flowers or leaves is relaxed a little here, allowing the visitor to sample the collection of traditional kitchen and medicinal herbs.

The eastern part of the park is on more open, drier and more sandy ground, with correspondingly different plantings. The Eastern Lawn features many hardy palms from drier climates. Both species of *Washingtonia* grow high above the large clumps of *Chamaerops, Butia,* and *Phoenix* species. Cycad enthusiasts will be interested in the recently planted Cycad Bed, with more than 20 species. Many old specimens of *Lepidozamia peroffskyana* and *Macrozamia communis* can also be found around the park.

The Cactus Garden looks quite at home, though few visitors realize these plants are native only to the Americas. Interestingly, here once stood a short-lived "Palm House," a small version of the original in Kew Gardens in London. It has been replaced by more conventional glasshouses, which are crammed with exotic tropicals: pitcher plants, orchids, coffee and cocoa plants, as well as two dozen palm species (Fig. 2).

There are feature plantings of Australian native plants—generally drab and unassuming, but occasionally surprising such as *Banksia* with their unusual flowers and colorful bottle-brushes (*Callistemon* sp.). Native palms are found everywhere. The most common is *Livistona australis,* which is fitting as it is the only palm native to our state. They grow superbly, whether as specimens in open lawns or in dense forest. Other natives are *Archontophoenix cunninghamiana,* a graceful cold-hardy feather palm, and two species of *Linospadix. L. monostachya* grows 3 m high, the tallest I've ever seen; the other, surprisingly, is *L. palmeriana* (Fig. 3).

There is a formally named Palm Lawn, with more than a dozen species, perhaps planted a little too close together (Fig. 5). This little knoll forms a natural stage; in summer lights are strung from the palm trunks and stage productions of Shakespeare's *A Mid-Summer Night's Dream* are held. Species here include *Livistona mariae,* a native of the desert valleys of the Australian interior. Its juvenile leaves are a bright red color. Unfortunately the species does not thrive here—it does not like the cool winters. In contrast is *Hedyscepe canterburyana,* less than 10 years in the ground, and already six feet high. This palm from Lord Howe Island is virtually unknown in cultivation; it appears well adapted to cooler climates. There is a pair of *Sabal bermudana* with cigarlike trunks. In one corner is a group of *Brahea armata* (Fig. 4), a beautiful palm with blue-green leaves and a finely ringed trunk. It also has bizarre inflorescence, and the flowers are carried on huge stalks several meters long.

A City Rainforest

At the center of the park lies the jewel of the gardens—The Fern Gully. Here, in a valley formed by a tiny stream, a mature temperate rainforest has been established. On entering you are in another world—cool, damp, shady, and lush. This has been achieved by a mixture of canopy-forming trees from many parts of the world, with majestic height and spreading branches. Beneath are various native and exotic ferns, and other moisture- and shade-loving plants, such as bamboos, orchids, and palms (Fig. 6).

Trunks of *Livistona* and *Archontophoenix* crowd you, their crowns often out of sight above. Both species flower and fruit freely and the ground is carpeted with seedlings. As in the wild, few of

these will survive for long, due to crowding and low light, but the lucky few that germinate in a slightly brighter spot grow rapidly. By and large these are left undisturbed here, and plants of all ages can be seen in a near-natural setting. Both *Howea* species grow here too, though they rarely flower or fruit, not being tall enough to obtain the open sunlight they require. Some very impressive clumps of *Rhapis* can be seen, some 5 m tall. Between the palm trunks are a few clumps of *Chamaedorea* sp.

High above in the canopy reside the gardens' most famous residents, a large colony of fruit bats. Though officially nocturnal, they seem to be light sleepers. They constantly disturb each other's sleep with their continuous chattering and squealing. Some of their favorite roosting spots are in the crowns of palms, giving them a bizarre appearance (Fig. 7). The bats spend all but the coldest months of the year here, feeding on flowers and fruits from trees in the park and nearby back yards.

The Fern Gully is a place of great peace and beauty—and only a mile from the office towers and traffic of the city center. In summer, its shady paths are a cool refuge from summer heat. In winter, when visitors are few, and the only sound is the flowing stream and the silent dripping of rain, it is truly a magical place, my favorite spot in all of Melbourne.

I've only had time to mention some of the highlights of these beautiful gardens. I hope I've been able to convince palm enthusiasts in Australia and overseas to put Melbourne on your list of places to visit. In 1996 the visitor can look forward to many special birthday events, from twilight concerts and stage events, to sculpture exhibits. Whether you take in these events, or simply stroll through the park and admire Nature's gifts, you will certainly enjoy your visit to the Royal Botanic Gardens, Melbourne.

Appendix. Palm species growing in the RBG Melbourne.

Archontophoenix cunninghamiana
A. alexandrae
Butia capitata
Brahea armata
Calamus muelleri
Chamaerops humilis
Chamaedorea elegans
C. microspadix
C. sp.
Hedyscepe canterburyana
Howea belmoreana
H. forsteriana
Jubaea chilensis
Linospadix monostachya
L. palmerina
Livistona australis
L. chinensis
L. decipiens
L. mariae
Phoenix canariensis
P. dactylifera
P. loureirii
P. pusilla
P. reclinata
P. roebelenii
P. rupicola
P. sylvestris
Rhopalostylis baueri
R. sapida
Rhapis excelsa
R. humilis
Sabal bermudana
S. sp.
Syagrus romanzoffiana
Trachycarpus fortunei
Washingtonia filifera
W. robusta
In the Glasshouse:
Archontophoenix alexandrae
Arenga australasica
A. engleri
A. westerhoutii
Calamus australis
C. caryotoides
Calyptrocalyx lauterbachiana
C. sp. *New Guinea*
Carpentaria acuminata
Caryota mitis
Chamaedorea microspadix
Coccothrinax argentata
Cryosophila warscewiczii
Dypsis lutescens
Hydriastele microspadix
H. wendlandiana
Licuala ramsayi
L. spinosa
Normanbya normanbyi
Pinanga sp.
P. sp.
Pholidostachys sp.
Pritchardia eriostachya
Ptychosperma sp. *"Ferguson Is."*
Rhapis excelsa
Thrinax radiata
Veitchia joannis
Wodyetia bifurcata

Appendix. Continued.

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Economically Important Rattans of Central Sulawesi, Indonesia

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Rattans are a large and diverse group of Old World climbing palms in the subfamily Calamoideae that are widely used throughout Asia for household purposes and furniture manufacturing. Perhaps nowhere is rattan more economically important than in the Indonesian province of Central Sulawesi where tons of cane are harvested for the furniture industry and thousands of households rely on rattan for cash income and domestic uses.

It is thus somewhat surprising that the rattan flora of Central Sulawesi remains poorly described and that little is known about its ecology or role in rural households. This paper identifies economically important rattan and their uses and values, estimates of plant and cane populations, and some of the opportunities and constraints to local management of wild rattan in southern Lore Lindu National Park (LLNP) in Central Sulawesi (Fig. 1). This region is of major conservation importance and is also a significant, but now illegal source of rattan cane (Schweithelm et al. 1992).

The Identity, Use, and Value of Rattan

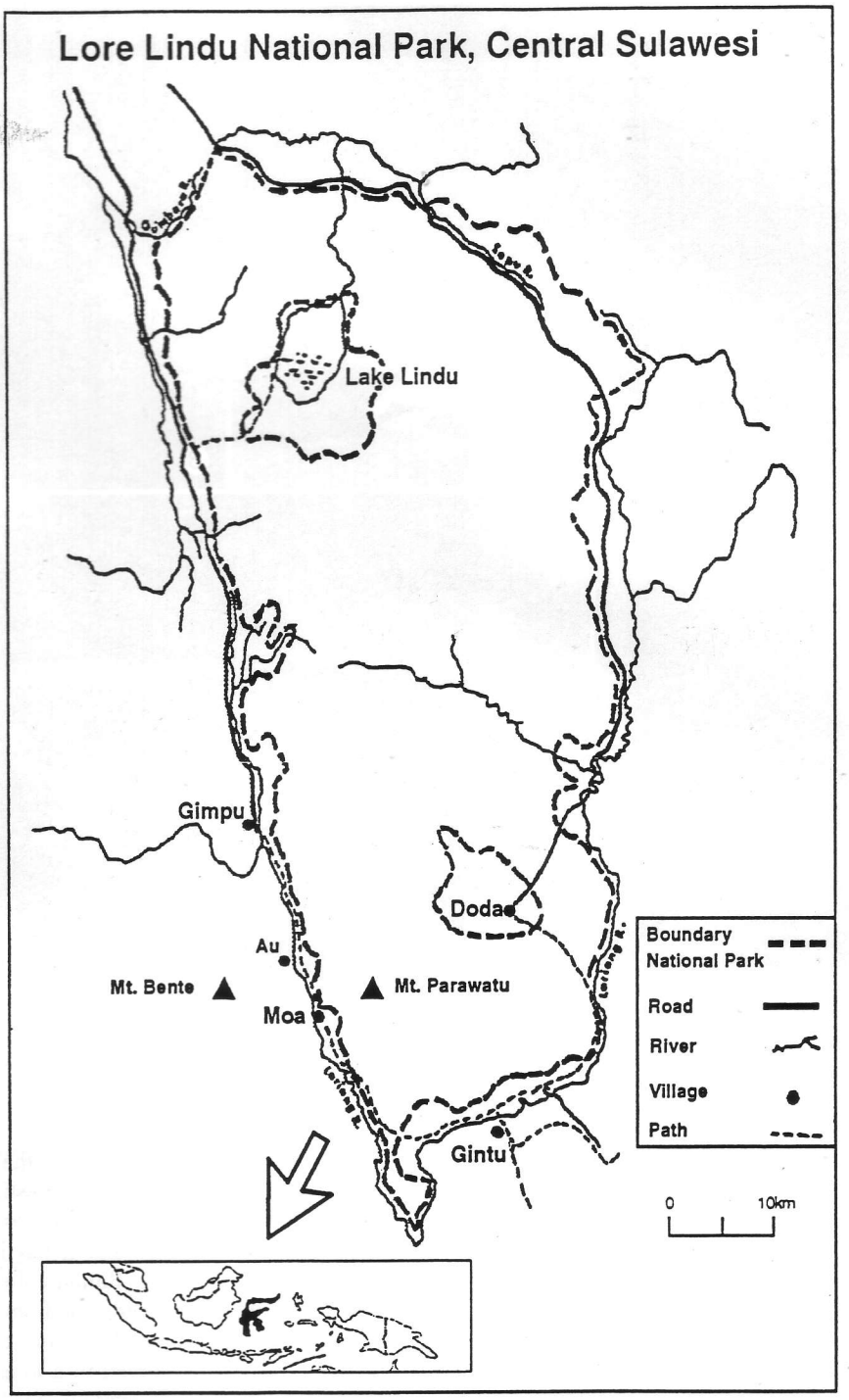
A survey of rattan use in two forest villages near southern LLNP, Moa and Au, suggests that six species are particularly important to rural households (Table 1). *Calamus zollingeri* ('batang'), a robust, clustering species, which produces high-quality, large-diameter canes dominates the commercial rattan trade. In addition, young 'batang' shoots are eaten as a vegetable and canes occasionally used in traditional medicine (in a solution of cinnamon, clove, and eucalyptus oil) for topical treatment of muscle ailments and broken bones.

'Togisi' (*Calamus leptostachys*) is also widely gathered. It is a solitary or clustering species that produces excellent-quality small-diameter canes, which are split for commercial sale or for household binding and weaving. 'Noko' (*Daemonorops robusta*) is a robust, clustering rattan that produces low-quality cane; it is not gathered commercially, but young shoots are prized as a vegetable and eaten regularly by local people. Boiled shoots of *C. zollingeri* and *D. robusta* taste somewhat like asparagus, with *D. robusta* preferred by most due to its sweeter taste. The rattans 'lambang' (*Calamus ornatus* var. *celebicus*), 'ombol' (*Calamus symphysipus*), and 'ronti' (*Calamus leiocaulis*) are collected commercially, for weaving into roofing shingles (leaves) and for binding, respectively, but are less widely used than the other three species.

Household economic reliance upon cane harvesting varies. Families who lack access to irrigated rice production, such as many in Moa, are particularly dependent upon rattan harvesting, while others collect cane only as a supplementary source of income. In Moa and Au, virtually all able-bodied men between the ages of 15 and 40 gather *C. zollingeri* cane for cash income at least occasionally. Cut cane is either sold in the village (to a local trader) or floated down river to Gimpu where purchase prices are higher. The cane is then transported by truck to the provincial capital of Palu where rattan processing facilities boil, straighten, remove exterior silica sheaths, and otherwise prepare the cane for shipment to furniture manufacturing centers on Java.

The volume of rattan harvested from the region is not known. The Indonesian Government reports that the entire Central Sulawesi province produced 17,300 tons of cane in 1993, with 5438 tons produced in Donggala District (Bappeda 1994). However, a rattan transport cooperative near Gimpu, a small subdistrict within Donggala, recorded 12,000 tons of cane transported out of the Lariang River drainage alone in 1993 (KUD, pers. comm.).

The economic importance of rattan to rural households can be glimpsed by working with collectors in the field. An experienced collector can gather approximately 200 kg of cane a day. Good-quality cane sells for Rp 100/kg in Moa or Rp 150/kg downriver in Gimpu; thus collectors can



1. Location of study area near Lore Lindu National Park, Central Sulawesi.

2. Large-diameter rattans such as *Calamus zollingeri* are used to make furniture in Java. 3. The rattan *Calamus zollingeri* prefers high-light environments such as those found in natural tree fall gaps. 4. *Calamus leptostachys* produces high-quality cane that is split and used for binding and basketry. 5. Rattan canes are floated down river where they are loaded onto trucks for transport to cane-processing facilities in Palu, Central Sulawesi.

earn up to Rp 20,000/day (US $1 = Rp 2,200; 1995). Average earnings from cane harvesting are much lower than this due to time spent transporting cane from forest to market and the tiring nature of the work, but still exceed alternative wage opportunities.

Rattan Plant and Cane Supplies in Natural Forests

To estimate rattan populations, I established three 10 × 500 m transects in primary collecting areas near Moa and Au and recorded the number of plants and canes, evidence of harvesting and sprouting, and cane lengths of the six locally important species (Table 2). Interestingly, *C. zollingeri* is the most abundant species is all sites, notwithstanding the fact that it has been repeatedly harvested for years. Rattan collectors in Au, for example, have gathered cane from the sampled forests for approximately 20 years. Similarly, 396 cut canes/ha were observed in a forest near Moa, with 140 canes/ha still available for harvest.

The effects of rattan harvesting on plant and cane populations are not known. This preliminary study suggests that *C. zollingeri* populations may be lower (76 vs. 176 and 104 mature plants/ha)

Table 1. Economically important rattans in Moa and Au, Sulawesi.

Species	Local Name	Uses, Market and Value
Calamus leptostachys Becc. ex Heyne	togisi	binding (hh[a] and sale) (Rp 2,500[b]/100 split canes)
Calamus leiocaulis Becc. ex Heyne	ronti	binding (hh and sale) (Rp 2,500/100 split canes)
Calamus ornatus var. *celebicus* Becc.	lambang	secondary commercial cane (Rp 50–150/kg) fruits (hh)
Calamus symphysipus Becc.	ombol	roofing (hh and sale) (Rp 200/shingle)
Calamus zollingeri Becc.	batang	primary commercial cane (Rp 100–350/kg) food (shoots; hh and sale) (Rp 100/shoot) medicine
Daemonorops robusta Warb.	noko	roofing (hh and sale) (Rp 200/shingle) food (shoots; hh and sale) (Rp 100/shoot)

[a] hh—used for domestic household purposes, not sold.
[b] Rp 2,200 = US$ 1.00 (1995).

Table 2. Rattan populations in forests near Mao and Au, central Sulawesi (summary of data from 10 × 500 m transects). na—not applicable; plants not harvested for this purpose.

	Plants (ha)		Canes (ha)		Sprouts (ha)	Mean Cane Length
Species	Mature	Immature	Mature	Cut	Cut for Food	(m)
C. leptostachys						
Moa	30	336	16	4	na	14 ± 10
Moa	16	178	8	0	na	10 ± 7
Au	32	418	28	0	na	18 ± 13
C. leiocaulis						
Moa	2	44	2	0	na	15
Moa	10	14	12	0	na	14 ± 5
Au	12	50	10	2	na	11 ± 6
C. ornatus						
Moa	14	132	4	0	na	29 ± 24
Moa	20	162	20	0	na	16 ± 9
Au	6	4	10	0	na	11 ± 3
C. symphysipus						
Moa	4	24	na	na	na	9 ± 2
Moa	8	52	na	na	na	10 ± 1
Au	0	4	na	na	na	—
C. zollingeri[a]						
Moa	174	612	140	396	18[a]	28 ± 16
Moa	104	392	98	166	16[b]	25 ± 14
Au	76	308	38	108	0[b]	16 ± 8
D. robusta						
Moa	10	620	na	na	8[b]	13 ± 6
Moa	20	988	na	na	30[b]	15 ± 4
Au	22	608	na	na	4[b]	15 ± 6

[a] Aggressive, clustering species; not all immature are distinct individuals.
[b] Immature, young shoots eaten, evidence of previous collection does not persist (no woody cane stumps).

and mean cane lengths shorter (16 m vs. 28 and 25 m) in Au, where cane-harvesting pressures are greater, than in Moa; only 508 m of harvestable *C. zollingeri* cane/ha were observed in the Au forest, while 2,450 and 3,920 m/ha were observed in Mao. On the other hand, rattan collectors in Au report no changes in the availability of *C. zollingeri* canes over the years. Rattan populations in Au and Moa may simply differ due to edaphic, elevation, and other environmental variables.

Conservation and Management Implications

The effects of rattan harvesting on plant and cane populations are part of an ongoing study that seeks to develop sustained-yield cane-harvesting guidelines and explore opportunities for local management of rattan. At present, large quantities of *C. zollingeri* are harvested illegally from within Lore Lindu National Park. However, local residents collected rattan in this area long before it was designated as a park and many believe they have traditional rights to forest products.

The Director of the Indonesian Department of Forestry Conservation recently indicated that the Government of Indonesia may support the establishment of traditional-use zones in Lore Lindu National Park. This represents a significant departure from the strictly preservationist policies of the past. To establish traditional rattan-use zones, it will first be necessary to determine the abundance of rattan plants and canes, cane resprout and growth rates, the effects of cane harvesting on other flora and fauna, existing customary and legal systems of forest extraction rights, and means by which forest communities might manage rattan harvesting.

At present, Au appears to be the only village in the region that is attempting to manage rattan extraction. In 1989, Au villagers unilaterally declared that rattan gathering in the forests to the west of the village would no longer be open access, but would instead be reserved for the exclusive use of Au residents. Their rationale was to insure a continued supply of rattan for home use and cash income, and to protect the watershed upon which the village's irrigated rice fields depend.

The attempt by Au residents to manage rattan resources raises several interesting questions. What is the history of forest product access in Au and how did the community establish an exclusive-use zone? Is the exclusive-use zone respected by rattan collectors from neighboring villages and if so, why? How was Au able to implement these guidelines on public forest land without involvement by Indonesian government authorities? Is the current rate of rattan harvesting sustainable? Answers to these questions must await further study. However, it is interesting to note that Au collectors gather most *C. zollingeri* cane within one-hour walk of the village and most *C. leptostachys* cane within 20 minutes, all from the village forest. Furthermore, village leaders and rattan collectors from nearby villages report that they are aware of and respect the Au exclusive-use zone.

Joint community and government management of forest resources poses many challenges. However, Au residents appear to have initiated several components of effective forest management, including defining rightholders, the type of rights granted, and when and where these rights extend. If rattan can be harvested on a sustainable basis without adversely affecting biodiversity conservation objectives and if local communities can manage cane harvesting on public lands, granting forest villages exclusive-use zones for the extraction of rattan could generate much-needed incentives for conservation among a population that is currently distrustful of park management efforts.

Acknowledgments

This research was made possible through the generous field assistance provided by Arnol and War of Moa and Yosialue of Au. Johannis Mogea and Padmi Kramadibrata identified the rattan; voucher specimens are deposited in Herbarium Bogoriense. Marty Fujita and Nengah Wirawan of The Nature Conservancy provided crucial logistical support and Jill Belsky shared ideas and critical insights. The research was supported under Grant No. HRN-5600-G-00-3047-00, Program in Science and Technology Cooperation, Human Capacity Development, Bureau for Global Programs, Field Support and Research, USAID; and the University of Montana.

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CHAPTER NEWS AND EVENTS (*Continued from p. 28*)

Palm Symposia in Tenerife, Canary Islands, Spain in February 1997

The Canary Islands Agricultural Research Institute (ICIA), the International Society for Horticultural Science (ISHS) and the Spanish Society for Horticultural Science (SECH) have organized the Second International Symposium on Ornamental Palms and other Monocots from the Tropics (PALMS97) to be held in Tenerife (Canary Islands, Spain) on February 3–6, 1997.

Anyone with internet access can obtain additional information about it at the URL http://www.icia.rcanaria.es/eventos/palms97/in_palms97.html. If you don't have internet access, please contact: Manuel Caballero-Ruano, I.C.I.A.-Dto. Ornamentales, Apdo. 60 38200 La Laguna, Tenerife, Spain by mail, telephone (34 22) 476331, fax (34 22)476303, or email: mcruano@icia.rcanaria.es for more information.

Fous de Palmiers (France) News for First Half of 1996

The new year got off to a great start for 12 Fous, who spent 10 days discovering the palms of India, escorted by member Jan Duclos-Maim who organized the trip. After flying from Paris to Bombay they were welcomed by a sentinel of two *Roystonea,* the beginning of a voyage of discovery that would take them from Goa to Hampi, admiring on the way *Borassus flabellifer, Phoenix sylvestris,* and *Cocos nucifera,* to name just a few of the species. Following their trip they put together a beautiful "carnet de voyage" with text written by author Georges Marbeck and photos by Jean-Pierre Godeaut.

In February a visit to professional palm growers in and around Hyères-Les-Palmiers was organized and 30 members from Perpignan on the Spanish border to Menton on the Italian border came to learn and see what was for sale.

On March 16, there was a visit to the Domaine du Rayol on the Riviera, attended by 35 people. From now on, this will be scheduled as an annual event. The same day up north, Jean Gourier organized a visit to the tropical greenhouse of the Jardin des Plantes in Paris, a get-together appreciated by members who do not live in the South of France. On the weekend of March 30–31, the city of Pradet organized a festival of rare plants coinciding with the Mediterranean Assembly of Nurserymen-Collectors. The Fous are signed up for next year for this exceptional event.

The month of May marked the beginning of our campaign to encourage planting *Jubaea chilensis* widely throughout western and southern France as well as points north, including Paris. With extensive media coverage, thanks to journalist Michel LIS on both television and radio, our operation *Jubaea* began at the plant expo on the grounds of the Château de Courson near Paris. The operation was initiated by Jean Gourier and Jan Duclos-Maim, with the patronage of Professor Juan Grau of Chile. They were assisted by Jean-Michel Doremus, Thierry Vourch, and Didier Borderioux, who was nicknamed the "Germinator" due to his success in germinating *Jubaea* seed and his generous donation of seedlings for the operation. We signed up more than 30 new members at Courson and gave away more than 200 plants and hundreds of seeds. The association was overwhelmed by the response to the campaign, receiving more than 2 000 letters requesting information/plants/seeds of *Jubaea.* It is our way of thanking previous generations of palm nuts for planting the *Jubaea* that we enjoy today and making sure there will be many more, wherever they can grow and prosper, both in France and elsewhere in Europe!

The annual visit of the Villa Les Cedres at St. Jean-Cap Ferrat drew 50 visitors on June 7, always a popular event. The following weekend, 10 Fous visited private gardens in Venice, Italy, discovering the palms growing there. The city of Hyères-Les-Palmiers organized a two-day event, June 20–21, entitled "Journéés Techniques Sur le Palmier," which included talks and demonstrations.

We finished the semester with the publication of our journal, *Le Palmier N° 14,* bigger and better than ever. For this issue, we adopted a new format, the same in size as that of *Principes*, 32 pages in all, with numerous black and white photos and drawings. This issue included articles by Gérard Dorin relating his experiences growing palms and

(*Continued on p. 54*)

Principes, 41(1), 1997, pp. 48–49

Palm Conservation Action Plan Completed

More than a decade of collaborative work to assess the conservation status and utilization patterns of the world's palms has culminated in the publication of the IUCN, Species Survival Commission, Palm Specialist Group's action plan. The Action Plan itself is the result of the collective efforts of 30 palm specialists from around the globe.

The objectives of the Palm Action Plan are to identify the most threatened palm species, to present recommendations for conservation that satisfy their specific requirements, and to provide strategic guidelines for the conservation and sustainable utilization of the many palms that provide food, construction materials, and so on, as well as an important source of income for many people.

The increasing demands on the world's natural resources pose a serious threat to palm biodiversity. The two main threats are habitat destruction and overexploitation. Habitat destruction poses the most permanent and widespread threat to palms throughout the world, but particularly in tropical cloud and rain forests. Species whose habitat range is limited to a small area are most at risk. The situation is particularly alarming for those species restricted to islands. Of the 224 Endangered palm species identified, 141 are restricted to islands (including 69 species from Madagascar and 19 from Borneo). Eleven of these palms represent monotypic genera and therefore are of special concern.

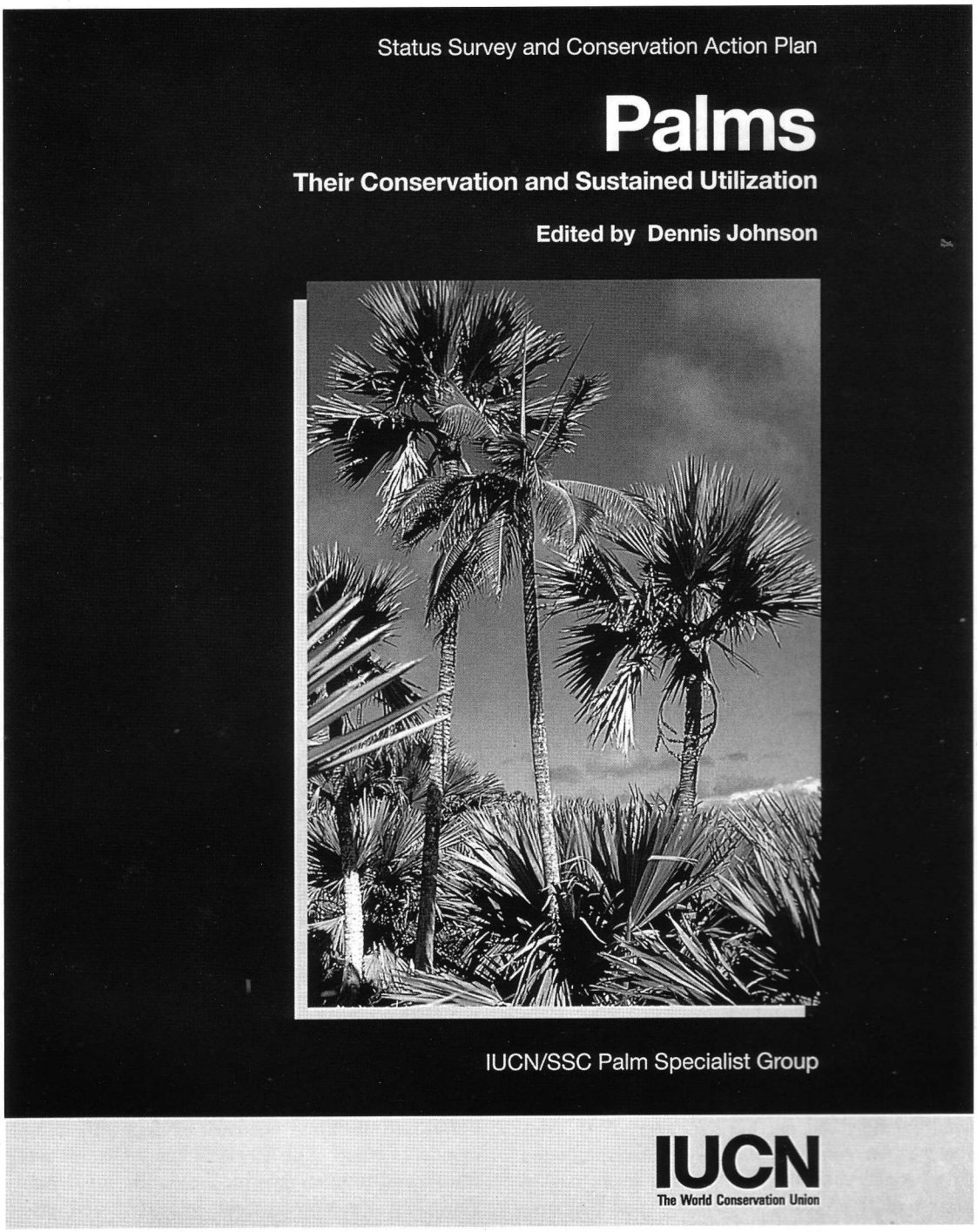
Overexploitation is nearly as serious in some instances. The population decline of commercial wild rattan palms used in furniture making has had severe impacts on local and international markets, not to mention local biodiversity. Species used for edible palm hearts, timber and fiber, and ornamental plants are others whose populations are in serious decline. The Action Plan identifies where extraction is sustainable and where, on the contrary, overexploitation may be contributing to extinction.

Chapters 1 through 5 of the Action Plan give background information on the Palmae including the taxonomy, distribution patterns, and references to the significant literature on the family. The importance of taxonomic knowledge, habitat protection, and *ex situ* conservation is discussed in the context of the overall conservation of palms.

Regional overviews with specific country accounts are presented in chapters 6 through 11. These accounts highlight the most endangered species, provide specific recommendations for conservation action, and indicate where more research is urgently needed before even remedial action can be taken. Chapter 12 is a summary and assignment of priorities of the conservation actions discussed earlier. Among the top priorities are:

- Compilation of palm conservation checklists for the Atlantic Forest of Brazil and the forests of Irian Jaya and Papua New Guinea, followed by the establishment of appropriate conservation management plans.
- Implementation of management plans for Endangered palms in Madagascar and the Mascarenes, as well as on the islands of Vanuatu, Fiji, and Hawaii.
- Carry out rescue actions for other palms on the verge of extinction in Cuba, Egypt, India, Sri Lanka, and Malaysia.
- Conduct field studies to assess conservation status and requirements of a large number of palms with unknown or Indeterminate status.
- Establish a secretariat for the Palm Specialist Group to serve as a source of technical data and information, carry out fund raising, disseminate information about palms to the general public and to educational institutions, and to coordinate global palm conservation efforts.

The Palm Action Plan is intended for use by conservationists in all sectors of society including scientists, policy makers, government officials, educators, planners, and grant-awarding organizations. Scientists are encouraged to use this Action Plan in direct consultation with policy makers, government officials, and grant-awarding organizations when developing their research projects. Government officials and policy makers in turn may use the project ideas to develop plans for broad-based conservation initiatives to include a number of threatened plant and animal groups.



Members of the Palm Specialist Group will endeavor to stimulate the implementation of the recommendations contained in the Plan. The various palm societies, commercial nurseries, and individuals are encouraged to join the efforts to protect and preserve the biodiversity of this important plant family.

DENNIS JOHNSON

Principes, 41(1), 1997, pp. 50–51

Callus Formation from Inflorescences in Rhapis excelsa

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ABSTRACT

The purpose of this study was to develop a method for vegetative propagation of *Rhapis* palm through tissue culture. Young inflorescences were used as an explant source. For callus induction different concentrations of auxins were evaluated. Callus was induced on most of the inflorescences tissues with the highest concentrations of growth regulators.

Rhapis are decorative, small, clump-forming fan palms, useful for planting in many situations, as they have a graceful shape and may be used both outdoors and indoors, growing in low light conditions. *Rhapis excelsa* is one of the best garden palms but because of its very slow growth plants tend to be expensive and therefore the species is not widely planted (Jones 1984). Some larger specimens or some rare species, such as the variegated *Rhapis* are worth several thousands dollars (Reynolds 1982).

Most propagation is by division of the clumps, but each mature palm produces an average of two offshoots per year (McKamey 1983). Seeds are not usually available (Rodríguez 1994). "However, they are more readily available than in 1983. The problem is still finding reliable seed sources which will supply true *R. excelsa,* not *R. subtilis* or *Guihaia.* A seedling takes three years to develop mature leaves, and only then can it be correctly identified as *R. excelsa.* Many growers have made quite an investment in seed, only to discover years later that they did not have *R. excelsa*" (L. McKamey, pers. comm.). When seeds are germinated in the usual manner, this process takes two to three months or more, depending upon temperature (Blombery and Rodd 1982). Several researchers interested especially in palms have developed protocols for clonal propagation of oil palm (*Elaeis guineesis* Jacq.), date palm (*Phoenix dactylifera* L.) and coconut (*Cocos nucifera* L.) using tissue culture technology. The aim of this study was to evaluate the effect of auxins on callus formation and plant regeneration to find a more efficient method for clonal propagation.

The inflorescences, which arise from the upper leaf sheaths, are male and female on separate plants and usually pinkish at the beginning, turn light green and finally white at anthesis (Blombery and Rodd 1982; L. McKamey, pers. comm.). Pollination requires both male and female plants (McKamey 1989). For collecting immature *Rhapis* inflorescences we used a technique developed by Rillo (1989) to collect nondestructively immature coconut inflorescences for tissue culture purposes. The inflorescences were surface sterilized by immersing them for 20 min in 2% (w/v) calcium hypochlorite solution and adding three rinses in autoclave distilled water after the sterilization.

The outermost sheath of leaves was carefully removed under sterile conditions and discarded. Inflorescences were sliced into 1–2 mm sections and inoculated onto MS medium (Murashige and Skoog 1962), supplemented with auxin and activated charcoal. The pH of the medium was kept at 5.6–5.8 by using sodium hydroxide prior to adding agar. Medium was sterilized in an autoclave at 121°C and 1.2 kg/cm^2 for 15 minutes. Explants were cultured in a growth chamber at 25° ± 2°C under dark.

As reported for many palms, *Rhapis* callus production was very slow. The first sign of callusing (floral bud swelling) becomes evident after three months (Verdeil et al. 1994). When the callus was transferred to medium with a reduced auxin concentration the development increased and produced more defined white structures, ensuring calloid growth. The results showed that auxin, at selected levels, promoted callus formation on immature inflorescences of *Rhapis excelsa.* After three months of incubation in the dark, calli were white to pale yellow in color and had a hard con-

1. Callus formed from immature inflorescences of *Rhapis excelsa.*

sistency (Fig. 1.) Several tissues from mature donor plants have been used as starting explants in reliable protocols for palm plant regeneration. Immature inflorescences represent an important explant source for somatic embryogenesis of oil and coconut palm trees (Texeira et al. 1994, Verdeil et al. 1994).

The work with oil palms shows that other palms may be similarly propagated by tissue culture. The results presented here proved that callus can be induced and multiplied from inflorescence explants of *Rhapis* palm. Success in obtaining callus was probably the result of using very young inflorescences and the presence of a suitable concentration of auxin and activated charcoal. Similar results were achieved for male and female inflorescences, although male ones formed calli in all auxin concentrations. However, female inflorescences responded only to the highest levels of these plant growth regulators.

Histological studies performed by Verdeil et al. (1994) showed that globular white callus was formed from male floral meristems. They observed a very highly significant influence of 2,4-D concentration on the percentage of explants bearing callus. The auxin concentration was reduced during several subcultures followed by addition of BAP. Calli produced in cultures derived from immature inflorescences of *Rhapis* palm was similar to those observed in callus lines derived from immature inflorescences of coconut (Verdeil et al. 1994) and oil palm (Teixeira et al. 1994).

Micropropagation should find a ready application in the coconut, date, and oil palm industries and in the production of desired ornamental palms. Only the techniques of micropropagation will allow a rapid increment in sufficient number of *Rhapis* palms. Vegetative multiplication of the individual remains a promising possibility for the production of homogeneous planting material and for substantial improvement in plant homogeneity.

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Principes, 41(1), 1997, pp. 52–53

Observations on Abnormal Developmental Patterns of Axillary Buds in Date Palm (Phoenix dactylifera)

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ABSTRACT

Two patterns of probably advanced development of mixed axillary buds in date palm, *Phoenix dactylifera* L., cultivar '*Mishrig Wad-Khatib*' are reported. It appears that this cultivar is particularly prone to produce abnormal shoots and would repay further studies on such developmental patterns.

Studies on axillary buds of the date palm, *Phoenix dactylifera* L., were initiated by Faris in 1932 (Faris 1932). However, further studies are few despite the importance of axillary buds in date palm yield and conventional vegetative propagation or in vitro micropropagation (Bouguedoura 1982, Booij et al. 1993). Reuveni et al. (1974) recognized the presence of distinct vegetative and inflorescence buds in date palm. Recently four types of axillary buds are recognized in the date palm—vegetative, fertile inflorescence, sterile inflorescence, and mixed buds, which show the morphological characters of the first two types (Bouguedoura 1982). The palm produces most of the vegetative buds during its early stage of growth (youth stage) (Bouguedoura 1980, 1982). During this stage the mixed buds are also produced although in a low frequency (1%) (Bouguedoura 1980, 1982). Fertile inflorescence buds are produced during the mature reproductive stage but some vegetative buds may develop in this stage and grow into offshoots (high offshoots).

Observations on Developmental Patterns of Mixed Axillary Buds

This note reports two developmental patterns of lateral growth in date palm, cultivar '*Mishrig Wad-Khatib*' that probably resulted from the development of mixed axillary buds.

Fig. 1 shows a lateral growth on a young, fruiting, date palm with vigorous growth, cultivar '*Mishrig Wad-Khatib*', 50 cm above the soil level. Dissection from the base shows that there were full-grown prophyll-like bodies packed one within the other. Leaflets were recognized on the outer bract-like bodies. The lateral growth thus resembles an offshoot.

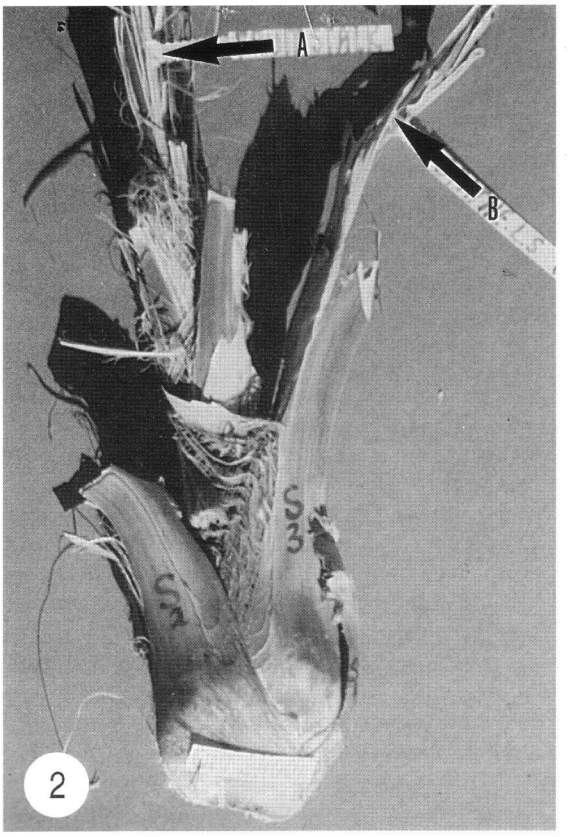
Up to this stage this description resembles what was reported by Davis (1967) on coconut and described as inflorescence growing into simple shoots. However, Figure 1 shows further development as the central growth, inflorescence-like structure, terminated in a narrow growth that carried out of season flowers then parthenocarpic fruits. No development of rachillae was recognized. Bouguedoura (1988) (pers. comm.) stated that she observed a date palm bract that enclosed developing leaves and suggested that the above phenomenon may represent an advanced stage of development of a mixed axillary bud, which gives rise to leaf-like structure followed by flowers and fruits.

Figure 2 shows another developmental pattern of a lateral growth on the same date palm cultivar. Dissection shows that true leaves were produced first followed by the development of bract-like structures and a terminal inflorescence-like structure showing flower sites. The axillary bud subtended by leaf number (3) developed into a bract-like structure.

This phenomenon is well known to local date palm growers in the northern region of Sudan. They describe the above lateral growth as an aborted offshoot and often discard it. They acknowledge its occurrence in high frequency in this cultivar in particular.

Discussion

The common position of vegetative and inflorescence buds in palms is axillary (Fisher and Dransfield 1978). In palms each offshoot is of unlimited growth and not terminated by flower or



1. Axillary growth in date palm. (A) Outer bract-like body terminated with leaflets. (B) Inflorescence-like structure bearing parthenocarpic fruits. 2. Axillary growth in date palm. (A) Terminal inflorescence-like structure. (B) Bract-like body in the axil of the third leaf.

inflorescence (Moore and Uhl 1982). The two developmental patterns described above are contrary to the normal pattern of shoot growth in date palm. The position of these abnormal growths on the palm was consistent with the statement of Bouguedoura (1980) that mixed axillary buds are produced during the vegetative stage of the palm growth. If the origin of this lateral growth is a mixed axillary bud, these observations indicate different developmental patterns of mixed axillary buds. The date palm cultivar '*Mishrig Wad-Khatib*' is a suitable cultivar for further studies on mixed axillary buds.

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CHAPTER NEWS AND EVENTS (*Continued from p. 47*)

other exotic plants in a cliffside village in Dordogne, a new species of palm discovered in New Caledonia discussed by Jean-Christophe Pintaud, the latest in the saga of the palms of the city of Pau in southwestern France by Maïté Lefevre, a fascinating study of *Copernicia*, the wax palms, by Pierre-Olivier Albano, and the enigma of the *Sabal* palms in France written by Jacques Deleuze, not to mention the news of the association.

Fous de Palmiers has grown by leaps and bounds in 1996 and is now one of the biggest chapters of IPS, counting more than 600 active members, not only in France but elsewhere in Europe and around the globe.

STEVE SWINSCOE
IPS Chapter Representative
Fous de Palmiers

Central Florida Palm Society (CFPS) Seed Distribution

The Central Florida Palm Society (CFPS) has been distributing palm seeds for some time among members of the local chapter. Earlier this year, we started listing our offerings worldwide on the PALMS-ALL internet listserver (or ipsc list) provided by the IPS as a members' service, and the response has been tremendous.

Seeds distributed under this mechanism have included *Syagrus orinocensis* (single trunk form), *Catoblastus* (*Wettinia*) *praemorsus, Ceroxylon interrupta, Borassus* sp. aff. *B. aethiopum, Syagrus schizophylla, Bismarckia nobilis, Copernicia macroglossa,* and *Roystonea borinquena.* Suggested donation amounts have varied from a few cents per seed up to $3 each for the large *Borassus.*

The CFPS has greatly benefited from this effort as a way to help increase funds for chapter activities. The involvement of all members of the local chapter is encouraged to provide seed from their own collections, as well as seed provided from other contacts. We thank Joe Michael (Florida) and Cesar Diaz (Venezuela) for their generous contributions to our effort.

Perhaps this mechanism, with a wider participation from all IPS chapters, can take the place of the central IPS Seed Bank recently discontinued by the International Palm Society. Our goal is not to compete with seed vendors, but rather to supplement what is available to the members of IPS. It's easy and fun, and we can take pride in bringing everyone who shares this admiration of palms closer together.

NEIL YORIO
Central Florida Palm Society

News from the South Florida Chapter

The South Florida Chapter of the IPS conducted a field trip to "Tour the Gardens of North Dade" on September 28. The tour group met at the home of President Dan Keys promptly at 9 a.m., then toured a number of palm-rich gardens. These were private gardens not typically open to the public.

The group met at Fairchild on October 22 for "A Fall Show & Sale Slideshow Preview." Lester Pancoast arranged and showed slides collected from various sale vendors, featuring palms to be available at the upcoming Fall show. This was followed less than two weeks later by the "World's Largest Palm Show and Sale" on November 2–3 at Fairchild Tropical Garden. Further details of this show and sale will follow later.

FTG members also enjoyed the garden's annual "Ramble—A Garden Festival" on December 7–8. Fairchild Tropical Garden will also hold their 1997 Spring Plant Sale on April 26–27. Many unusual plants, including palms, will be offered for sale by the garden.

The Chapter's December meeting featured Chuck Hubbuch, Fairchild's Curator of Palms, who spoke on "Palms of the Caribbean Basin." In addition, a new Board of Directors was announced.

News from the Palm Beach Chapter

Over 100 people attended our annual picnic and auction in September at Ruth Sallenbach's botanical paradise. Attendees came from all over Florida, from as far away as Key West, Melbourne, and Ft. Myers. There were a huge variety of palms, cycads, and other rare and unusual plants at the auction, which raised $1,400 for the chapter.

Results from our Fall Sale, held October 12 and

13 at Morikami Park, were outstanding considering that rainy conditions held down attendance. Over 1 100 palms and cycads were sold for total sales of $19,264 (of which $16,291 was in plant sales).

The Chapter met on November 6 to hear Chuck Hubbuch from Fairchild Tropical Gardens talk on the palms of Haiti and the conservation work being done to save them. For the auction, he brought an *Attalea crassispatha*—one of the rarer palms in the Americas as well as one of the most beautiful.

Our Annual Christmas Party was held on December 4 at Mounts Botanical Garden. Santa provided lots of goodies. The first 1997 meeting will be in February.

News from the Broward County, Florida

On Sunday, November 16, starting at noon, The Broward County Palm & Cycad Society held their Annual Picnic at Flamingo Gardens. Barbecue was provided. There were free palms provided to all attendees, and of course lots of good company.

Gulf Coast Chapter News

The summer meeting of the Gulf Coast Chapter was held at the home of Dr. and Mrs. Tom Mignerey in Cantonment, Florida (Pensacola) on July 21, 1996. We were joined by members of the Louisana Chapter. A covered dish lunch on the grounds provided a pleasant setting for socializing and the informal meeting. The "covered dish" format worked so well it was decided to continue the practice for future meetings. A very successful plant auction was held.

In response to a request for a new editor of the chapter newsletter *Fan & Feather,* brothers Bill and Joe Watkins agreed to serve as co-editors.

A luncheon in the beautiful palm garden of Maxwell Stewart in Mobile, Alabama, was the setting for the chapter's fall meeting on October 25, 1996. Maxwell's extensive landscaping and variety has created a park-like display of palms. Highlights of the meeting included amending chapter by-laws and an auction, which included palms rarely planted in our area.

Panama City Vice-President Frank Storli reports that talks with the city about moving the very unusual four-headed *Butia capitata* are progressing.

Mobile Vice-President Tim Gwaltney reports that several palms were donated to Sister City Fairhope for planting in the Fairhopers' Community Park. Donated plants included *Trachycarpus* sp., *Serenoa repens* "Silver," *Chamaerops humilis,* and *Cycas revoluta.*

JOE WATKINS
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Improved IPS Palm "Photographic Library" on the World Wide Web

The IPS has had a rudimentary library of palm & cycad "photographs" or "graphical images" in place on the IPS web site for quite a while. Over the past several months, many members have contributed additional graphics images (generally scanned photographs) and other members have made available images on their own web sites for direct linking. In addition, more palm photos from former issues of *Principes* and the journals of the many IPS affiliate societies have been scanned and added to this library, with an emphasis on color images.

As a result, this photo library now includes photographs of a wide variety of different palm species, many of them rare and unusual. These are actually magnetic files in either JPG or GIF format, readable by a wide variety of graphics software and importable into major Word Processing software packages such as Microsoft Word for Windows and others.

This photo library can be reached by taking the hot link to "palms & cycads" on the main IPS home page at URL = http://palms.org/ where you will be led to an alphabetical list on the various palms in the linked library, along with the source of the image. As mentioned, many of these are actually images in the IPS internet server directories, from where they can be readily downloaded to your own computer. Others are links that will take you to those images on web pages constructed by others.

If you have images (or photographs) you would like to see uploaded and maintained on the IPS web space and are not familiar with how to do this, then please contact Jim Cain for further information (see also additional related information on FTP upload in the recent IPS Membership Directory that you received with your October 1996 *Principes*).

JIM CAIN
104706.666@compuserv.com

Louisiana Chapter News

The Louisiana Chapter of the IPS met on August 25 at the home of members Kit Blue and Robert Whitney. Prior to the meeting, the group enjoyed an epicurean feast provided by the host, featuring seafood lasagna prepared by Kit's son, Robert Bruce, chef at the Palace Cafe. If that was not enough, the group was treated to live entertainment, with pianist Joey Arndt providing the melodies. Twenty-five members were present. A palm auction was held featuring four beautiful palms donated by local nurseries: American Aquatic Gardens (*Butia capitata*), Daly Landscape (*Livistona chinensis*), The Plant Gallery (*Trachycarpus fortunei*), and Talen's Nursery (*Syagrus romanzoffiana*). In addition, a nice *Phoenix roebelenii,* donated by Isidore Grisoli, was raffled off, as was a smaller specimen of *Sabal causiarum.*

The first meeting in October was held on the beautiful Bayou Barataria in Jean Lafitte at the home of members Joe Baucum and Cindy Telkamp. Members were encouraged to visit the Jean Lafitte National Park either before or after the meeting.

The group also held a joint meeting with the Gulf Coast Chapter at the home of Maxwell and Gloria Stewart (see write-up under Gulf Coast Chapter news).

Palm & Cycad Society of Southwest Florida is Formed

On August 24, the newest Florida Chapter, the Palm & Cycad Society of Southwest Florida, was formed. The group elected Bill Garcia—President, David Prall—Vice President, and Sally Betts—Secretary/Treasurer. The meeting was held at Palm Tree Gardens in Cape Coral, which is the private plant collection of David and Geri Prall. David led a group of over 40 people for a garden tour of their plant collection, consisting of over 250 different species of palms and cycads, along with bromeliads, orchids, succulents, and other plants. Since the Pralls have been members of the International Palm Society and have been collecting plants since the early 1980s, they have many mature specimens in the landscape. Geri Prall showed the attendees the new Palm & Cycad shirt that was first introduced at the Biennial in Southern California this August. The T-shirt is now available for sale at meetings, palm sales, and by mail order.

Larry Noblick, Director of Collections at The Montgomery Foundation, identified some of the *Syagrus* hybrids in the Prall collection. Ed and Nancy Hall, Secretary/Treasurer of the Central Florida Chapter of the IPS, were on hand to lend their expertise to the newly founded chapter. A plant raffle was held after the elections; Bill Garcia won the door prize.

The new chapter will be holding meetings at palm collections throughout the Fort Myers/Lee County and Naples area. Meetings are scheduled tentatively for 10 a.m. on the fourth Saturday of every month. Any members interested in attending the meetings should contact one of the officers listed above for final information on date and place. The new chapter has applied for formal affiliation as a Chapter of the International Palm Society.

GERI PRALL
Southwest Florida Palm & Cycad Society

Central Florida Palm Society News

The fall 1996 meeting of the Central Florida Palm Society Chapter of the IPS was held at the home of Bob and Marita Bobick on November 9. The social part of the meeting began at noon, allowing 2–3 hours to walk the garden, socialize with fellow CFPS members and guests and time to talk palms. This was followed by a very sucessful plant auction and then a formal meeting.

Several exciting changes are taking place in the CFPS chapter. John Stryjewski presented a summary of new bylaws that several members have been putting together. These were well received by the audience. Neil Yorio summarized his and Mike Dahme's seed distribution efforts (see "Central Florida Palm Society [CFPS] Seed Distribution" in this *Principes* issue). Liz and John Stryjewski also presented the format they are proposing for the new CFPS Bulletin for general discussion. New officers were elected as well and the CFPS is looking forward to the new direction the chapter it taking. Following the formal meeting, with their usual flair, the Bobicks transformed a pot-luck dinner into a gourmet affair. Paul Craft and Peter Mayotte then gave a slide show (despite the slide projector's objections to the unusually cold night) of their recent trips to Cuba and the beautiful palms they have seen there. A bonfire was lit for those that wished to relax and enjoy further socializing.

The University of South Florida (USF) Fall Sale was held on October 12. The Fall sale is compar-

atively new, with a sale formerly only in the Spring. The Harry P. Leu Gardens will also be holding a plant sale on April 5 and 6, 1997. Admission to the gardens will be free.

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News from Western Australia

The Palm & Cycad Society of Western Australia (PACSOWA) met at the Leederville Town Hall, Cambridge Street, Leederville on October 21, 1996. The main theme of the meeting was a discussion by the Committee and other interested members of the various palm look-a-likes that can be found in Perth, which are often confused with true palms or cycads. Members who own "look-a-likes" and wanted to discuss them were encouraged to bring them along. In addition, George Sevastos gave a short talk about *Acanthophoenix rubra,* a rare palm from the Mascarene Islands.

Another display and plant sale was held by the Society at the Dianella Shopping Centre on November 14–16.

Only a few members turned out for the Gascoyne Park September 28 workday. They were John Banasiewicz, Linda Therkelsen, Karen Surace, Barry Shelton, and Cliff Britto. Despite the small number of people, quite a lot of work was accomplished. Among other tasks, Barry and Cliff bought along two *Brahea edulis* that they had dug up from Norm Patterson's garden. The next working day for Gascoyne Park was held on October 26.

The trip to Wattleup Nursery (Palms Galore) at Lot 18 Wattleup Road was held on October 27, 1996. John and Ann have an excellent collection of rare palms and cycads in their private section and many members enjoyed this chance to get a guided tour of one of the best palm and cycad nurseries in the State.

edited from emails of DARRYL HARDIE
dhardie@agric.wa.gov.au

News from the Texas Chapters

The Texas Chapter of the IPS meeting on October 26 featured Dr. Alan W. Meerow, author of the bestselling palm book, *Betrock's Guide to Landscape Palms.* Dr. Meerow gave an interesting lecture on various aspects of palm culture—with focus on transplanting techniques/requirements and nutrient requirements/deficiencies. This meeting was arranged by Grant Stephenson and held at his nursery, Horticultural Consultants, in west Houston, with the lecture held indoors at a nearby hall. Weather cooperated and the previous night's rains held off for the day.

The Houston area group also met at November 16 at Darren Oeschler's home in Seabrook, Texas, to view Darren's selection of large palms. A "palm fossil" expedition is tentatively planned for East Texas and Louisiana during the winter months.

The South Texas Palm Society (PSST), newly affiliated with the IPS in 1996, continues palm activities in far south Texas. The PSST chapter met at the home of Charles and Lana Vieh in San Benito on November 10.

The PSST, in connection with Charles Vieh, also organized a field trip this winter into northern Tamaulipas, Mexico. Members of the Houston-based group participated in this field trip. The tour departed the Vieh house in San Benito on December 6, and spent the first night in San Fernando. Saturday was spent touring the area around Ciudad Victoria and Ciudad Monte, with the night spent in the area. Sunday was spent exploring around Tula, with the group returning to San Benito on Monday, December 9.

JIM CAIN
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Pacific Northwest Chapter News

The Pacific Northwest Palm & Exotic Plant Society held their annual summer barbecue at the home of Rudi and Donna Pinkowski on August 11. This was well attended, with over 60 people turning up to enjoy the afternoon.

At the end of the summer, the Society pitched its tent again at Vancouver's Pacific National Exhibition. The focus was an uncovered display of palms and other exotic plants to emphasize the "hardy outdoors" aspect more effectively. Our newest and oldest member (92 years young) was signed up at the PNE, bringing total paid membership to 270.

The September 23 meeting at Van Dusen Gardens drew 40 people, all enthusiastic and full of good ideas. Jim Reynolds provided a slide show of the August Biennial Meeting of the International Palm Society in southern California, as our featured attraction.

On November 5, the Society met at Victoria

Free-Net on Vancouver Island, to talk about "Palms on the Internet."

Meetings for 1997 will begin with the Northwest Flower and Garden Show at the Washington State Convention Center in Seattle February 5–9. This will be followed by the Society's Annual Spring Plant Sale on March 23 at the Van Dusen Gardens in Vancouver, with a general meeting to be held the following day. There will also be a general meeting at Van Dusen Gardens on May 26. Visitors are welcome.

Southern California Chapter Meetings

We had a very good meeting in Ventura on September 21. The palms at Pauleen Sullivan's house and apartments were spectacular as usual. Santa Barbara and Ventura County Chairperson John Tallman coordinated the meeting, and presented a very interesting panel discussion. The panelists, Don Tollefson, Pauleen Sullivan, Ralph Velez, and Phil Bergman, each presented a short answer to questions on cultural practices, favorite palms, etc. posed by John Tallman. All of these people are experienced palm growers of many years, and are successful, but each does things a little differently. We took in about $850 from the auction and raffle.

Our next meeting is at Leland Lai's in Malibu on November 16. He has a new garden with many large palms that he has moved in. This will also be our annual "Concoction Auction," which typically has the biggest and best palms for auction of any of our meetings.

Our annual banquet will be on January 18. Phil Morgan has arranged for us to use the facilities of the Aliso Creek Inn in Laguna Beach.

GARY WOOD, President
Southern California Chapter
palmnut@telis.org

News from the Hawaii Island Chapter

Over 40 Hawaii Island Chapter members and guests jammed an extension service classroom October 24 for a seed propagation workshop. They were treated to a first-class presentation by a couple of palm professionals. Ken Foster and Jeff Marcus moved smoothly through their syllabus with an entertaining mix of personal anecdotes and practical advice, and everyone had a chance to get his or her hands dirty cleaning and planting seed. Each participant received two 4-inch pots, filled with medium, and seeds were distributed. The seeds included *Wettinia praemorsa, Aiphanes caryotaefolia, Euterpe edulis,* and many more.

On Sunday, November 17, chapter members visited two outstanding gardens in Hawaiian Paradise Park. These were gardens you would not want to miss! Garrin's garden is eight years old, spacious and unique in its design, with long vistas and a small lake. The garden contains numerous rare and beautiful palms, including an Andean wax palm *Ceroxylon* sp., a variegated *Aiphanes,* and many more, amid tropical fruit trees, flowering trees, orchids, and bromeliads. The group then travelled to Helen and Bev Carlson's home. Helen and Bev's garden is 17 years old and contains many fine palms and over 140 cycads, along with one of the finest bromeliad collections on this island. The Palm Society served refreshments at the Carlson's when the garden tours were completed.

Hawaii Island Palm Society member and master lei maker Alice Aumua recently represented Hawaii at the Pacific Festival of Arts, on the island of Upolu, in Western Samoa. Taking time off from the festival, Alice walked about the town, checking out the gardens. Among the other sights were large ivory-nut palms.

KEN BANKS, Editor
Hawaii Island Palm Society
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News from Southern Queensland Branch, PACSOA

The Southern Queensland Group (SQG) of PACSOA met on October 20 at Dennis and Lynda Nico's home in Carindale. The group was able to see what one can do on a small block within a short time. It took only five years to establish this lovely garden.

The SQ Group also met on November 18 at Uniting Church in New Farm to hear Tony Huntington, who gave a talk about his recent trip to New Guinea. This was followed by a raffle, which included many palms and cycads donated by members.

The group's Christmas Breakfast was held on December 8 at the Planetarium Gardens Restaurant, Mt. Cootha Botanical Gardens, Mt. Cootha. A tour of the gardens followed the breakfast.

BOOKSTORE UPDATE

JAN. 1997

☞ **AUSTRALIAN SYSTEMITIC BOTANY; the Vanuatu Palms.** (J. Dowe, 1996, black/white photos, paperback, 59 pp. **$35.00**

A GUIDE TO PALMS AND CYCADS OF THE WORLD. (L. Stewart, 1994, 246 pp..full color, line drawings and maps for each genus **$35.00**

A GUIDE TO THE MONOCOTYLEDONS OF PAPUA NEW GUINEA, PART 3, PALMAE (R.J. Johns and A.J.M. Hay, Eds., 1984, 124 pp.) **$8.00**

BETROCK'S GUIDE TO LANDSCAPE PALMS *(A.W. Meerow, 1992, 153 pp. - all color.)* ***$29.00***

☞ ***CHAMAEDOREA PALMS*** *(D. Hodel, 1992, 350 pp., 127 pp. of superb color) EXCELLENT!* ..... ~~$69.95~~
LIMITED TIME (P.S. members) ***$29.95***

COCONUT RESEARCH INSTITUTE, MANADO (P. A. Davis, H. Sudasrip, and S. M. Darwis, 1985, 165 pp., 79 pp. color)..... **$35.00**

CULTIVATED PALMS OF VENEZUELA (A. Braun, 1970, 94 pp. and 95 photographs.) **$7.95**

DESERT PALM OASIS (J. W. Cornett, 1989, 47 pp., 41 pp. color) **$8.95**

DISEASES AND DISORDERS OF ORNAMENTAL PALMS (A. R. Chase and T. K. Broschat, 1991, 56 pp., color on each page)..... **$29.00**

☞ **EL CHAGUARAMO** (A. Braun, 1996, 32 pp., paperback, 21 pp. with color.) (In spanish) **$10.00**

☞ **EL CULTIVO DI LAS PALMAS EN EL TROPICO** (A. Braun, 1988, 23 pp. in color, 66 pp. all together) (In spanish) **$10.00**

EUADOREAN PALMS FOR AGROFORESTRY (H.B.. Pedersen and H. Balslev, 1990, 105pp.) **$15.00**

FIELD GUIDE TO THE PALMS OF THE AMERICAS (A. Henderson, G. Galeano and R.. Bernal, 1995. A guide to the 67 genera and 550 species of palms found in the Americas. 256 color photos, 42 line drawing, 553 maps.) **$75.00**

FLORA OF TROPICAL EAST AFRICA, PALMAE(J. Dransfield, 1986, 52 pp.) **$23.00**

FLORES DES MASCAREIGNES (La Reunion, Maurice Rodrigues, 1984, 31 pp.) **$8.00**

FLORIDA TREES AND PALMS (S. A. Rose, A. A. Will, Jr., T. B. Mack, 1984, 30 palm species, 120 pp.) **$6.00**

☞ **GROWING PALMS IN A TEMPERATE CLIMATE (THE DIAMOND LANE GUIDE)** (D. Tollefson, 1996, 151pp., 8 color photos, spiralbound, clear plastic cover, paperback, pracical useful information **$30.00**

☞ **IDENTIFYING PALMS** (M. Gibbons, 1993, 126 color photos, 80 pp., compact study guide and palm identifier.) **$9.00**

KEY GUIDE TO AUSTRALIAN PALMS (L. Cronin, 1989, 180 pp., 85 pp. color) **$21.95**

LAS PALMAS CULTIVADAS (A. Braun, 1994, 64 pp., color, Spanish, The cultivated palms of highland Andean cities in South America) **$10.00**

LAS PALMAS DE LAS SABANAS DE VENEZUELA (A. Braun, 1995, Spanish, 59 pp.) **$12.00**

LEXICON PALMARUM (J. Dransfield and H.. Beentje) - a glossary of botanical terms used in palm studies, in English, French, German, Spanish and Portuguese. 64 pp., 60 drawings ..... **$16..00**

MAJOR TRENDS OF EVOLUTION IN PALMS (H. E. Morre, Jr., N. W. Uhl, 1982, 69 pp.) **$6.00**

OIL PALMS AND OTHER OILSEEDS OF THE AMAZON (C. Pesce, 1941, translated and edited by D. Johnson, 1985, 199 pp.) **$24.95**

PALM COLLECTION OF THE DURBAN BOTANIC GARDENS (A. Lambert, 1994, 118pp., color photos **$17.00**

☞ **PALMERAS DE BOLIVIA** (H. Balslev & M. Moraes, 1989, 99 pp., 18 b/w photos, paperback, in spanish) **$10.00**

PALEM INDONESIA (in Indonesian) (Sastraprdja, Mogea, Sangat, Afriastini, 1978, 52 illustrations, 120 pp. For English translation add $3.00) **$5.50**

PALMS AND CYCADS AROUND THE WORLD (J. Krempin, 1990, 267 pp., 267 pp. color) REVISED EDITION **$52.50**

PALMS IN AUSTRALIA (David Jones, 1984,'278 pp., over 200 color photographs) **$40.00**

☞ **PALMS OF SOUTH FLORIDA** (G. Stevenson, reprint 1996, 100 full page b/w line drawings, 251 pp., softbound, excellent information **$20.00**

PALMS OF MADAGASCAR *(John Dransfield and Henk Beentje, 1995) EXCELLENT! (Dcc.. 95)* ***$82.00***

PALMS OF THE AMAZON (A. Henderson), 1995, 362pp. many line drawings) **$100.00**

PALMS OF THE NORTHERN TERRITORY (AUSTRALIA) (A. White, 1988, 41 pp., 21 photographs, some color) **$5.95**

PALMS OF THE WORLD (Formerly - **PALMS**, A. Blombery & T. Rodd, 1982, 192pp., 212 color photographs) **$35.00**

PALM SAGO (K. Ruddle, D. Johnson, P. K. Townsend, J. D. Rees, 1978, 190 pp.) **$10.00**

PALMS OF THE SOLOMON ISLANDS (Dowe, Dennis, McQueen, Birch, 55 pp., 39 pp. photos, 8 in color) Four excellent chapters. **$9.95**

PALMS OF THE SOUTH-WEST PACIFIC (J. L. Dowe, 1989, 198 pp., 33 pp. color) **$29.95**

PALMS OF SUBEQUATORIAL QUEENSLAND (Robert Tucker, 1988, 91 pp., 12 pp. color, many black and white photographs and maps) **$20.00**

PALMS THROUGHOUT THE WORLD (David Jones, 1995, 410 pp., over 200 color photographs) **$55.00**

SECRET OF THE ORIENT DWARF RHAPIS EXCELSA (L. McKamey, 1983, 51 pp.) **$7.00**

THE GENUS PTYCHOSPERMA LABILL (F. B. Essig, 1978, 61 pp.) **$6.50**

THE INDIGENOUS PALMS OF NEW CALEDONIA (H. E. Moore, Jr., N. W. Uhl, 1984, 88 pp.) **$12.00**

THE PALMS OF RIO'S JARDIM BOTANICO (1992, 15pp., some color) **$5.00**

THE STRUCTURAL BIOLOGY OF PALMS (P. B. Tomlinson, 1990, 477 pp.) **$120.00**

TROPICA (A. Graf, 7000 color photos, 1138 pp.) **$175.00**

TROPICAL RAINFOREST (A. Newman, 1990, 241 pp., World survey of endangered habitats, all color.) **$45.00**

VENEZUELAN CLOUD FOREST (A. Braun), 1994, 54 pp., 16 pp. color, English & Spanish **$11.00**

PALM PAPERS (Postage Included)

A NEW PRITCHARDIA FROM KAUA'I, HAWAI'I (Reprint from Principes, R. W. Read, 1988, 4pp.) **$2.00**

HARDIEST PALMS AND FURTHER INFORMATION ON HARDY PALMS (J. Popenoe, 1973, 8 pp.) **$3.00**

NOTES ON PRITCHARDIA IN HAWAII (D. Hodel, 1980, 16 pp.) **$2.50**

RARE PALMS IN ARGENTINA (Reprint from Principes, E. J. Pingitore, 1982, 9 pp., 5 beautiful drawings) **$2.75**

PALMS FOR SOUTHERN CALIFORNIA (Trish Reynoso, 1996, 11 pp.) **$5.00**

PALMS FOR TEXAS LANDSCAPES (R. Dewers & T. Keeter, 1972, 3 pp.) **$1.25**

PINANGA ISSUE OF PACSOA (#16, 1987, 17 pp.) **$2.50**

☞ *New arrivals*

The palm books listed above may be ordered at the prices indicated plus $3..00 extra per book, overseas U.S. $3.50, to cover packaging and book-rate postage, (California residents please add 7.25% sales tax.) Foreign checks must be in U.S. dollars and payable on a USA bank. No credit cards. If insured by IPS, add 10% extra. Please include your International Palm Society membership number. ALL SALES FINAL. Send check payable to:

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Back Cover

Lad on burro with "árganas" (panniers), woven from leaves of the silver thatch palm (*Coccothrinax argentata*) on the left and of the sabal palm (*Sabal domingensis*) on the right, 11 km east of Santiago Rodríguez (June 30, 1994). See pp. 15–28.