

Palms

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THE INTERNATIONAL PALM SOCIETY, INC.

The International Palm Society

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FRONT COVER

Immature fruits of *Plectocomia assamica*, a palm from the Ledo Road, Myanmar. See article p. 115. Photo by A. Henderson.

Palms (formerly PRINCIPES)

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BACK COVER

Another startlingly lovely palm from the Ledo Road, the leaf sheath of a *Calamus* in the *C. nambariensis* complex. See article p. 115. Photo by A. Henderson.



NEWS FROM THE WORLD OF PALMS

In this issue we present a new regular feature for PALMS – *Growing Palms*. Compiled by Randy Moore, this feature will run short items highlighting aspects of growing palms, such as handy tips for dealing with commonly encountered pests and diseases, methods for boosting palm growth, record-keeping for palm collectors and many other aspects of palm horticulture. We invite all you growers out there to consider what experiences of growing palms you would like to share with others, write them down and send them to Randy Moore or to the Editors. We are convinced that many members of the IPS have valuable experiences in growing palms that could be of great interest to the membership.

On 13 June 2005 the BBC website ran an extraordinary story under the title *Date palm buds after 2,000 years*. The same story appeared in several newspapers across the world. Israeli researchers claimed that they had succeeded in growing a date palm from a 2,000-year-old seed from a batch discovered during an excavation of the ancient fortress of Masada. In the report, Dr. Sarah Sallon, a pediatric gastroenterologist and director of the Louis L. Borick Natural Medicine Research Center in Jerusalem, claimed that the palm is from a variety that became extinct in the Middle Ages and was reputed to have powerful medicinal properties. Seeds from the same batch from Masada were radiocarbon-dated and shown to be 2000 ± 50 years old. The seed that germinated was assumed to be the same age. It is difficult not to be skeptical about this extraordinary report. We wonder how the researchers could claim that the seed was from a variety of the date that became extinct in the Middle Ages – what variety was this, and how could it be identified from the seeds alone? Could contamination with modern date seeds or a simple greenhouse mix-up be ruled out? Nevertheless, this is an astonishing claim.

Two other items in the news remind us that palms, both real and artificial, are sometimes the focus of controversy. The UK News Telegraph website recently reported that 17 artificial palms installed at a marina in Brighton, UK, are causing an uproar with some of the residents. While no photographs were included in the news item, the artificial palms, 20-foot steel poles clad in coconut fiber and topped with plastic “leaves,” certainly do not sound appealing. A spokesperson for the marina claimed, “The trees are part of our efforts to make the marina an inspiring lifestyle destination. We took advice and were told that the high salt content of the soil and the wind and climate meant that real palms would not have survived.” Meanwhile, the San Luis Obispo Tribune reported that real palms, in this case, Canary Island date palms and Mexican fan palms, are striking a discordant note along a scenic drive in Cambria, California. A local resident has lined the driveway to his estate with some 50 palms valued at an estimated \$60,000. The coastal highway along which the estate is located is an acclaimed scenic route, and some residents have complained that the non-native palms are jarringly inappropriate choices for landscape material. In both the Brighton and Cambria cases, the news reports stated that the disputes are unresolved.

On a happier note, we are pleased to report that Dies Palmarum, the 4th European Palm Biennial, is scheduled for 24–26 November 2005. The event, hosted by the Centro Studi Ricerche per le Palme, is held in Sanremo, Italy, and promises to be a lively and informative event whose theme this year is “Palms of the Genus *Phoenix*.” Information about the event is on the website <http://digilander.libero.it/centrostudipalme/new/>.

THE EDITORS

GROWING PALMS

Horticultural and practical advice for the enthusiast

Edited by Randy Moore

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Getting Juiced: Fertigation of Palms

Feeding your palms can occupy a significant amount of the time spent in the garden. In a small garden with just a few palms, a pail of granular fertilizer or a watering can with soluble fertilizer will suffice. However, there is a point at which the size of the garden grows too large for manual methods. Measuring and mixing by the bucket or watering can become time-consuming, inconvenient and laborious. Fertigating (fertilizing and irrigating) a large palm garden by injection of concentrated, water-soluble fertilizer into the irrigation system is an alternative worth considering.

A very simple system for small gardens is to mix the fertilizer in a 32-gallon trash can and deliver it by dipping and filling buckets to each plant. Or, a small submersible water pump can be placed in the bottom of the trash can and connected to a garden hose. The liquid fertilizer can be delivered to all of the palms within reach of the hose. To measure the dose, first count how many seconds it takes to fill up a one gallon container. The gardener can then count and measure the amount being supplied to each palm with some degree of accuracy.

Venturi Injectors. There are devices that attach between the faucet and the hose that siphon concentrated fertilizer out of a container. The pressure difference between the water line and the container is used to draw the concentrated fertilizer solution into a valve and mix it with water. These injectors are relatively inexpensive.

The Siphonex unit is popular with small growers. It draws up the concentrated solution through a small suction tube and dilutes it at a rate that depends on the flow of water through the hose. The typical injection ratio is 1:16. The hose length is limited to no more than 75 feet.

For small to medium-sized gardens, there is a new in-line fertilization device made by Fertile Earth™ (www.FertileEarth.com). The company also produces several fertilizer formulas to be used with their devices. Additionally, they produce a supplement called BioNatra™ that contains micronutrients, complex carbohydrates, enzymes, vitamins and other growth stimulants. Tested by several palm growers, this product is proving to be effective for stimulating biological activity and unlocking available nutrients.

With a Venturi-type injector, water pressure variations can cause variable amounts of fertilizer to be injected. Injection ratios are typically very low. The device must be cleaned after each use to prevent it from becoming clogged.

Proportional Injectors. More sophisticated units for feeding larger gardens are available. This type of injector is proportional to the volume of water entering the mixing chamber. A dose of fertilizer concentrate is added to a fixed volume of water in the mixing chamber creating a blended solution that is supplied to the palms through the irrigation system. The ratio is adjustable. A proportional injector will create an accurate blend irrespective of water pressure and flow rates.

The fertilizer injector used in my system is the 100 GPM (gallons per minute) D20S from Dosatron® (Dosatron International, www.dosatronusa.com). While it is relatively expensive to install this type of system, a proportional injector is reliable and easy to maintain. A system for a two-acre palm garden will cost around US\$2,000.

Some of the other proportional units that are available are DosMatic (www.DosMatic.com), Chemilizer, H.E. Anderson Ratio:Feeder, Smith Measuremix and Gewa Injector (Germany). Many units are sold with a preset ratio.

It is important to purchase an injection unit that is capable of handling the volume of the irrigation system. Initially, I mistakenly purchased the more economical 20 GPM unit that did not have the capacity to supply my irrigation system, causing the unit to lock up.

Proportional fertilizer units typically have a flow range capacity of 5–100 GPM. They can be arranged in parallel (to increase water flow) or serial configurations (for multiple solutions). They operate with just about any water pressure from 2 psi to 120 psi (pounds per square inch). The mixture ratio is adjustable on the more sophisticated units. The ratio can be adjusted from 1:500 to 1:50 (0.2% to 2.0%).

To calibrate the mixture's dilution ratio, an electrical conductivity (EC) meter is used. The meter will provide a reading of the concentration of the water-soluble fertilizer solution. The meter that I use is the Agri-Meter Model AG-5 made by Myron L Company. This meter measures a conductivity range of 0 to 5 mmhos/cm. Typically I never exceed 1.5 mmhos.



2. A 100 GPM Dosatron proportional fertilizer injector in use in the author's garden.

The fertilizer used in such a system demands that it be totally dissolved. Some fertilizers do not dissolve well and cannot be used in a fertigation system. Others like fish emulsion are thick and viscous and may jam up the fine openings in the irrigation spray heads.

The mainstay of my palm nutrition program is a 20:20:20 water soluble fertilizer with chelated micronutrients. Monterey Maxi 20:20:20 Micro is sold in 25 lb. bags (Monterey Chemical Company, P.O. Box 35000, Fresno, CA 93745 USA). Information on the contents can be found at www.regulatory-info-monterey.com.

The fertilizer is mixed in the water storage tank at double-strength using one-half of the required water. When fully dissolved, the remaining water is added while maintaining constant agitation. Water quality and temperature will also determine how easily the fertilizer dissolves. Interestingly, as the fertilizer goes into solution, the water temperature will drop.

My system uses a 300-gallon tank that holds 500 lbs. of fertilizer. I juice the palms with every watering until the 300-gallon tank of liquid fertilizer is depleted. Since nobody likes to eat the same thing all of the time (including palms), my nutrition program is supplemented with blood meal, bone meal, SuperThrive™ additive and kelp meal. I do not have problems with the fertilizer “settling out” of the solution, so the mix does not require agitation before each use.

Cleaning the system on a frequent basis helps to prevent it from becoming clogged. On a regular basis, fresh water should be used to flush the entire system. A fresh water by-pass around the injection unit is an important part of the installation.

In Southern California, I begin using the fertilizer injector system at the beginning of the growing season, which usually starts in March when the soil temperature begins warming and nighttime lows are above 50°F. These conditions often prevail until late October or early November, when I discontinue use for the season. Of course, the length and timing of the growing season varies by location.

My personal results with fertigation have been remarkable. I have been able to take many palms from seedling stage to maturity in a seven-year period, while other factors, such as favorable climate (no devastating freezes), ample watering and mulching, have also been factors in my results. With so much invested in developing a palm garden, a fertigation system is a small added initial investment that pays big dividends. – Jeffry Brusseau, Vista, California, USA 🌴

Hydro Chams

As my passion lies with *Chamaedorea*, I wondered if a hydroponic growing system could be used to speed up their growth. The goal was to produce seeds more quickly. I have been testing this system for the last 12 months and it appears to be a worthwhile endeavor.

In general, hydroponics involves growing plants in solutions or moist inert materials. The necessary nutrients are supplied to the plants in the solution. This is accomplished without soil as the growing medium.

My hydroponic set-up is a basic flood and drain system using plastic hydroponics troughs, a 120-liter food-grade bin (recycle tank), a submersible pond or fountain pump, regular plastic plant pots filled with expanded clay (fired, porous clay spheres) and a 24-hour analog timer (Fig. 1). The system does not use water heaters or artificial lights; rather, it relies on ambient temperatures through summer and winter and natural lighting.

The troughs sit just out of level on mesh benches above the recycle tank. The pump fills the troughs from the opposite end completely flooding the pots which sit in the troughs. At the low end of the troughs I have fitted two drains – one at the bottom end of the trough and another higher on the same end. The lower drain is restricted by a gate valve allowing the nutrient to fill the trough completely and then drain the trough when the pump shuts down. The higher drain ensures the trough does not overflow. The system runs three 15-minute cycles per day. I had thought of reducing back to two cycles per day for the winter months, but even as the weather has cooled down, there seem to be no signs of over-watering.

I first set up the system in June (early winter in Australia) 2004 with four plants – two *C. ernesti-augusti* and two *C. tepejilote* – to see what would happen. After the first two months there were no signs of any increased growth. I marked new



1. The author's hydroponic system.



2. Conventionally grown *Chamaedorea metallica* (left) compared to the same species grown hydroponically.

“spears” of the hydroponic plants and regular potted plants of the same, for a growth comparison. After testing the water, the four plants drew all of the nutrients (down to a “safe” level) from the 120 liters of water within four weeks while only using 2 liters of water. As the weather started to warm up, progressing through spring and during summer, the nutrient level uptake declined and water usage increased. I was surprised the nutrient uptake declined but expected the water use to increase, also taking evaporation into consideration. At the beginning of spring, I added a few more *Chamaedorea* seedlings, two double-planted *C. cataractarum* and two double-planted *C. metallica*. Figure 2 shows one of the double planted hydroponically grown *C. metallica* along with its “comparison,”

a conventionally grown, double planted *C. metallica*. All four plants in Figure 2 were from the same batch of seeds and were growing at the same growth rate before I placed two of the four into the hydroponic system in September 2004. I think the results speak for themselves.

The system is relatively inexpensive to maintain. An average cost per month, taking power, water and nutrient costs into consideration would be about US\$15.00. Initial setup costs would vary depending on size and monitoring equipment used. The size of this system would allow up to twelve 200 mm (8”) pots and initial set-up costs including monitoring equipment (a pH and EC meter) were around US\$125.00

When these plants flower, it will be interesting to see whether the flowers/inflorescences are more plentiful and whether pollen and seed quantity/quality differs from conventionally grown plants. In the meantime, I am looking at introducing a few more “exotic” species to the system. I think *C. tenella* would be a great candidate. – Jason Cox, Port Kennedy, Australia 🌴

Quick Fix for Palm Fronds

Have you ever experienced a partially broken palm leaf, caused by strong winds, improper transport or by the falling frond of a taller palm? In my garden, falling fronds from 40-year old *Rhopalostylis* are the biggest hazard to delicate understory palms. Damage of this sort can be very frustrating because frequently one of the newer leaves is broken, and it detracts from the overall appearance of that palm. It may take a few years for that leaf to become the lowest leaf and ready for removal. Over the years, I have developed a technique to repair many of these damaged leaves.

If the leaf is merely bent or only partially severed, it is possible to apply a simple splint to the break. A length of flat stick or bamboo stake can be used. The stick should extend an inch or two below and above the break, and should be secured to the leaf by 20–30 lb test monofilament fishing line, or with green plastic garden tying tape (Fig. 1).

If the break is not too severe, this method is usually successful, and the splint can be removed as early as a month later. I have found this technique is most effective on my smaller palms such as species of *Chamaedorea* and *Linospadix*. Larger and longer leaves are less successful but are still worth the attempt. – Jim Wright, San Diego, California, USA 🌴



1. A petiole splinted with a small wooden stake and plastic tying tape.

Preventing Blow-Over of Palms in Containers

Wind can play havoc with containerized palms. Palm leaves are all too effective at catching the wind, with the result that even gentle breezes can knock down potted palms. Palms often have small root balls (in correspondingly small pots) in proportion to their above-ground parts, a situation that exacerbates their instability. The problem is particularly acute in commercial nurseries, where blow-over can break and disfigure leaves, dislodge palms from pots and cause top dressings of granular fertilizer to spill. Containerized palms lying on their sides will not receive proper irrigation and can dry out if not placed upright quickly. The cost of righting fallen palms, re-applying fertilizer and repotting can be substantial. Are there solutions for hobbyists and professional growers?

Obviously, windbreaks (hedge rows, screens, fences) can mitigate wind intensity, and locating containerized palms in sheltered locations in the garden or nursery is a viable strategy. If relocating palms is not possible, then some sort of staking or supporting mechanism becomes necessary. For seedlings in small pots, methods of holding the pots upright include placing pots on benches made of wire mesh such that the pots slip partially through the openings between the wire, thereby holding the pots upright (Fig. 1). This method has the added advantage of allowing good air circulation and free drainage. A similar level of support can be obtained by using plastic trays and racks that are manufactured to hold square or round pots or tubes (Fig 2). Each tray may hold a dozen or more pots, so they are cost effective. Their disadvantage is that they impede air circulation by holding plants close to one another and provide hiding places for pests such as snails and slugs. Be sure to use trays that have drainage holes.



1. Seedlings grown in plastic tubes are supported by the wire mesh of the bench.



2. Trays of molded plastic are available to hold round or square pots.

Some growers place containerized palms into supports made of concrete blocks. One block supports one or two pots and can be reused for many seasons. The blocks are bulky and heavy, but they can be deployed around the nursery where needed. However, concrete blocks are hiding places for snails and slugs. A variation on the concrete block system employs lengths of bamboo that run over the surface of the pots and whose ends are anchored by blocks (Fig 3). The poles function like straps, holding the pots to the ground.

Purpose-built systems are available commercially. One kind (<http://www.alabama.wire.com>) is a wire basket – a ring of wire to encircle a pot and stakes to anchor the ring to the ground – that holds a pot to the ground. Pot-in-pot systems are also available, or could be made using regular plastic pots. A “socket” pot is permanently buried in the ground up to its rim, and the containerized plant sits in this socket. An advantage of this system is that a



3. The ends of these bamboo poles are anchored by concrete blocks, effectively "strapping" the pots to the ground.

below-ground socket keeps the root ball well insulated from temperature fluctuation. A major disadvantage is the high cost of installing the socket pots, and once installed, they must be used in place or re-installed for use elsewhere. In addition, the socket pots may impede drainage or collect standing water. With both basket and pot-in-pot systems, the palm's container must match the size of the basket or socket, so the grower is locked into using the pot size required by the system.

As an alternative or as a supplement to supporting the base of the plant, growers may use a guy wire or trellis system to support the top of the plant. In its simplest form, this system is simply a wire that runs horizontally along the

nursery row at 1.0–1.5 m above the ground. Palm stems are tied to the horizontal guy wire to prevent blow-over. The most inexpensive ties are made from strips of webbing or mesh (which dry faster than rope after irrigation), but manufactured ties, such as Tree-Mate-O™ (www.tmateo.com) or High Caliber Tree Collar™ (www.treebag.com), are available. They are designed to hold a stem firmly but without leaving a scar or without girdling, but the additional cost of purchasing and installing such devices can be significant. Another disadvantage, reported by some growers, is that the devices can be tedious to disconnect from the plant.

In a recent study in a Louisiana tree nursery, Parish (Parish, R. L. Blocking blow-over. *Ornamental Outlook*, April 2005, pp. 10, 11.) found that all of the tested staking methods performed satisfactorily; however, all but one of the tested staking methods added more than one dollar in labor and material costs per plant. The only inexpensive method is the one employed by many nursery professionals – driving a stake into the ground through both the root ball and plastic pot. Depending on the height of the pot (and the depth and texture of the underlying soil) a metal rod 45–80 cm long is used. Typically, rebar (concrete reinforcing bar) is the stake of choice. Parish (2005) reported that the only problem with this method is the potential hazard to workers and vehicles posed by rods left sticking up in the ground when the plants are moved or sold. In addition to worker safety, one needs to consider plant safety when using the rebar technique. Be careful to keep the rebar stake away from the stem of the palm. This precaution is particularly critical with palms that form underground stems or saxophone-shaped establishment growth. Do not drive the rebar through the stem! Also, the roots of palms may not regenerate after damage as quickly as dicot tree roots do, so staking the pot runs some risk of injuring the roots. The risk is probably acceptable when weighed against the risk of damage caused by blow-over. – *Scott Zona, Miami, Florida, USA.* 🌴

Palms of the Ledo Road, Myanmar



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1. *Salacca secunda* growing
along a stream near Tanai.

The Ledo Road in Myanmar, constructed during World War II, passes through country rich in palms.

Construction of the Ledo Road in Mynanmar began in early 1943, at the height of the Second World War. In 1942, Japanese forces had overrun Rangoon, capital of Burma, and cut off the Allies' supply line to Chinese forces under Chiang Kai-shek, battling the Japanese in China. The American air force began supplying the Chinese by flying from Assam, in northeastern India, to Kunming in China. But this was not enough to move the huge amount of material promised by the US. In January 1943, the American army began building a road in order to move supplies. Its route was from the railhead in Ledo, northeastern India, through Kachin State in northern Burma to Myitkyina, and from there to the Burma road that led to Kunming.

The Ledo Road, as it became known, was built through extremely difficult terrain and at a huge cost in lives and money. The route not

only crossed steep mountain ranges, but also the Hukaung Valley, a large, flat, forested area which floods for many months of the year in the monsoon season. When it was completed in early 1945, the tide of war had turned, and the road was little used. At the end of the war, Burma (now known as Myanmar) gained independence from the British. The country was closed to foreigners, and the road fell into disrepair.

For various reasons this area of northern Myanmar has retained its forest cover and its wildlife. The human population is relatively low. There is severe malaria in the region, and the Hukaung Valley itself floods during the monsoon season, making travel all but impossible. By the end of the twentieth century, this region contained one of the largest intact areas of forest in southeast Asia. It also contained populations of large

2. *Calamus tenuis* with its distinctive ridged leaf sheaths.



mammals, such as tigers and wild elephants, animals that were rapidly disappearing from other parts of Asia.

Beginning in 1993, the Wildlife Conservation Society of New York and the Nature and Wildlife Conservation Department of the Forestry Department in Myanmar began to plan for the conservation of this region. One result of this was the Hukaung Valley Tiger Reserve, established in 2001. It covers a large area of almost 12,000 square kilometers, with the Ledo road running right through the middle. In early 2005 we traveled along the Ledo Road in order to survey the rattans of the Hukaung Valley and to estimate the impact of rattan harvesting in the Reserve.

We flew from Yangon (as Rangoon is now known) to Myitkyina, where we began our journey. The road from there to Tanai is in

good repair, and it is only a five-hour trip by car. The first palms we saw were *Calamus guruba* and *C. viminalis*, growing with a species of *Salacca*. These are common roadside palms in this area. When we entered the Hukaung Valley itself, these species were replaced by *Calamus floribundus* and another species of *Salacca*, *S. secunda* (Fig. 1). This *Salacca* from Kachin State in northern Myanmar is almost certainly the same as that described by Griffith, as *Salacca secunda*, first collected just across the border in northeastern India. Another species of *Salacca* occurs in Myanmar, in the southern part of Kachin State. I believe this to be an undescribed species, differing from *S. secunda* in its regularly arranged (as opposed to irregularly arranged) leaflets. This undescribed species is also known from adjacent Yunnan in China and just reaches northern Thailand. To complicate matters further, these two



3. *Livistona jenkinsiana* in flower near Tanai.



4. *Pinanga sylvestris* in the forest near Shinbuiyang, with another unidentified species of *Pinanga* to its left.

species appear more similar to *Eleiodoxa* than to other species of *Salacca*. Near Tanai we collected a variety of rattans, including *C. tenuis*, *C. floribundus*, *C. palustris* and *C. leptospadix*. *Calamus tenuis* (Fig. 2) is heavily exploited in this area, and all along the banks of the Tanai River we saw the camps of rattan collectors. Species of *Pinanga* were also very common in the forest here, and this was the most confusing genus we came across. At least three species occurred in the forest near Tanai, and we saw others later. Planted in villages near here was *Livistona jenkinsiana*, in full flower at this time of year (Fig. 3).

From Tanai to the next village, Shinbuiyang, the road is less well maintained, and the journey involves driving through at least two large rivers. We traveled on an old truck with four-wheel drive. It was an exciting ride. Near Shinbuiyang we found *Calamus flagellum* and *Pinanga sylvestris* (Fig. 4). In some places here we came across reminders of the War – rusting jeeps and trucks, almost completely consumed by the forest.

After Shinbuiyang the road enters the mountains, and the palm flora becomes more diverse. Just a few kilometers into the hills we collected *Areca triandra*, *Arenga westerhoutii*,

Caryota maxima, *Livistona jenkinsiana*, *Pinanga* spp., *Wallichia densiflora*, and *Wallichia caryotoides*, and various species of *Calamus*, including *C. henryanus*, *C. erectus* (Fig. 5), *C. gracilis* and *C. kingianus*, as well as an undescribed species (Fig. 6). Also here was a massive *Plectocomia*. Collecting this was interesting. Several of our field assistants could not pull it from the forest, such was the grip of its thorny leaves on the surrounding trees. Fortunately the two elephants that we had hired for our return journey happened by, and one of them easily pulled the huge palm from the forest. Study of this specimen, and another collected later, in fruit, showed it to be *Plectocomia assamica* (Front Cover). This species has been repeatedly confused with others, but is easily distinguished by its regularly arranged leaflets.

The furthest north we reached was the village of Namyung. Near here we found *Calamus gracilis* and an interesting species of *Wallichia*, possibly *W. triandra*. There were also some species of *Calamus* here belonging to the *C. nambariensis* species complex. Some of them had beautifully colored leaf sheaths (Back Cover). We returned from Namyung to Shinbuiyang on foot, with the elephants



5. *Calamus erectus* growing on a steep slope in the forest.

carrying our baggage. We camped in several places along the road and were surprised how cold it was at night. On some nights the temperature dropped to 8°C. Given these low temperatures, the palm flora here is surprisingly rich. Walking the Ledo Road was a good way to study the palms, as the forest grows right up to the road.

On our return to Myitkyina we visited the confluence of the two rivers that form the Ayeyarwady River. Even along the roadsides here, in disturbed vegetation, there were plenty of palms, including *Calamus henryanus*, *C. guruba*, *C. erectus*, *Wallichia densiflora* (Fig. 7) and *W. caryotoides*. On the day we were due to fly back to Yangon we found that flights had



6. Close up of the leaf sheath of a possible new species of *Calamus*.

been temporarily suspended and so were forced to take the train instead. The 45-hour trip was memorable and gave us plenty of time to study the palms of central Myanmar. Just outside Myitkyina our old friends *Calamus guruba*, *C. viminalis* and *Salacca* sp. appeared,

now growing with *Phoenix loureiroi*. After Mandalay, *Borassus flabellifer* dominated the landscape in huge numbers, and in villages and towns were a few plants of *Corypha* and *Phoenix*. Nearer to Yangon we were happy to see large clumps of *Calamus arborescens*. We



7. *Wallichia densiflora*.

had seen this in only one place before, on the road not far from the railway, but now we could confirm that it is quite common in villages near Yangon. Growing with it were *Daemonorops jenkinsiana*, *Licuala peltata*, and another species of *Salacca*, *S. wallichiana*. Just as we entered Yangon, a few plants of *Nypa fruitcans* were seen along some tidal rivers.

Acknowledgments

We are grateful to the Forestry Department, Yangon, Myanmar for granting permission to survey the palms of the Hukaung Valley Tiger Reserve. Fieldwork in Myanmar was supported by a grant from the National Geographic Society.

xLytoagrus dickensonii*, a New Nothogenus and Nothospecies for the Hybrid from Cultivation of *Lytocaryum weddellianum* and *Syagrus romanzoffiana

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Although hybrids between two palm genera are uncommon, Bill Dickenson of California has made one between *Lytocaryum weddellianum* and *Syagrus romanzoffiana* that has resulted in an exceptionally handsome and elegant palm. The hybrid's size, cool tolerance and highly ornamental nature make it especially appealing to palm collectors and growers.

Hobbyists, collectors, and growers of palms have frequently turned to hybridization to amplify the diversity of palms suitable for cultivation in marginal growing areas with the development of cool or cold tolerance being a primary objective. The Cocoeae tribe, in particular the Butiinae subtribe, which includes the genera *Allagoptera*, *Butia*, *Cocos*, *Jubaea*, *Jubaeopsis*, *Lytocaryum*, *Parajubaea*, *Polyandrococos*, and *Syagrus*, has been especially exploited for intergeneric hybridization. The genera are fairly closely related and hybridize relatively easily while two of them, *Butia* and *Jubaea*, are among the most cold-tolerant palms.

Collectors and hobbyists have attempted just about every possible intergeneric hybrid in the Butiinae although the most common are *Butia* and *Jubaea*, *Butia* and *Syagrus*, and *Jubaea* and *Syagrus*. One of the first and still most successful intergeneric hybrids in Butiinae is $\times$ *Butiagrus nabonnandii*, a cross between *Butia capitata* (Pindo palm) and *Syagrus romanzoffiana* (queen palm). Although originally probably an unintentional hybrid, it is so popular and highly sought after that collectors, hobbyists and growers now intentionally make this cross. Merrill Wilcox of the University of Florida championed and promoted this hybrid in the 1970s although



1. *×Lytoagrus dickensonii*: habit, with Bill Dickenson (Hodel 1970, holotype).

others have made it since, and it still occasionally arises unintentionally when the two parents are in proximity in gardens and collections.

More recently ardent, long-time International Palm Society member William (Bill) W. Dickenson of Fullerton, California near Los Angeles, has been attempting hybrids between various Butiinae genera to expand the diversity of cool-tolerant palms suitable for cultivation in southern California. His work has resulted in a new, unusually elegant and handsome intergeneric hybrid between *Lytocaryum* and *Syagrus*. Of exceptional ornamental merit, the new hybrid genus name, *×Lytoagrus*, is formed from the first and last parts, respectively, of the two correct names of the parent genera while the specific epithet, *dickensonii*, honors

Dickenson, who not only made the cross but has long contributed in various ways to the activities of the Palm Society of Southern California, a chapter of the International Palm Society.

***×Lytoagrus* Hodel, gen. hyb. nov.** (*Lytocaryum* Toledo $\times$ *Syagrus* Mart.).

***×Lytoagrus dickensonii* Hodel sp. hyb. nov.** (*Lytocaryum weddellianum* (H. Wendl.) Toledo $\times$ *Syagrus romanzoffiana* (Cham.) Glassman).

Palma inter *Lytocaryum weddellianum* et *Syagrum romanzoffianum* quasi intermedia et hybridatione harum specierum orta, magnitudine habitus inter parentes media, ad illud habitu maiore, rachidibus foliorum et petiolis longioribus differt, ad hoc habitu minore et pinnis dispositis ordinate differt.

Typus: CULTIVATED. U.S.A., California, Orange County, Fullerton, garden of William W. Dickenson. *D. R. Hodel 1970* (holotypus K, isotypus BH). Figs. 1–6.

Solitary tree palm. Trunk 1 m tall, 10–13 cm diam., tan, ringed; internodes 5–8 cm, upper part covered with old persistent leaf bases. Leaves 15–18, spreading, slightly arching; leaf

2. *×Lytoagrus dickensonii*: unusually long petioles with leaf base fibers (*Hodel 1970*, holotype).



Table 1. Comparison of some morphological characters of the intergeneric hybrid *×Lytoagrus dickensonii* and its parents *Lytocaryum weddellianum* and *Syagrus romanzoffiana*.

Character	<i>Lytocaryum weddellianum</i> ^{1, 2}	<i>×Lytoagrus dickensonii</i>	<i>Syagrus romanzoffiana</i> ^{1, 2}
Trunk	5–8 (15) cm diam.	10–13 cm diam.	25–50 cm diam.
Leaves			
Petiole	5–40 cm long	1 m long	40–90 cm long
Rachis	65–85 cm long	2.1 m long	2.5–4.4 m long
Pinnae	50–60 per side, 20–30 × 0.5–1.5 cm, regularly arranged, in one plane, glossy green adaxially, silver-gray abaxially	80–85 per side, 70 × 2 cm, ± regularly arranged, in one plane, glossy green adaxially, tan whitish abaxially	150–200 per side, 70–85 × 2–3.5 cm, irregularly arranged in groups, spreading in several planes, green adaxially and abaxially
Inflorescences			
Rachis	32–36 cm long	75 cm long	90–125 cm long
Rachillae	40–62	130	80–280
Fruits	1.7–2.3 × 1–1.7 cm, green to orange, mesocarp fibers splitting open along 2 or 3 seams	2.8 × 1.5 cm, greenish, mesocarp fibers not splitting open	2–3 × 1–2 cm, yellow to orange; mesocarp fibers not splitting open

¹Glassman, S. F. 1987. Revision of the Palm Genus *Syagrus* Mart. and Other Selected Genera in the Cocos Alliance. Illinois Biological Monograph 56. University of Illinois Press, Chicago, IL.

²Henderson, A., G. Galeano, and R. Bernal. 1995. Field Guide to Palms of the Americas. Princeton University Press, Princeton, NJ.

bases 30 cm long, deeply split, tubular only briefly at base, densely covered with tan tomentum, margins with tan hairy fibers extending on to petiole for 38–50 cm, some of these occasionally coalescing into tan sheets 2–3 cm wide; petiole to ca. 1 m long, 5 cm wide near base, 2 cm wide at apex, ± flattened adaxially, rounded abaxially, margins sharply angled; rachis to ca. 2.1 m long, attenuate, covered with whitish tomentum on margins abaxially; pinnae 80–85 per side, lower middle pinnae the largest, these to ca. 70 × 2 cm, decreasing in size toward apex of blade and there to 13 × 0.3 cm, proximal pinnae 38–64 × 0.3–0.6 cm, ± regularly arranged and spreading flat in one plane, 1.3–3.8 cm distant, only a few pinnae per blade aggregated, glossy green with prominent and elevated midrib adaxially, tan-whitish with only slightly elevated midrib and with a few scattered, tan, medifixed ramenta to 8 mm long near rachis

abaxially. Inflorescences 5, interfoliar, arching; prophyll 60 cm long, thick, coriaceous, tan, 2-keeled; peduncular bract 1.5 m long, thick, coriaceous, nearly woody, green and prominently striate with tan tomentum; peduncle to ca. 1 m long, 3.2 cm diameter at base, 1.9 cm diam. at apex, flattened and densely covered with deciduous tan tomentum adaxially; rounded abaxially, margins rounded; rachis to ca. 75 cm long; rachillae 130, simple, spreading at right angles to and evenly distributed around rachis, strongly flexuous, proximal to ca. 45 cm long, distal to ca. 15 cm long, the distal 1/3–1/2 portion of the proximal rachillae and distal 5/6 of the distal rachillae slender and threadlike and with staminate flowers, the remaining proximal portions of all rachillae 5 mm diam. and with pistillate flowers. Staminate flowers on a stalk 1 mm high, 8–9 × 4–5 mm, yellow; calyx 1.25 × 2 mm, triangular-cupular, prominently 3-



3 (above). *Lytoagrus dickensonii*: leaf blade with regularly arranged pinnae flat in one plane. 4 (below). *Lytoagrus dickensonii*: long, erect peduncular bract (above) formerly enclosed the pendulous inflorescence (both Hodel 1970, holotype).

lobed, sepals connate in basal $1/2$, lobes narrowly triangular, boat-like, spreading, acute; petals $8-9 \times 1.5-2$ mm, boat-like, erect, valvate, free to base, acute, faintly nerved when dry; stamens 6, filaments slender, $1-1.25$ mm long, anthers $2.5-3$ mm long; pistillode slender, 1 mm high. Pistillate flowers $6-7 \times 5-6$ mm high, conical, yellow; calyx 5 mm high, sepals 5×5 mm, triangular, cupular, nerved, imbricate in basal $2/3$, tip acute, erect, margins dark; petals 6×5 mm, triangular, cupular, prominently nerved, imbricate in basal $5/6$ with a free, mucronate, erect, valvate tip 1 mm long; ovary 4.5×3 mm, ovoid, densely brown tomentose, stigma 3-lobed; staminodes $1-1.25$ mm, tooth-like, membranous. Fruits 2.8×1.5 cm, ellipsoid.

For many years Bill Dickenson has attempted intergeneric hybrids in the Butiinae, primarily *Butia* with *Syagrus*, *Cocos* with *Jubaeopsis* and *Lytocaryum* with *Syagrus*. Most of Dickenson's hybrids failed but a cross he made in 1994, using a containerized *Lytocaryum weddellianum* in his own collection as the seed plant and a *Syagrus romanzoffiana* cultivated in Fullerton or nearby Brea as the pollen plant, succeeded and resulted in about 25 seeds. Only three or four of these seeds germinated and all but one of these eventually died, leaving just one good





5 (above). *×Lytoagrus dickensonii*: nearly mature fruits, portion of rachillae with staminate flowers have been removed to collect pollen. 6. *×Lytoagrus dickensonii*: pistillate flowers (both Hodel 1970, holotype).



seedling. Bill grew this seedling on for several years, eventually planting it out in his garden in 1999. The palm has grown steadily for several years without sustaining any damage from temperatures of 0°C (32°F). By 2005, it was about three meters tall overall with 15

centimeters of clear trunk and about a meter of trunk clothed in old leaf bases and fibers.

Although intermediate in size between the smaller *Lytocaryum weddellianum* and the larger *Syagrus romanzoffiana* (Table 1), the handsome *×Lytoagrus dickensonii* is decidedly more like its former parent in appearance primarily because of its regularly arranged pinnae, glossy green above and tan whitish below. Petioles of the hybrid are longer than those of either parent and are especially long in relation to the leaf blade, giving the palm an open, airy appearance and enhancing its graceful, elegant nature. Being a small- to medium-sized palm makes *×Lytoagrus dickensonii* particularly appealing for our ever-diminishing yards and gardens.

A curious feature of *Lytocaryum weddellianum* is the manner in which the fibers of the mature fruits split along two or three seams to reveal the naked, brown endocarps. Fibers of the mature fruits of *×Lytoagrus dickensonii* do not split open, and are more like those of its other parent *Syagrus romanzoffiana*.

There is little doubt that *Lytocaryum* and *Syagrus* are closely related. Several workers in the past have even included *Lytocaryum* in *Syagrus* although recent alignments have kept them separate.

***Dypsis robusta*, a Large New Palm from Cultivation**

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1. *Dypsis robusta*, type plant in Marcus nursery, Hilo, Hawaii, Hodel 1969 (photo by D.R. Hodel)

A large, robust, solitary new *Dypsis* has flowered and fruited in Hawaii and has been widely distributed. It is named and described here as a new species.

Since publication of *The Palms of Madagascar* (Dransfield & Beentje 1995), several new species of *Dypsis* have been discovered, described and named. Jeff Marcus, an ardent collector and commercial palm grower, discovered two of these new *Dypsis* cultivated in Hawaii, one in his own nursery near Hilo. Marcus and others widely distributed seeds and seedlings of these new *Dypsis*, and they were subsequently described and named as *D. carlsmithii* and *D. albofarinosa* (Dransfield & Marcus 2002, Hodel & Marcus 2004). Now Marcus has discovered a third new *Dypsis* in his nursery, and because he has been distributing seedlings, it is appropriate to describe and name this large, robust new species.

Dypsis robusta Hodel, J. Marcus & J. Dransf., sp. nov.

Dypsis ifanadianae affinis sed trunco maiore, vaginis foliorum maioribus cera alba et tomento rubiginoso, rhachidibus foliorum longioribus pinnis pluribus, inflorescentiis 4 ordines ramificantibus differt; *D. tsaravoasirae* affinis sed foliis spiraliter dispositis, vaginis foliorum cera alba et tomento rubiginoso, rhachidibus foliorum longioribus, inflorescentiis maioribus interfoliaceis 4 ordines ramificantibus differt. Typus: Hawaii, in horto Jeff Marcus, Hodel 1969 (ex J. Marcus) (Holotypus K). Fig. 1.

Solitary, robust tree palm (Fig. 1). Trunk 1.4 m tall, 36.4 cm diam. 1 m above ground, flaring to 64 cm diam. at ground level; internodes 5–6.5 cm, dark green covered with white waxy indumentum, aging to brownish gray with vertical fissures; leaf scars 3.8 cm wide. Leaves 14, pinnate, ascending; base massive, 95 cm long, 25 cm wide adaxially and 40 cm wide abaxially at pinnae, flaring out to 115 cm wide in proximal 35 cm, thick, $\pm$ woody, 12 cm thick at pinnae, 3–4 cm thick midsheath, 1.5 cm thick at proximal margins, 3–5 mm thick at distal margins, orange-brown adaxially, densely covered with white waxy indumentum densely punctuated with ragged, branched, lacerate, fringed, reddish brown scales 2–2.5 mm high, sometimes with auricles to 8 cm high on either side of rachis; rachis to 4.6 m long, distally twisting nearly 180°, 25 cm wide and broadly channeled adaxially at sheath, 40 cm wide and broadly rounded abaxially at sheath, both surfaces green and densely covered with white waxy indumentum and reddish brown tomentum, adaxial channel to 4 cm deep but gradually narrowing and becoming shallower until at mid-blade a flat-

topped ridge and then 40 cm distally of mid-blade into a narrow sharply angled ridge 1.5 cm high, gradually dissipating near tip, rachis 4 cm wide midblade and 3 mm wide at tip, rounded abaxially and covered with white waxy indumentum, freshly cut surfaces with pinkish tinge; pinnae 135–140 per side, regularly arranged but twisting rachis and ascending pinnae with drooping tips imparting the appearance of being irregularly arranged and lending a somewhat plumose effect to the blade, most proximal 63 $\times$ 1.3 cm, at 1–2 m distally of sheath 120 $\times$ 4.5 cm, at 3 m distally of sheath 80 $\times$ 5 cm, most distal 18 $\times$ 0.5 cm, thick, coriaceous, dark glossy green adaxially with prominently raised light green midrib and thickened marginal nerves, 5–6 inconspicuous nerves between midrib and each margin, green with distinct glaucous bloom abaxially and prominently raised midrib, scattered light brown to tan, ragged, lacerate, medifixed rammenta 4–10 mm long on midrib abaxially and these most common in mid-blade and in proximal 30 cm of each pinna, pinnae 4–7 cm apart in proximal meter, 3–4 cm apart mid-blade to tip, forward pointing, spreading and flat with slightly drooping tips in proximal 1 m, at mid-blade ascending off rachis and blade $\pm$ V-shaped, tips drooping, pinnae flat in distal 1 m. Inflorescences protandrous, interfoliar, branched to 4 orders, most proximal branches of first three orders of branching the largest and most complex and progressively becoming smaller and less complex distally until most distal represented by simple rachillae; peduncle 1 m long, 9 cm wide, 5 cm thick, arcuate, green, covered with patchy reddish brown tomentum; only tip of prophyll or 1st peduncular bract seen, this portion 18 cm long, green, stiff, coriaceous, flattened, 2-keeled, sparsely covered with reddish brown tomentum; 3 rudimentary peduncular bracts present, most distal 10 cm below most proximal branch, 1.5 cm high, next lowest 20 cm proximal below most proximal branch, 2.5 cm high, most proximal 38 cm below most proximal branch, 18 cm long; rachis 1.7 m long, green with some reddish brown tomentum, 43 1st order branches; most proximal 1st order branch with sub-peduncle 18 cm long, 4.5–5.7 cm wide, flattened, 2.3 cm thick, sub-rachis 97 cm long with 32 2nd order branches; most proximal 2nd order branch with sub-peduncle 12.5 cm long, 1.2–1.9 cm wide, flattened, 1 cm thick, sub-rachis 30.5 cm long with 15 3rd order branches;

most proximal 3rd order branch with subpeduncle 2.5 cm long and branched into 2–3 rachillae; all branches and rachillae of all orders subtended by bracteoles; rachillae (12–)20–25 cm long, 4 mm diam., spreading, ± stiff but drooping and yellow-green in fruit. Flowers (fresh flowers at anthesis not seen) borne in triads in cleft-like pits 1.5 mm high, 3 mm wide, 1 mm deep, proximal lip of pit cliff-like, slightly mucronate, triads 3–5 mm apart proximally, 2–3 mm apart distally; each staminate flower subtended by a small, thin, crescent-shaped, nearly transparent bracteole 0.2 mm high on outer side; pistillate flower subtended by 2, thin, light green, nearly transparent, imbricate bracteoles 0.5 mm high. Fruits 14 × 12 mm, very broadly ellipsoid, orange, stigmatic remains basal, just above perianth; mesocarp mucilaginous, 1 mm thick. Fruiting perianth 6.5 mm wide; sepals imbricate in basal 1/5, very briefly connate, broadly rounded apically, 2 × 3 mm; petals imbricate in basal 1/3–1/2, very briefly connate, 3 × 4–5 mm, rounded-triangular; staminodes 6, triangular, 0.8–1 mm high. Seeds 11 × 9 mm, obovoid-ellipsoid; endosperm homogeneous; embryo slightly distal of middle.

Measurements for the description were taken from non-dried, fresh material Marcus had collected and sent to Hodel. Dried rachillae are more slender, floral pits more prominent, and proximal lip of floral pit sharper, thinner and more knife-like than in fresh rachillae.

Dypsis robusta keys to couplet F21, Key 6 in *The Palms of Madagascar* but has homogeneous endosperm like *D. ifanadianae* and *D. tsaravoasira*. It differs from the former in the larger trunk diameter (36.4 vs. 18 cm), larger and different colored leaf base (95 vs. 72 cm, waxy white with reddish brown tomentum vs. green), longer rachis (4.6 vs. 3 m) with more pinnae per side (130 vs. 55), and inflorescence branched to 4 rather than 3 orders. It differs from the latter in the spirally vs. tristichously arranged leaves, different colored leaf base (waxy white with reddish brown tomentum vs. green), longer rachis (4.6 vs. 3.5 m), and larger (1.8 vs. 0.6 m) and interfoliar rather than infrafoliar inflorescence branched to 4 rather than 3 orders.

Dypsis robusta has somewhat similar leaf bases to those of *D. hovomantsina* but differs in the

wider (to 5 vs. to 4 cm), regularly arranged rather than irregularly arranged pinnae, longer rachis (4.6 vs. 3.5 m) with more pinnae per side (130 vs. 96), larger (1.7 vs. 0.48 m), interfoliar rather than infrafoliar inflorescence branched to 4 rather than 3 orders, and homogeneous rather than deeply ruminate endosperm.

Marcus originally obtained several small plants of *Dypsis robusta* from the late Maria Walford-Huggins Boggs of Australia in 1991 or 1992. Boggs, who did not say where the plants originated, called the species *Chrysalidocarpus* ‘Stumpy’ (not to be confused with *Dypsis* ‘Stumpy,’ which was later named and described as *D. carlsmithii*). Few large or mature plants of this species are known in cultivation. Marcus gave one plant to Florida nurseryman George Zammis, but its fate is unknown. Arden Dearden and Clayton York in Australia have plants, but they have not yet flowered. Kampon Tansacha has one plant in his Nong Nooch Tropical Garden in Thailand that has recently flowered (Michael Ferrero, per. comm.). Marcus has erroneously referred to this palm in the past as *D. prestoniana* although more recently he has distributed it as *Dypsis* ‘Maria’s Stumpy.’ Clayton York (per. comm.) reported that this species may have originally been introduced erroneously as *D. caniculata*.

Dypsis robusta would make a fine ornamental for parks, public areas, and large gardens in the tropics and warm subtropics. Its suitability for more temperate areas, such as regions with a Mediterranean climate, is unknown. The type plant in the Marcus nursery in Hilo, Hawaii has a short but robust trunk about 1.5 m tall, is 6 m tall overall, and has been flowering for about a year. The twisting rachis and ascending pinnae with drooping tips impart the appearance of being irregularly arranged and lend a somewhat plumose effect to the blade although pinnae are regularly arranged in one plane.

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***Guihaia grossifibrosa*, the Dragon Scale Palm – An Endangered Species from Limestone Mountains in Northern Vietnam and China**

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Guihaia grossifibrosa is a poorly known dwarf fan palm, a typical element of the indigenous vegetation of ancient karst limestone hills and low ridges, widespread in northern Vietnam and China. In this article the authors give more information about the habit of this species and describe the natural conditions of its habitats in Vietnam.

Guihaia J. Dransf., Lee & Wei is genus of Coryphoid palms comprising two species distributed in karst-limestone areas of southern China and northern Vietnam (Dransfield et al. 1985). While the type species of the genus, *G. argyrata* (Lee & Wei) Lee, Wei & J. Dransf., is a common plant in southern China and is quite well studied, the second species – *G. grossifibrosa* – is much less well known and is represented by only a few collections. A detailed description of this plant and its ecology is provided below, based on recently collected material from the territory of northern Vietnam.

Guihaia grossifibrosa (Gagnep.) J. Dransf., Lee & Wei, *Principes*, 29, 1: 12, Fig. 8. 1985. *Rhapis grossifibrosa* Gagnep. in *Notulae System.* 6: 159. 1937 and in Humbert, *Fl. Gen. Indochine* 6: 994. 1937. Type: ANNAM: massif de Lin-ca, prov. de Vinh, *Poilane* 16383 (P).

Unbranched dioecious fan palm, solitary or in clumps of 2–5 individual stems of different height, rarely forming ± dense groups with more than 5 trunks, each terminated by a very open crown. Trunk rigid, erect, 0.5–2.5 m tall (female samples usually more compact and smaller, up to 2 m high) in upper part densely

1. *Guihaia grossifibrosa* in its natural habitat.

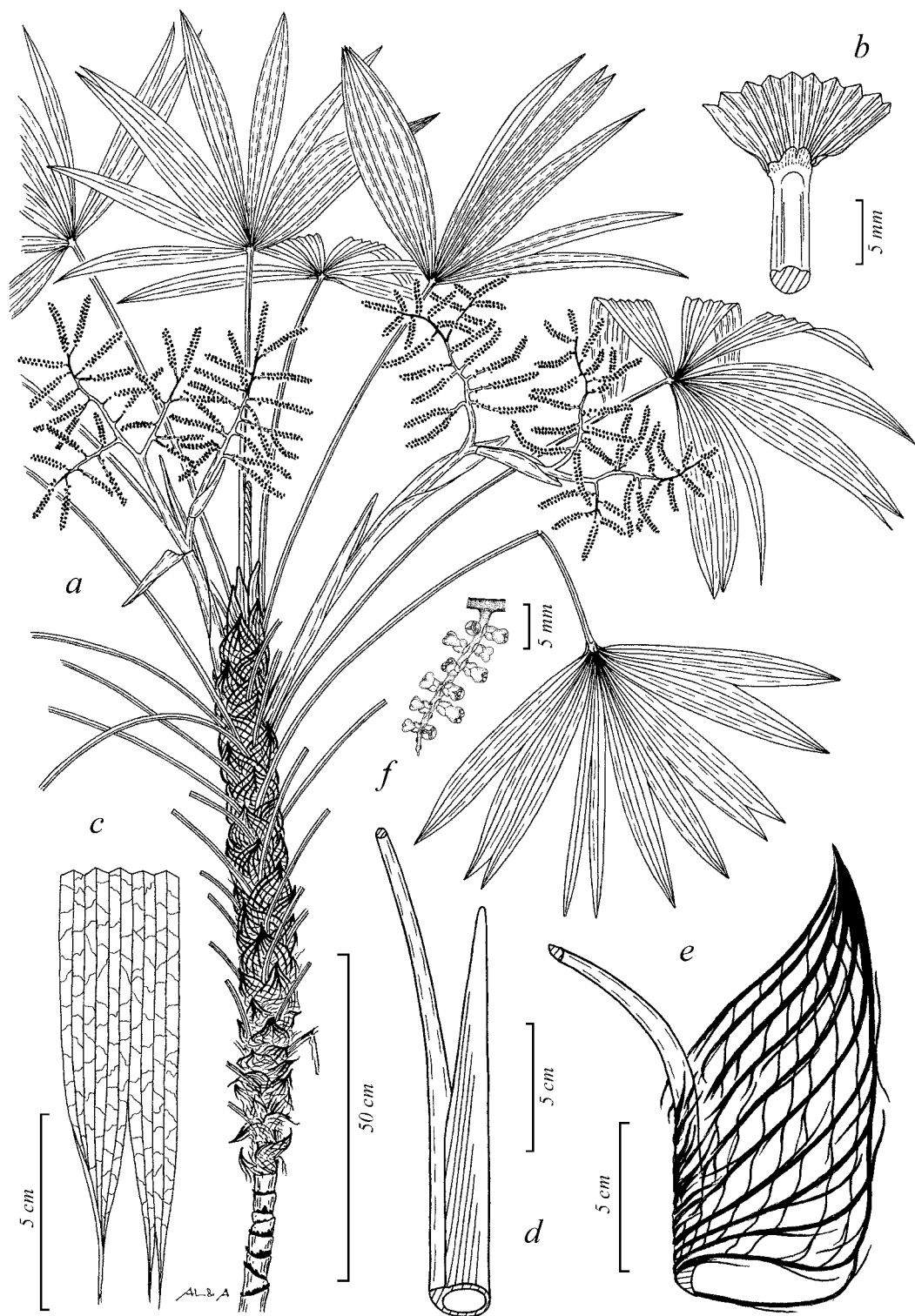


covered with persistent leaf sheaths, 4–8 cm in diam., bare near the ground, 1.5–2.5 cm diam., with internodes 1–1.5 cm long. Leaves 6–12(14) in crown; sheaths, when young narrow, cylindrical, hardly splitting, 18–12 cm long, 1–1.5 cm wide, dull brown, with dull gray-brown papyraceous hairs; sheaths of old leaves widening to 6–8 cm, deep brown to black, glabrous, shortly cylindrical to broad ovate, inflated, split into linear, very rigid, coarse, woody, wire-like anastomosing segments, often disintegrating into free, more or less reflexed spike-like tips, surrounding stem with wire-like rigid netlike covering; ligule-like tip deep brown to black, glabrous, erect, 6–15 cm long, with very rigid and hard, beak-like apex, at the base dissected into network of numerous anastomosing linear rigid segments; petiole narrow, slender, rigid, 0.5–1 m long, 2–3 mm broad, subterete, broadening and flattened to the base up to 5–6 mm wide, slightly curved in basal portion (strongly curved in old leaves), $\pm$ straight toward the leaf blade, glabrous, smooth along margin, green or dull brown near trunk;

adaxial hastula semi-circular, erect, 2–2.5 mm high, sometimes irregularly dissected into two unequal lobes, hairy when young with dull gray-brown papyraceous caducous hairs, on old leaves glabrous; leaf blade leathery, dark green above, light green (sometime whitish) below, broadly fan shaped in outline, 40–45 cm long from hastula, palmately segmented from near the base into 6–10(12) unequal segments, each segment linear to elliptic, (0.8)1–3(6) cm wide, broadest segments commonly partially dissected from periphery, smooth (in male samples) to sparsely, very finely denticulate along margin (in female samples) with 1 to 6(10) prominent longitudinal veins, longitudinally folded, sometimes slightly narrowing to acute apex, hairy above (in young leaves) at the base with sparse short papyraceous dull gray-brown hairs. Inflorescence 1–2(3), branched to 3(4) order, situated in leaf axils near the apex of the trunk, 40–70 cm long, with light dull brownish to deep brown, rigid, narrowly lanceolate smooth laterally compressed basal bracts; basal bracts 2(3), 15–30 cm long, 1–2 cm wide,

2 (left). Steep inaccessible slopes and cliffs of ancient limestone ridges and hills composed of marble-like crystalline highly eroded limestone at elevations 500–900 m a.s.l., the home of *Guihia grossifibrosa*. 3 (right). Open primary dry coniferous forests with *Pinus fenzeliana* and *Pseudotsuga sinensis* on rocky ancient limestone are typical habitats of *Guihia grossifibrosa*.



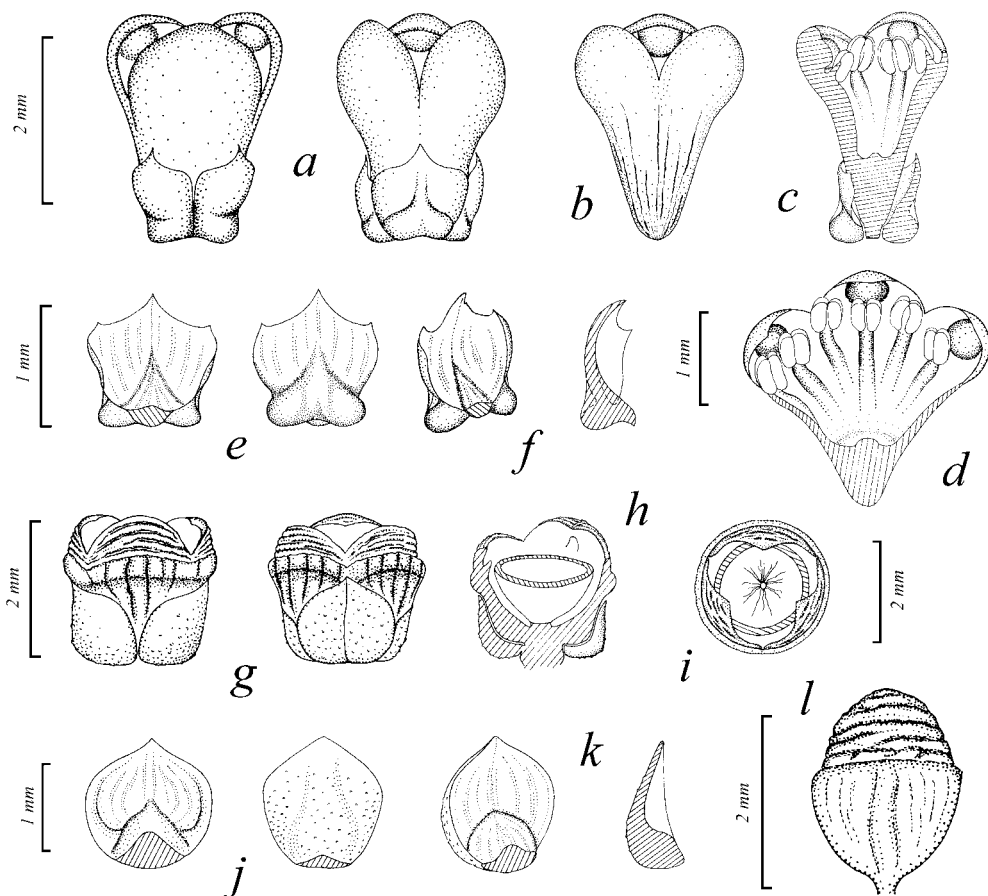


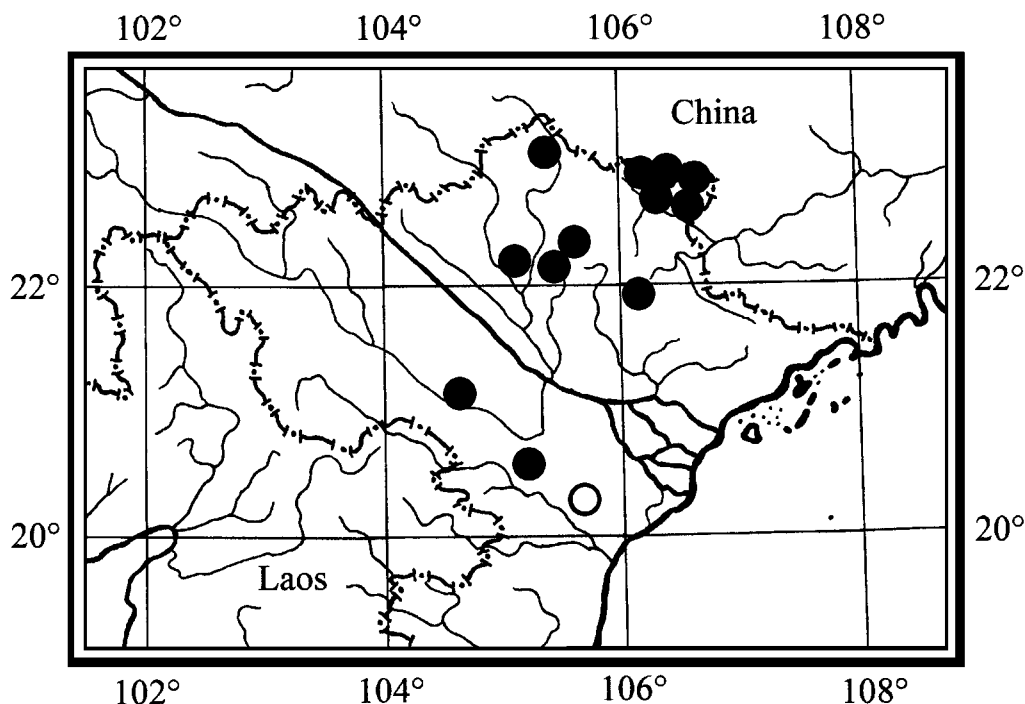
4. *Guihia grossifibrosa*. a. habit; b. base of leaf lamina with ligula (hastula); c. apical part of leaf segments; d. base of young leaf with leaf sheath; e. base of adult leaf with leaf sheath; f. rachilla with male flowers. All drawn from male sample - HAL 4741 by Leonid Averyanov and Anna Averyanova.

densely hairy with dull gray-brown short papyraceous hairs (when young) or glabrous (when old), tubular in basal portion, acuminate at the apex; peduncle erect, very rigid, 20–30 cm long, 5–7 mm broad, oval in cross section, enveloped by basal bracts; rachis very rigid, 20–25 cm long, 3–4 mm wide, slightly flexuous, with 2–3 main branches, with 1 rigid brown bract similar to basal inflorescence bracts, hairy (when young), 6–9 cm long, 4–8 mm broad; rachillae numerous, (0.5)1.5–8(10) cm long, rather straight, rigid, with numerous, sessile, densely spirally arranged, yellowish to yellow-green flowers, each flower with very small insignificant triangular bracteole. Flowers unisexual, sessile, radially symmetrical; male flowers shortly cylindrical or broadly shortly conical, 2.4–2.6 mm long, about 2 mm wide, campanulate;

sepals 3, free, scale-like, ovate to subquadrate, 2–2.2 mm long, 2–2.4 mm broad, indistinctly trilobed or broadly tridentate at apex, thickening into broad inflated broadly triangular woody base; petals 3, narrowly triangular, 2.4–2.6 mm long, 1.5–1.8 mm wide, with orbicular apex, three times longer than sepals, inside at the apex with prominent hemispherical cushion, connate from the base to 3/4 their length into conical fleshy tube, finely longitudinally wrinkled; stamens 6, $\pm$ similar, in two whorls, not exceeding the petals, filaments adnate to the perianth, anthers subsessile oblong reniform, 0.3–0.4 mm long, 0.2–0.3 mm broad, dehiscent longitudinally along lateral margin; pistillodes absent; female flowers shortly cylindrical to subglobose, 2–2.2 mm long and broad; sepals 3, free, scale-like, broadly ovate to

5. *Guihia grossifibrosa*. a. male flower, side view; b. corolla of male flower, side view; c. male flower, longitudinal section; d. male flower, half-dissected and flattened; e. sepals of male flower, view from adaxial and abaxial side; f. sepal of male flower, side view and longitudinal section; g. female flower, side view; h. female flower, longitudinal section with half developed ovary; i. female flower, with transverse section of half developed ovary, view from the top; j. sepals of female flower, view from adaxial and abaxial side; k. sepal of female flower, side view and longitudinal section; l. petal, view from abaxial side. All drawn from HAL 4741 (male sample) and NTH 3543 (female sample) by Leonid Averyanov and Anna Averyanova.





6. *Guihia grossifibrosa*. Map of distribution in Vietnam. Studied populations confirmed with herbarium collections are marked with dots; the open circle designates a locality based on observations not confirmed with voucher herbarium specimens.

suborbiculate, 1.4–1.6 mm long and broad, thickened at the base, finely verrucose outside; petals 3, ovate, about 2 mm long, 1.8 mm wide, outside in upper part with transverse low inflated band, at basal half smooth or indistinctly longitudinally wrinkled, in apical portion with irregular transverse rough wrinkles, deeply connate into rigid woody cupule with only free roundish apices of petals; staminodes 3 (rudiments of stamen of inner whorl), small, tooth-like; gynoecium unknown. Fruit 1-seeded; young fruit briefly stalked, ovoid, with thin exocarp and with few weak fibers in mesocarp; old ripe fruits (fallen on ground) black, spherical, about 1 cm in diameter; seed unknown. Fig. 1, 4, 5, 7–10.

Flowering Period. April–June.

Ecology. Lithophytic and terrestrial erect unbranched fan palm 0.5–2(2.5) m tall. Primary rather open and dry evergreen seasonal lowland and submontane coniferous (particularly with *Pinus fenzeliana* and *Pseudotsuga sinensis*) and broad-leaved forests on rocky tops and cliffs of remnant ridges and hills composed of marble-like crystalline highly eroded limestone at elevations 500–900 (1100) m a.s.l.

Distribution. Vietnam. Bac Kan prov. (districts: Ba Be, Cho Don, Na Ri), Cao Bang prov.

(districts: Ha Lang, Tra Linh, Trung Khanh), Ha Giang prov. (Dong Van district), Ninh Binh prov. Nho Quan district, Cuc Phuong national park [sight record on steep, inaccessible cliffs], Son La prov. (Moc Chau district), Thanh Hoa prov. (Ba Thuoc district). Fig. 6.

Specimens Examined. Vietnam, Bac Kan prov., Cho Don distr., Nam Mau Municipality, Ba Be national park around point 22°23'22"N 105°37'09"E, 500 m, 23.12.2002, J. Regalado, N.T. Hiep, L. Averyanov et al., HLF 609 (HN); Phia Khao village, Cau Muc locality, 22°17'32"N 105°31'27"E, 900–1000 m, 26.12.2002, P.K. Loc, L. Averyanov, T.V. Thao et al., HLF 807 (HN); same locality, around point 22°15'52"N, 105°32'01"E, 800–900 m, 21.5.2004, L. Averyanov, N.T. Hiep, P.V. The, N.T. Vinh, HAL 4741 (HN, LE); Na Ri distr., Liem Thuy Municipality, village Lung Vai, around point 21°57'18"N, 106°06'12"E, 500–700 m, 28.5.2004, L. Averyanov, N.T. Hiep, P.V. The, N.T. Vinh, HAL 4982 (HN); Cao Bang prov., Ha Lang distr., municipality Thang Loi, vicinities of Ban Hao (22°43'N 106°40'E), about 43 km to E from Cao Bang town, 700 m, 26.11.1998, L. Averyanov, P.K. Loc, N.X. Tam, CBL 681 (HN); Tra Linh distr., municipality Quang Vinh (22°51'N 106°14'E), about 21 km from Cao Bang town to the N, 800–850 m, 9.12.1998, L.

Averyanov, N.T. Hiep et al., CBL 997 (HN); Quoc Toan municipality, near Thang Heng lake in environs of Thang Heng and Lung Tao villages, 800–900 m, 4.1.1996, L. Averyanov, N.T. Hiep et al., VH 2466 (HN); vicinities of Lung Tao village (22°45'N 106°19'E), about 12 km from Cao Bang town to the NNE, 600–800 m, 14.12.1998, N.T. Hiep, P.K. Loc, L. Averyanov et al., CBL 1238 (HN); Trung Khanh distr., Ngoc Khe Municipality, Pac Nga village, around point 22°54'59"N, 106°31'44"E, 750–850 m, 12.6.2004, L. Averyanov, P.K. Loc, P.V. The et al., HAL 5655 (HN); Ha Giang prov., Dong Van distr., Tu Tinh municipality (23°05'N 105°15'E) 40.7 km to 43° of Ha Giang city, 600–750 m, 10.10.1999, N.T. Hiep, L. Averyanov, P. Cribb et al., NTH 3543 (HN, LE); Son La prov., Moc

Chau distr., municipality Chieng Hac, vicinities of Co Liu village (20°51'N 104°38'E), 900–1100 m, 29.5.1999, N.T. Hiep, P.H. Hoang, L. Averyanov, NTH 2951 (HN); Thanh Hoa prov., Ba Thuoc distr., Co Lung municipality, territory of Pu Luong protected area, near Pu Luong village (20°27'01"N, 105°11'03"E), 500–550 m, 13.4.2001, N.T. Hiep, L. Averyanov, D.T. Doan et al., HAL 929 (HN).

Notes. This palm was first described by Gagnepain based on collections made by Poilane in the Massif de Lin-ca, province of Vinh, in Vietnam. The geographical origin of the type may be questionable, as it is reported from an area of southern Vietnam with mainly siliceous rocks. *Guihaia grossifibrosa* is an



7. *Guihaia grossifibrosa*, adult flowering male samples in natural habitat.

8. *Guihaia grossifibrosa*, inflorescences and leaves (adaxial and abaxial sides) of male samples.



obligate calcium dependent species and typically inhabits rocky karst limestone in northern Vietnam. Its occurrence in southern Vietnam has not yet been confirmed by recent field investigations. It is also known from southern China (Dransfield et al. 1985).

The first time we became aware of this unusual dwarf palm in northern Vietnam was during initial exploratory expeditions in the karst limestone areas of northern Vietnam supported by U.S. National Geographic Society and American Orchid Society. Dr. N.T. Hiep

and Prof. L. Averyanov found it in 1996 with a number of other calcium dependent endemic plants, some new to science, most famous of which was *Paphiopedilum helenae* Aver. The discovery of numerous new species emphasized how important the floristic complex of karst limestone area in northern Vietnam is as a center of plant diversity.

During detailed explorations of Cao Bang province two years later *Guihaia grossifibrosa* was collected and observed many times, and we recognized this palm as a typical shrubby

element of the rocky and cliff habitats on tops of remnant, highly eroded, limestone ridges. Extensive field investigations of limestone regions of northern Vietnam during the next few years detailed the distribution area of this species as widespread throughout the northwest of the South Chinese and the northeast of the North Indochinese floristic Provinces of the Indochinese floristic Region of the Indomalaysian Subkingdom of the Paleotropical Realm (Averyanov et al. 2003a, b; Averyanov 2004). Up to now it has been found in most administrative provinces of northern Vietnam where primary vegetation on rocky karst limestone still survives. The plant was recorded from Ha Giang, Cao Bang, Bac Kan, Son La, Ninh Binh and Thanh Hoa provinces (Fig. 6). In some cases, however, it is found on rocky vertical cliffs inaccessible for collecting and such records are not confirmed by voucher herbarium samples. In the last few years *G. grossifibrosa* was collected in the extreme north of Cao Bang province very near to the Chinese border. Identical landscapes on both sides of the border gives clear evidence that the palm may also be common on the Chinese side of the border if it has not become extinct due to more widespread deforestation.

Natural conditions observed throughout the range of distribution of *Guihia grossifibrosa* were described in detail in a number of our previous publications (Averyanov et al. 2000, 2002, 2003a, b, in press; Averyanov 2004). The climate here is classified as monsoon tropical climate with a cool winter and summer rains (Nguyen Khanh Van et al. 2000). Commonly, annual rain precipitation averages around 1500–1700 mm, with mean annual temperatures 20–22°C. A hot damp summer with an abundance of torrential heavy rain from May–June until September–October is typical for the area. The winters are dry and rather cool from October up to April. Average summer temperatures usually vary between 23–28°C, the usual winter temperatures (at elevation 174–520 m a.s.l.) hover around 11–16°C. On the coldest winter nights, at elevations 520 m in open places the temperatures may approach -3.5°C. Night cloud and fog are common in the mountains and mountain valleys at elevations higher than 500 m a.s.l.

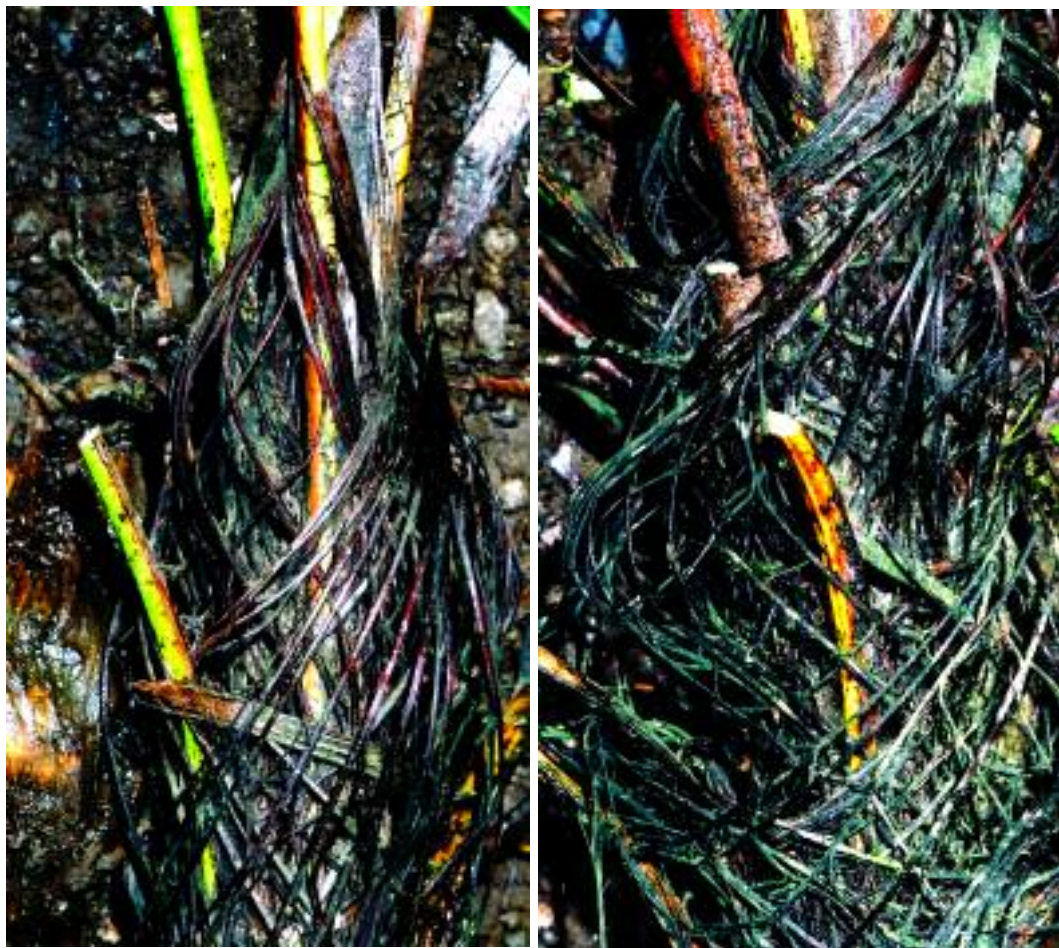
Guihia grossifibrosa was found as an integral floristic element of the shrubby understory in primary open evergreen, more or less seasonal, tropical lowland and submontane coniferous and broad-leaved forests on rocky limestone

mountains. It grows predominantly at elevations 500–900 m a.s.l. (Fig. 2.). The species is a typical inhabitant of open limestone outcrops, steep rocky slopes and ledges of vertical cliffs. It is particularly common in light coniferous forests with *Pinus fenzeliana* and *Pseudotsuga sinensis* (Fig. 3). Fragments of these forests cover isolated rocky tops of highly eroded remnant limestone formations, which appear as numerous hills or small mesa-like mountains with very steep slopes and numerous vertical cliffs (Fig. 2). Mountains at the localities of *Guihia grossifibrosa* are composed of solid crystalline white to deep gray marble-like limestone, which represents a relictual geologic formation derived from marine deposits of late Paleozoic and early Mesozoic age (Dovzhikov et al. 1965a, b). Deep erosion of the ancient highly metamorphosed marble-like limestone formed a spectacular landscape.

Other conifers occasionally appearing as canopy dominants of limestone forest are *Calocedrus rupestris*, *Dacrycarpus imbricatus*, *Fokienia hodginsii* and *Keteleeria davidiana*. This forest stratum on tops of mountains reaches 15–20 m tall, but can reach up to 25–30 m on slopes protected from wind. Some broad-leaved trees, such as *Platycarya strobilacea* (Juglandaceae) and several tropical oaks (*Quercus* spp.) occur sometimes in this stratum with the conifers. Projected plant cover of the first stratum is not too high and averages about as 15–25% only.

The second forest stratum includes many species of trees commonly 6–15 m tall with total projected cover of their canopies up to 40%. Among the most common species here are *Acer tonkinense* (Aceraceae), *Aglaia* sp. (Meliaceae), *Apodytes dimidiata* (Icacinaeae), *Boniodendron parviflorum*, *Nephelium* sp. (Sapindaceae), *Carpinus* sp. (Betulaceae), *Celtis* sp. (Ulmaceae), *Ficus* sp. (Moraceae), *Lysidice rhodostegia* (Fabaceae), *Pistacia weinmannifolia* (Anacardiaceae), *Radermachera boniana* (Bignoniaceae), *Reevesia* sp. (Sterculiaceae), *Sapium rotundifolium* (Euphorbiaceae), *Schefflera pes-avis* (Araliaceae), *Sinosideroxylon racemosum* and *S. wightianum* (Sapotaceae). Some gymnosperm trees, such as *Nageia fleuryi* and *Podocarpus neriifolius*, are also regular components in this stratum.

The next stratum of the forest includes small trees and shrubs commonly 1.5–5 m tall. They develop more or less dense cover composed of a great number of species. Main co-dominants



9–10. *Guihia grossifibrosa*, leaf sheaths in male (9, left) and female sample (10, right).

here are species such as *Alstonia guangxiensis*, *Tabernaemontana* sp. (Apocynaceae), *Ardisia* sp., *Myrsine kwangsiensis* (Myrsinaceae), *Bischofia* sp., *Mallotus* sp., *Phyllanthus* sp. (Euphorbiaceae), *Cryptocarya chinensis*, *Litsea* sp. (Lauraceae), *Callicarpa* sp., *Premna* sp. (Verbenaceae), *Calophyllum balansae*, *Calophyllum* sp., *Garcinia fagraeoides*, *Garcinia* sp. (Clusiaceae), *Campylotropis bonii*, *C. henryi*, *Sophora tonkinense* (Fabaceae), *Carallia* sp. (Rhizophoraceae), *Decaspermum parviflorum*, *Rhodamnia dumetorum*, *R. trinervia* (Myrtaceae), *Diospyros kerrii*, *D. rufogemmata* (Ebenaceae), *Eriobotrya bengalensis*, *E. cavaleriei*, *Sorbus* sp. (Rosaceae), *Euonymus* sp., *Glyptopetalum thorelii* (Celastraceae), *Ficus* sp. (Moraceae), *Glycosmis puberula*. (Rutaceae), *Homalium petelotii* (Flacourtiaceae), *Illicium difengpii* (Illiciaceae), *Ixora* sp., *Psychotria* sp., *Tarenna collinsae* (Rubiaceae), *Ligustrum* sp., *Osmanthus* sp. (Oleaceae), *Lithocarpus* sp., *Quercus* spp. (Fagaceae), *Mahonia nepalensis* (Berberidaceae), *Mangifera flava*, *Mangifera* sp., *Pistacia*

weinmannifolia, *P. cucphuongensis* (Anacardiaceae), *Melientha suavis* (Opiliaceae), *Memecylon edule* (Melastomataceae), *Pittosporum* sp. (Pittosporaceae), *Polyalthia* sp. (Annonaceae), *Rhapis divaricata* (Arecaceae), *Strobilanthes* sp. (Acanthaceae), *Tirpitzia sinensis* (Linaceae), *Viburnum cinnamomifolium* (Caprifoliaceae) and *Xerospermum noronhianum* (Sapindaceae). Dwarf cycads, *Cycas dolichophylla*, may be observed on steep open slopes and cliffs. Projected cover of this forest stratum often reaches 40%, but on rocky outcrops and cliffs the shrub cover may be less than 10%.

The herbaceous species composition in habitats of *Guihia grossifibrosa* is extraordinarily rich and includes a great number of species among which most common are *Aglaonema* sp., *Amorphophallus* sp., *Arisaema* sp., *Typhonium* sp. (Araceae), *Alpinia* sp., *Hedychium* sp. (Zingiberaceae), *Ardisia maclurei*, *A. silvestris* (Myrsinaceae), *Aspidistra* sp., *Disporum cantoniense*.

Ophiopogon peliosanthoides, *Peliosanthes teta*, *Polygonatum punctatum*, *Tupistra* sp. (Convallariaceae), *Carex* sp. (Cyperaceae), *Elatostema* sp., *Procris* sp. (Urticaceae), *Impatiens* sp. (Balsaminaceae), *Lysimachia* aff. *microcarpa*, *L. insignis* (Primulaceae) and *Ophiorrhiza* sp. (Rubiaceae). Shady vertical cliffs represent the typical habitat of numerous obligate lithophytes, such as *Begonia aptera*, *B. cavaleriei*, *Begonia* spp. (Begoniaceae), *Chirita* spp. (Gesneriaceae), *Peperomia blanda* (Piperaceae) and numerous ferns.

Among the most common fern species observed in habitats of *Guihaia grossifibrosa* are *Adiantum caudatum*, *A. gravesii*, *Amphineuron tonkinense*, *Antrophyum* sp., *Asplenium griffithianum*, *Asplenium* sp., *Colysis bonii*, *C. elliptica*, *C. pothifolia*, *Ctenitopsis austrosinensis*, *Cyclosorus* sp., *Cyrtomium fortunei*, *Drymoglossum* sp., *Lemmaphyllum microphyllum*, *Necheiropteris ensata*, *Polystichum* sp., *Pteridrys* sp., *Pteris* sp., *Pyrrosia porosa*, *Tectaria polymorpha* and *Tectaria* sp.

The orchids reach extraordinarily high diversity in habitats of *Guihaia grossifibrosa*. Like this palm most of them are very rare, calcium-dependent, endemic species such as *Bulbophyllum ambrosia*, *B. longibrachiatum*, *Calanthe argenteo-striata*, *Habenaria ciliolaris*, *Liparis averyanoviana*, *Luisia appressifolia*, *Paphiopedilum emersonii*, *P. hangianum*, *P. helenae*, *P. hirsutissimum* var. *esquirolei*, *P. malipoense*, *Pholidota roseans*, *Renanthera citrina*, *R. vietnamensis*, *Rhomboda petelotii* and *Vanda fuscoviridis*.

Guihaia grossifibrosa is a common element of the shrub stratum in primary limestone forests. However, this palm never forms large dense populations and occurs commonly as scattered individuals or loose groups including usually not more than 3–5 growths of different heights. Male plants are usually a little bit taller, while female ones are shorter, more compact and robust. The plants are commonly rooted in deep vertical pockets in eroded limestone filled with rich deep brown well structured friable soil covered with leaf litter. Drainage of the karst limestone ground is very sharp, and rain water never accumulates in soils even during heavy rains.

Guihaia grossifibrosa has a dwarf habit with trunk 1–2 m tall (rarely up to 2.5 m) covered with unusual rigid scale-like leaf sheaths rather reminiscent of dragon scales. This unusual “dragon scale palm” obviously has potential

for ornamental horticulture but is not yet widely known in culture. Cultivation of this palm may be an important factor for its protection. *Guihaia grossifibrosa*, like many other indigenous endemic plants of the primary limestone floristic complex, is a highly endangered species, which could become extinct very quickly after logging of the forest and successive progressive deforestation. Effective regeneration of its populations in degraded secondary forests has never been observed in the studied areas. Without any doubt this rare Vietnamese endemic needs effective protection in all its discovered localities.

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Vietnam," American Orchid Society, 2004. We thank Dr. John Dransfield for confirming the identity of the palm and editing the manuscript and Ms. Anna Averyanova for transforming pencil sketches into ink drawings.

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A Key to Common Landscape Palm Disorders and Diseases in the Continental United States

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Palms in the landscape are susceptible to a wide range of diseases and disorders. This key should allow the reader to identify the most common diseases and disorders encountered in the continental United States.

Although most known diseases and physiological disorders of ornamental palms are discussed and illustrated in two recent books (Elliott et al. 2004; Broschat & Meerow 2000), diagnosis of a particular palm problem requires either a comprehensive understanding of all of the possibilities, or a systematic key to help the diagnostician focus on the cause of the problem. The following is a key to the most common diseases and disorders affecting landscape palms in the continental United States. Areas of the palm-growing world

outside the continental United States should still find this key useful, since physiological problems are the same wherever palms are grown. Disease and other pest problems, however, vary from region to region, and thus for practical reasons we have limited the geographical scope of this key. Some insect pests are included in the key, as the damage they cause may appear similar to some diseases or disorders. For a comprehensive reference on insects that damage palms, see Howard et al. (2001).

Since few people have immediate access to analytical laboratories, this key is based solely on visible symptoms. Fortunately, visual symptoms are sufficient to accurately diagnose the majority of palm problems. Visual symptoms are also the first step in determining which diagnostic lab to use for further analysis and which tissue should be sampled for analysis. A laboratory analysis should be used only in conjunction with the field diagnosis of the problem. It is critical to understand that plant diagnostics is not nearly as sophisticated or infallible as human medical diagnostics. Just because a laboratory report suggests deficiencies of one or more nutrient elements or the presence of one or more potential pathogens does not mean that those deficiencies or pathogens are the actual cause of a particular problem. Thus "false positives" are a common and often misleading weakness of laboratory diagnostics. In the case of palm diseases, "false negatives" are also a common problem, especially when the wrong tissue is sampled or a sample of poor quality is submitted to the laboratory.

If confirmation of a field disease diagnosis is necessary, it should be conducted by a qualified plant disease diagnostic laboratory. For example, molecular tests can be used to confirm *Fusarium* wilt and lethal yellowing, but only a few laboratories have this capability. Note that sometimes it is not possible to make a confirmation of a field diagnosis until a dead or dying palm is cut down. For example, palms affected by *Ganoderma* butt rot may die without producing conks (basidiocarps). However, when the palm is cut down and cross-sections made of the trunk, the disease will be easily confirmed.

Sampling the correct tissue is critical for an accurate diagnosis. One common error is to sample roots. However, root rots of palms growing in the landscape are uncommon, and are usually the secondary result of a palm being planted in the wrong environment – e.g., planting *Phoenix dactylifera* in soils that are routinely water-logged. A diagnostic laboratory will usually be able to isolate *potentially* pathogenic fungi from roots, but these fungi are seldom the *primary* cause of the problem observed. Likewise, soil sampling for potential pathogens is not recommended.

As with diseases, most nutrient deficiency problems can be readily diagnosed by visual symptoms alone. However, there are situations where multiple deficiencies may be present on

a single palm. Symptoms of these deficiencies may be present on different parts of the palm (e.g., old vs. new leaves) but may occasionally be superimposed on the same tissue. A common example of the latter is potassium and magnesium deficiency symptoms both being present to some degree on the older leaves of a palm.

Leaf nutrient analysis can be useful for distinguishing multiple deficiencies where the symptoms of one deficiency may mask those of another. Leaf analysis can also be used to confirm or clarify a diagnosis based on visual symptoms. However, there are exceptions. For example, leaf analysis is not particularly useful for diagnosing iron deficiency in any plant, and may not accurately assess the boron sufficiency status of a palm at any given time, due to the highly transient nature of boron deficiency. Since there is a delay of four or more months between the time that boron deficiency is experienced by the palm and when the affected leaf appears outside the bud area, sampling a newly emerging leaf merely shows the boron status of the palm at the time that leaf was developing four or more months ago, and not the current boron sufficiency status of the palm. Leaf nutrient analyses are usually based on samples of several leaflets taken from the center of the youngest fully expanded leaf. In pinnate-leaved palms, this leaf should have all of its basal leaflets (or spines in some species) expanded out and perpendicular to the petiole axis, as in older leaves.

Soil nutrient analysis has often been employed in the diagnosis of plant problems. Unfortunately, this technique has limited value for this purpose, and often leads to erroneous conclusions. Just because a nutrient element is found to be "deficient" in the soil, does not mean that the plant is unable to extract sufficient amounts of that element from the soil. Alternatively, a palm may be suffering from a deficiency of an element that is present in "sufficient" levels according to soil tests. Soil analysis can be useful for diagnosing problems such as high soluble salts, a disorder with symptoms very similar to those of chemical toxicities, or even potassium deficiency in some species. Soil analysis may also provide useful information such as soil pH, which could affect your choice of corrective fertilizers.

When collecting soil samples for laboratory analysis, it is best to scratch away the mulch

or other surface covering and obtain a cup or more of soil from the top 4–6 inches of the soil profile. Sample several areas under the canopy of a single palm, or from under the canopies of several palms, if they are all affected by a single problem. These samples should be thoroughly mixed, and about one cupful of the mixture taken to the soils laboratory for analysis.

Once a diagnosis is made, treatment for that particular problem can be obtained from recent books such as Elliott et al. (2004) or Broschat and Meerow (2000). These references contain discussions and illustrations of the palm diseases and physiological disorders included in this key and should be used in conjunction with this key. You should also consult with your local Cooperative Extension Service office for local updates.

The following key focuses on typical symptoms associated with each disorder or disease. However, atypical symptoms do occur. Also,

symptoms of a single disease or disorder vary among palm species, and to some extent, even within a single palm species. It is also important to consider the palm's environment and history when making a diagnosis. Remember that diagnosing palm problems in the landscape can be as much an art as it is a science, and experience is invaluable. The key is divided into five major headings based on location of symptoms observed.

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The Key

Note: Leaf symptoms of lethal yellowing (LY) vary greatly with palm species and coconut cultivars. In the United States, LY has thus far been found only in southern Florida. A similar disease has been observed in the lower Rio Grande Valley of Texas. The range of LY is restricted by the lack of cold hardiness of its insect vector.

A. Symptoms affecting the entire canopy (all leaves)

1. wilting

a. fungal conk (basidiocarp) present on trunk – **Ganoderma butt rot**

b. no fungal conk on trunk

1) older leaves dying and hanging against trunk; leaves may first become chlorotic or discolored – **lethal yellowing (symptoms primarily on 'Malayan Dwarf' coconuts)**

2) top of root system is not found within top 15 to 30 cm (6 to 12 inches) of soil – **palm planted too deeply**

3) soil is water-logged – **poor soil aeration**

4) cross-sections of trunk show rotting or discoloration of wood (determined after palm is cut down)

a) discoloration confined to lowest 1.2 m (4 feet), usually located in the center of trunk – **Ganoderma butt rot**

b) trunk discoloration at any height, usually concentrated on one side of trunk, with dark fibrous appearance – **Thielaviopsis trunk rot**

2. leaves reduced in size

a. leaves uniformly light green or yellow in color – **nitrogen deficiency**

b. leaves chlorotic and necrotic – **late stage potassium deficiency**

3. canopy growth at sharp angle to trunk axis – **boron deficiency**

4. collapse of crown

a. rapid (1 or 2 days) collapse of crown – **lightning damage**

b. moderately fast (more than 4 days) to slow collapse of crown

- 1) cross-section through crown area shows crumbly trunk tissue (actually insect frass) and possibly 18 to 25 mm (3/4 to 1 inch) long gray caterpillars – ***Opogona* (banana moth) larvae damage**
- 2) cross-section through crown reveals galleries packed with frass, sometimes with white beetle grubs or pupae – **palmetto weevil damage**
- 3) cross-section through crown area shows rotted black fibrous appearance, but not crumbly trunk or bud tissue – **Thielaviopsis trunk or bud rot**
5. leaves tattered – **wind damage**
6. leaflets missing or partially missing from leaf tips – **boron deficiency**
7. chlorosis or necrosis of distal portion of leaves close to high voltage power lines – **powerline decline**
8. leaves uniformly light green – **nitrogen deficiency or chronic iron deficiency**
9. “spotting” on leaves
 - a. uniformly colored necrotic spots accompanied by leaflet tip necrosis – **foliar spray toxicity**
 - b. “spots” not raised; variable in size and in color from yellow to black; most common on small, immature palms – **leaf spot diseases (e.g., *Exserohilum*, *Bipolaris*, *Calonectria*, *Pestalotiopsis*, etc.)**
10. leaf bases (and often dead leaf blades) covered with light salmon-pink spores – ***Gliocladium* blight**

B. Symptoms most severe on oldest leaves

1. chlorosis
 - a. one or more older leaves uniformly yellow to yellow-orange in color (typically accompanied by skirt of dead leaves hanging down against trunk; yellowed leaves may originate mid-canopy in some cases) – **lethal yellowing**
 - b. chlorosis confined to margins of leaves or leaflets; central portion of leaves or leaflets distinctly green – **magnesium deficiency**
2. leaves discolored, but not necessarily chlorotic; usually shades of red to dark brown or gray (typically accompanied by skirt of dead leaves hanging down against trunk) – **lethal yellowing**
3. leaflets of oldest living leaves necrotic on one side of rachis only and petiole/rachis have reddish-brown to brown or black streak and vascular discoloration evident in longitudinal section of petiole – ***Fusarium* wilt (primarily *Phoenix canariensis*, but may occur on *P. dactylifera*)**
4. reddish-brown to brown or black streaks or lesions on petioles or rachis; necrotic segments in fan palm leaf blades or uneven death of leaflets in pinnate palm leaf blades – **rachis blight (caused by one of several fungal pathogens; small fungal spore-producing structures may be present on surface of lesioned or streaked petiole)**
5. tip or marginal leaf or leaflet necrosis
 - a. leaflet tips necrotic and curled – **potassium deficiency**
 - b. leaflet tips not curled
 - 1) leaflet tips often broken off – **potassium deficiency (*Phoenix* spp.)**
 - 2) leaflet tips not broken off
 - a. leaflets have translucent yellow/ orange or necrotic spotting or yellow-orange discoloration – **potassium deficiency**
 - b. leaflets do not have translucent yellow/orange or necrotic spotting or yellow-orange discoloration – **potassium deficiency, soil salt injury, micronutrient or other chemical toxicity, water stress (often requires leaf nutrient analysis, soil analysis or knowledge of plant environment or management history to differentiate)**

6. chlorotic and/or necrotic, brown, or black “spotting”
 - a. very small ≤ 1 mm ($< 1/16$ inch) raised “spots” (actually fungal structures) – **Graphiola leaf spot (false smut) (primarily *Phoenix* spp.)**
 - b. 3 to 8 mm ($1/8$ to $1/3$ inch) raised black, diamond-shaped “spots” (actually fungal structures), often accompanied by leaflet tip necrosis – **diamond scale (only on *Washingtonia filifera* in California and Arizona)**
 - c. no raised spots – **potassium deficiency**
 7. gummy exudates (“bleeding”) from multiple small 5 to 8 mm ($1/5$ to $1/3$ inch) wounds in palm leaf bases – **weevil damage (e.g., *Metamasius* spp.)**
 8. old to middle-aged leaves have necrotic “skeletonized” patches with only veins and surface layers of leaf intact; underside of leaf necrotic patches typically covered in tubes of insect frass – **leaf skeletonizers**
 9. leaf kinks and hangs parallel to trunk
 - a. leaf remains healthy – **wind damage**
 - b. leaf dies
 - 1) multiple small 5 to 8 mm ($1/5$ to $1/3$ inch) wounds in leaf base – **weevil damage (e.g., *Metamasius* spp.)**
 - 2) no wounds and palm is *Adonidia merrillii* – **lethal yellowing**
- C. Symptoms affecting youngest leaves only
1. spear leaf (i.e., youngest unopened leaf) discolored or collapsed
 - a. spear leaf hanging down, but otherwise healthy – **boron deficiency**
 - b. spear leaf pulls out easily
 - 1) on cold-damaged palm – **secondary bacterial bud rot [Note: cold damage occurred weeks prior to bud rot symptoms]**
 - 2) non cold-damaged palm – **Phytophthora bud rot; Thielaviopsis bud rot; lethal yellowing (*Phoenix dactylifera*, *Borassus flabellifer*)**
 2. no new leaves emerging, but older leaves still green – **bud rot (bacterial, *Phytophthora* or *Thielaviopsis*) or non-pathogenic bud damage**
 3. new leaves chlorotic
 - a. necrotic streaking present – **manganese deficiency**
 - b. no necrotic streaking present – **iron deficiency**
 - c. green spots superimposed on chlorotic new leaves – **iron deficiency**
 - d. leaflets of chlorotic new leaves becoming necrotic and palm is *Roystonea* sp. – **royal palm bug damage**
 4. new leaves reduced in size, but older leaves full-sized
 - a. leaves mostly necrotic
 - 1) leaflets curled or frizzled; leaflet necrosis more severe towards base of leaf – **manganese deficiency**
 - 2) leaflets not curled or frizzled – **pre-emergent herbicide injury**
 - b. new leaves not necrotic, but crumpled and greatly reduced in size – **boron deficiency**
 - c. new leaves have truncated tips
 - 1) all leaflet tips truncated – **manganese deficiency (*Cocos* only)**
 - 2) distal leaflet truncated in inverted “V” shape – **boron deficiency**
 5. new leaves have sharply hooked leaflet tips – **boron deficiency**
 6. spear (and often other new leaves) fail to open normally – **boron deficiency**
 7. transverse puckering or transverse translucent streaking on leaflets – **boron deficiency**

D. Symptoms affecting flowers and fruits

1. flower stalks have blackened tips – **boron deficiency, lethal yellowing (look for other symptoms to separate deficiency from disease)**
2. premature nut drop in *Cocos*
 - a. stem ends blackened and water soaked – **lethal yellowing**
 - b. stem ends green to brown and not water soaked – **boron deficiency**

E. Symptoms affecting trunk

1. gummy sap flowing from trunk (“bleeding”)
 - a. bleeding from single large wound with evidence of wood rot
 - 1) light salmon-pink spores present on trunk – **Gliocladium trunk rot**
 - 2) light salmon-pink spores not present – **Thielaviopsis trunk rot**
 - b. bleeding from one or more widely dispersed areas throughout the trunk – **lightning injury**
2. holes in trunk at any location along trunk
 - a. large holes 15 mm (5/8 inch) – **borer damage (*Dinapete*) (on *Washingtonia* only in California, Utah, and Arizona)**
 - b. many small 5 mm (1/5 inch) holes, often in rows – **woodpecker feeding damage**
 - c. small holes 1 to 2 mm (1/16 inch), randomly dispersed; typically having sawdust plugs protruding out of hole – ***Ambrosia* beetle damage**
3. holes or wounds (5 to 8 mm; 1/5 to 1/3 inch) in crownshaft or trunk near canopy – **weevil damage (e.g., *Metamasius* spp.)**
4. longitudinal splitting of trunk
 - a. palm obviously dying – **lightning injury**
 - b. palm appears to be otherwise healthy – **excessive water uptake**
5. tapering of trunk (pencil-pointing)
 - a. leaves chlorotic and/or necrotic
 - 1) leaves chlorotic, but no necrosis present – **nitrogen deficiency**
 - 2) leaves chlorotic and necrotic – **late stage potassium deficiency**
 - b. leaves not chlorotic and/or necrotic – **reduced vigor due to routine overpruning, prior cold temperatures, or other environmental stress**
6. shriveling – **water stress (may be caused by waterlogged soils or deep planting)**
7. fungal conk (basidiocarp) on trunk – ***Ganoderma* butt rot (leaves often wilted; cross-sections reveal internal rot at base of trunk)**
8. trunk collapses on itself – ***Thielaviopsis* trunk rot**

Calyptrogyne plumeriana, a New Name for a Familiar Palm

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New studies of the phylogeny of geonomoid palms indicate that the genus *Calyptronoma* cannot be maintained. With its inclusion in *Calyptrogyne*, a new combination needs to be published.

The currently accepted *Calyptronoma plumeriana* (Mart.) Lourteig was first described as *Geonoma? plumeriana* by Martius in 1843. Subsequently Lourteig transferred the species to the genus *Calyptronoma* in 1989. A molecular phylogeny of tribe Geonomeae using regions of the nuclear genes phosphoribulokinase and RNA polymerase II has revealed that *Calyptrogyne* is nested within *Calyptronoma* and that the two genera should be treated as one (Roncal et al. 2002). The characteristic "calyptra" (petals fused at the tip to form a cap that falls at anthesis) found in both previously recognized genera supports this change. As the genus *Calyptrogyne* has nomenclatural priority, all taxa formerly included in *Calyptronoma* must now be called *Calyptrogyne*. The loss of *Calyptronoma* necessitates the transfer of *Calyptronoma*

plumeriana to *Calyptrogyne*. Here the new combination is made.

***Calyptrogyne plumeriana* (Mart.) Roncal, comb. nov.**

Geonoma ? plumeriana Mart., Palm. Orbig. 34. 1843. Type: Plumier's Catal. Gen. Tab. 1 habit excl. details and MSS 7, icons 7, 8, 9, 10.

The two other species of *Calyptronoma* already possess combinations in *Calyptrogyne*: *Calyptrogyne rivalis* (O.F. Cook) León and *Calyptrogyne occidentalis* (Sw.) Gomez Maza.

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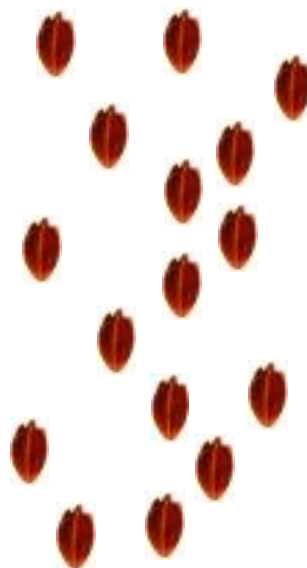
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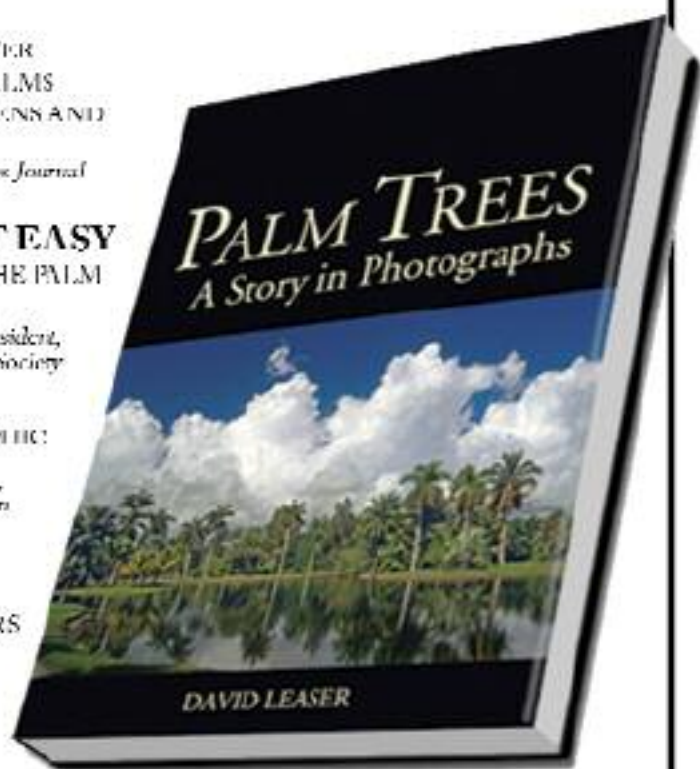
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