PALMS

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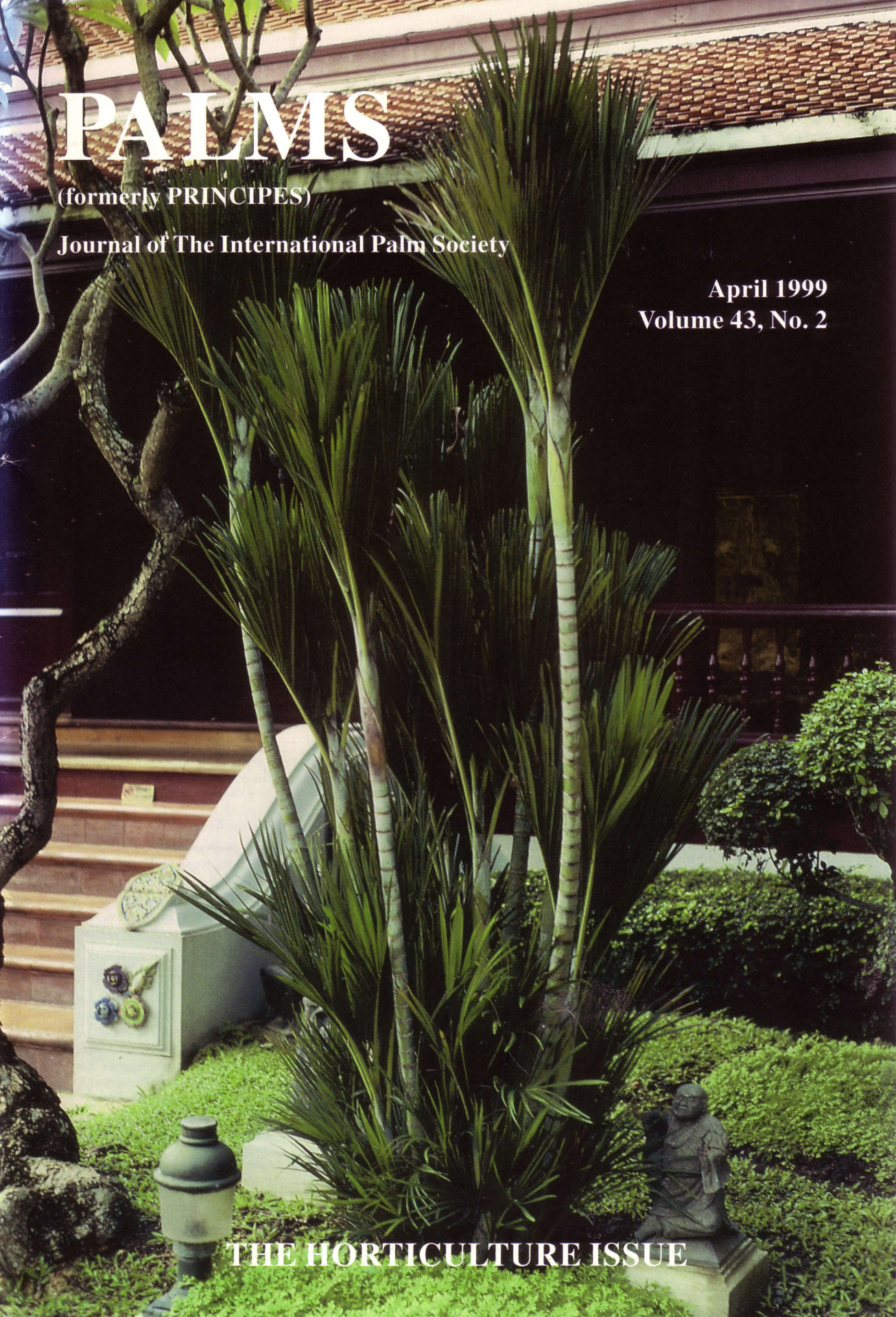

THE HORTICULTURE ISSUE

THE INTERNATIONAL PALM SOCIETY, INC.

THE INTERNATIONAL PALM SOCIETY

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Front Cover

An unusual form of *Dypsis lutescens* with short, stiff leaves epitomizes the principles of good horticulture and landscaping at the Prasart Museum, Bangkok, Thailand. (Photo: S. Zona).

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Accredited with the International Association for Plant Taxonomy for the purpose of registration of new non-fossil vascular plant names.

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A Practical Guide to Germinating Palm Seeds

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With most palms, propagation from seed is not difficult as long as a few basic requirements are met. Among the most important are fresh seed, good sanitation, proper medium, proper hydration, and adequate heat. Each of these points will be discussed separately, although they are interrelated.

Fresh Seed

The fresher the seeds are, the better the results will be (see Back Cover). To check the freshness of your seeds, cut open a sample seed and inspect the endosperm and embryo. The embryo should be fresh, firm, and not discolored. If the interior of the seed is rotten or has an unpleasant odor, it is unlikely to germinate. The endosperm is of two types, homogeneous or ruminate, and may be hard, oily, or even hollow. If the inside of a homogeneous seed is off-color, such as brown or gray, or if it smells bad, the seed is old or was harvested before maturity. Such seeds are also unlikely to germinate.

In a ruminate seed, the seed coat is infolded, creating dark, tangled streaks in the endosperm. Ruminate seed is more difficult to assess because of its more complex appearance.

Removing the Fruit Pulp

The fleshy or fibrous fruit pulp frequently contains growth inhibitors. Removing it before planting will improve results. Methods for doing this vary with the quantity and type of seeds, but most begin with a preliminary 48–72-hour soak in water. Soaking causes the pulp to ferment, which weakens it for easier removal. Change the water daily during the soak. Fruit that is slightly immature should be placed in a tightly closed plastic bag and kept in a warm spot for a week or so. This promotes ripening and softens the outer flesh for cleaning. Sometimes the seeds need to be soaked further to soften the pulp, sometimes not.

There are several ways to remove the seed coat. With small quantities of seeds, simply rub them by hand against a fine-meshed screen and wash away the pulp with water. Another way that works well with small amounts of seed is to shake them by hand in a closed container with water and small, rough-edged rocks. Pour off the water and pulp occasionally, add more water and shake again, until the seeds are completely clean. Seeds can also be cleaned with a knife or other sharp tool, but this is slow and a little dangerous.

Motorized cleaning devices make the job easier and are a necessity for commercial operations. For smaller quantities, use a rock tumbler. Put rocks and water inside with the seeds. Larger seed-cleaning machines can be purchased or fabricated. Some large-scale growers and seed dealers use cement mixers to do the job. The seeds are rotated in the drum for 10–45 minutes with water and rough-edged rocks of 7–10 cm. The time will vary with the machine and the type of seed and rocks. Some seeds are brittle, and without proper care may be damaged by power cleaning. Among large-seeded palms, *Actinorhytis* is particularly brittle and prone to damage, and many smaller seeds, such as *Pinanga*, must also be handled with care. When cleaning seeds, remember that the flesh of some types contain crystals of calcium oxalate, a skin irritant that can cause severe pain on contact, depending on the individual's sensitivity. For this reason, *Ptychosperma*, *Arenga*, *Caryota*, and *Wallichia* should be handled with care.

1. Right, a seedling of *Phoenicophorium borsigianum* showing adjacent germination. Left, *Phoenix* sp. showing remote germination. (Illustration by Marion Ruff Sheehan from *Genera Palmarum, A classification of palms based on the work of Harold E. Moore Jr.*)

Sanitation

Damaging insects such as seed-boring beetles may arrive with seeds. They may reduce germination and spread to other seed batches. To minimize these risks, seeds collected from the ground, whether in the wild or from cultivated plants, and seeds collected under unknown conditions should be soaked in a contact insecticide solution once the fruit pulp has been removed. The insecticide solution should be prepared at the same concentration you would use to spray for pests. Soak small, thinner-shelled seed, such as *Pinanga*, for 15 minutes. Soak larger, harder and less permeable seeds longer, from 20 to 45 minutes. Examples of these latter seeds are *Mauritia flexuosa, Bismarckia nobilis, Parajubaea cocoides,* and *Jubaea chilensis.* After the insecticide soak, rinse the seeds in clean water for 20 minutes.

After cleaning the seeds, hydrate them by soaking them in water for 24 hours, especially if you did not soak them to help remove the pulp. Within 24 hours most fresh, viable seeds will sink. There are exceptions such as *Manicaria saccifera* and *Metroxylon vitiense,* whose viable seed will float even after cleaning and soaking.

Whether or not to discard a batch of heavily infested, damaged seeds depends on their rarity and your ability to get more. For very rare seeds, when even a single germination could be valuable, plant it. Remember, however, with heavily infested seeds, especially in large quantities, there is the danger of introducing pests into your nursery. Balance this risk against the desirability of propagating the seeds and follow the treatment procedures described above.

Fungi flourish in the heat and humidity necessary for good germination, so equipment, fixtures, seeds and growing medium must be kept clean to prevent damping-off and other disease problems. You may want to soak seed in a fungicide before planting.

Planting Medium

Germinate the easy varieties in a commercial mix of peat moss or sterile sphagnum moss mixed with an equal amount of perlite or vermiculite. You may also use commercially prepared, finely cut coconut coir to which the same fast-draining material has been added. Sand, wood chips, screened rock or volcanic cinder screened to a maximum size of 9 mm can substitute for vermiculite or perlite. Whatever you use, the medium should be very porous and drain extremely well. All containers should have plenty of holes in the bottom to ensure quick and thorough drainage.

When containers and planting medium are ready, lay out the seeds on the surface, and before covering them, dust with a commercial insecticide. Bury the seeds in the medium to a depth of half the seed diameter and then cover everything with finely screened cinder (3–6 mm particle size), thick enough so it will not wash away during watering. This top-dressing dries out quickly and discourages the moss that grows on peat. Sand or finely crushed rock would work just as well. When planting is complete, place the containers on clean benches, 60–90 cm above the ground. Be sure to label your containers with a waterproof and fade-proof marker.

Palm seeds known as remote germinators may require special treatment and a little extra patience. Remote germinators push a shoot downwards as much as 20–25 cm before sending up the first leaf (Fig. 1). The larger ones such as *Voanioala* and *Borassodendron,* should be planted in deep containers such as citrus bags or large tubs, or be transferred to such containers soon after germination. If seeds and seedlings can be protected, the collector may want to plant large remote-germinators directly in the ground.

2. Germination bags suspended on a string near a metal roof where temperatures stay at 26–35°C (78–95°F) (top). Seedlings germinated in plastic germination bags and sphagnum moss. They are ready to be transferred to pots (bottom). (Photos: B. Langer)

Easy Germinators
Dypsis decaryi
Pinanga kuhlii
Pinanga crassipes
Archontophoenix alexandrae
Chamaedorea elegans
Chambeyronia macrocarpa
Licuala grandis
Veitchia joannis
Washingtonia filifera

Difficult Germinators
Basselinia species
Parajubaea cocoides
Neoveitchia storckii
Jubaeopsis caffra
Jubaea chilensis
Lavoixia macrocarpa
Physokentia insolita
Pseudophoenix species
Rhopalostylis baueri
Howea fosteriana
Voanioala gerardii

Hydration and Heat

At this point, the most important factor in seed germination is proper hydration, followed by constant high heat. Maintaining proper hydration is the trickiest of the two. Water your containers thoroughly, but just as important, let them dry out thoroughly before watering again. Over-hydration can drastically reduce the germination percentage. Once seeds begin to germinate, the containers will require more frequent watering. Seeds should be kept at 26–35°C. Some growers provide constant bottom heat by means of electric pads on their benches.

Difficult-to-Germinate Seeds

For difficult seeds and rare seeds, the most reliable method of germination is the Plastic Bag Method. For this method, seeds are blanketed in damp sphagnum moss and germinated in zipper-type, re-sealable plastic bags. Thoroughly saturate the sphagnum moss with water and wring it until no more can be expressed. Place the seeds and the sphagnum moss inside the plastic bags (along with a label) and keep the bags at 26–35°C (Fig. 2, top). Check inside the bags periodically to ensure that the sphagnum has not dried out. Once seeds have germinated (Fig. 3, bottom), place them in community or individual pots containing the potting mix described above and the quick-drying top-dressing. When transferring germinating seeds from the relatively sanitary conditions inside the bags to pots containing ordinary medium, treat them to a precautionary fungicide drench. Germination setups can also be improvised from plastic foam boxes with tight fitting lids, such as are used to pack fish or fruit. Fill the boxes ⅔ full of fine perlite pieces and lay the seeds on top. Use a hand mister to dampen thoroughly the seeds and perlite, replace the lid and place the box in a warm location. These germination boxes are space-savers, because they can be stacked. The tight-fitting lids help keep out fungus and insects, but the boxes should be checked periodically for hydration and germination.

A final method (if it can be called a method) is simply to germinate the seed on the ground in an out-of-the-way part of the greenhouse or garden. Growers have had good results this way with *Pelagodoxa henryana, Jubaea chilensis,* and some *Acrocomia* species. Discarded seed has also been found germinating in many a surprised grower's compost pile.

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Propagation by Division

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Clustering palms can be propagated by dividing the cluster into two or more pieces. Clustering palms in genera such as *Chamaeodorea, Cyrtostachys, Ptychosperma, Pinanga,* and *Dypsis* can be divided. *Rhapis* species have the clustering growth habit and are a convenient model for discussing propagation by division.

Dividing the *Rhapis* Palm

Division of the *Rhapis* can accomplish two things: it is a way to produce more palms, and it is method used to retain a favorite *Rhapis* in a favorite pot. Eventually, a *Rhapis* will outgrow its container. If you do not want to transplant it into a larger pot, then a simple solution is to remove one or two offshoots and return the main plant to the same container. You will have your original plant plus several new *Rhapis* palms. Division is usually most successful in spring or early summer when the palms are actively growing.

The main stem is the life support system of offshoots (pups) until they grow leaves and roots of their own. Often, an old and tired plant will have lost many roots and is supported by the root systems of its attached pups. If you want to retire the poor old thing, remove all pups and discard the main plant. If the main plant still has a few roots and years left, leave several pups attached to sustain it.

Step-by-step division of *Rhapis excelsa* specimens

Rhapis excelsa may be divided many ways. One may remove a single offshoot (pup), a cluster of offshoots, or separate the palm into several large clumps. The method is the same for all sizes of divisions. I have used a single pup division as an example:

1. Take the palm out of the container. Next, remove all the soil from the roots by loosening it with your hands and using a gentle spray of water. This procedure will expose a sturdy root system and attached offshoots.

For large *Rhapis excelsa* specimens, think big, and have on hand many bags of potting soil, large pots, a roomy work area, and a strong assistant. Large *R. excelsa* specimens can be divided into several clumps or individual canes. The decision can be made after you examine the root system.

2. Choose a pup which has mature leaves and enough roots to fill a 5-inch (13-cm) or larger pot. Use sharp pruning shears to cut the pup as close to the main stem as possible (Fig. 1). Now, using a chopstick and your fingers, very gently untangle and separate the pup's root system from the main mass of roots.

3. Once this slow but necessary deed is done, pot the pup in a container just large enough to accommodate the root system (do not overpot). Often, you must carefully twist the pup downward as you are potting, in order to spiral long roots into the pot. Fortunately, *Rhapis escelsa* roots are very flexible.

1. A small specimen *Rhapis excelsa* with an offshoot ready for division. The dashed line indicates the place where the plant may be divided.

4. Lastly, trim a few older leaves from the division (like pruning branches on a newly transplanted tree). Water thoroughly. Place in a shady spot with protection from wind, sun, and extreme temperatures.

5. A few days later, check your new division. Do not be surprised to see it popped up as if roots have turned into springs. Simply settle the palm back into the pot and firm the soil around the roots.

Care of the New Division

For several months, new divisions should be grown under very low light or deep shade. root stimulator may be lightly applied. Water when the soil is almost dry. If you do not have a greenhouse, leaves should be misted daily in hot or dry weather. Newly potted divisions usually remain inactive for several months and then begin to grow.

A Message from the President and Associate Editor

Several decades have elapsed since a comprehensive monograph on palm horticulture was last published. This Horticulture Issue began over five years ago as an initiative of the Board of Directors of the International Palm Society. The intent was to give palm enthusiasts information on all aspects of palm growing. The Associate Editor took on this special project and began soliciting ideas and manuscripts. Although size limitations restricted us somewhat, we made every attempt to make this a publication that all International Palm Society members will find useful. Information has been solicited to benefit growers in all types of growing environments, and contributions have come from around the world. There are no universally right answers regarding palm horticulture. However, the information presented in this issue is based on years of experience by many successful palm growers.

We hope that you find this publication both useful and enjoyable. You will note an additional emphasis on palm horticulture in all future issues of *Palms*. We are especially pleased to launch the new "Horticulture Column" in this issue. Our intent is for the International Palm Society to provide useful information to everyone from the university scientist to the hobbyist. Our Bylaws state that we operate for "scientific and/or educational purposes related to the study of palms, their propagation, culture, conservation, care and development." We trust that this issue fulfills some of these goals.

PHIL BERGMAN, IPS President
SCOTT ZONA, Associate Editor

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Basics of Container Culture

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Anyone interested in growing palms must have some familiarity with growing palms in containers. For a seedling to get large enough to be introduced into the garden, it must initially be grown in a container. Even the hobbyist should use containers in his "home nursery" as he accumulates palms for future plantings.

Types and Sizes of Containers

The industry standard in containers is a black plastic pot with UV stabilizer added to the plastic during manufacture. Alternatives include plastic grow-sacks, clay pots, ceramic pots, or even containers made from recycled paper material that can be planted directly into the ground. Grow-sacks are affordable but do not last long and need stabilization to avoid falling over. Clay pots are attractive but need more frequent watering and break easily. For extremely large plants, wooden boxes are often used.

It is imperative that any pot used has ample drainage holes in the bottom. A container must give ample soil volume for growth and weight for stability. In general, palms prefer deep pots to shallow ones.

Transplanting a Palm

A palm can usually grow well in the same container for one to two years before transplanting into a larger container is needed. A new seedling should be grown in a small container, typically 10–20 cm in depth. In one to two years this seedling needs to be "stepped up" into a larger container. A general rule is to repot when the plant's roots are coming out of the bottom of the container, when the soil is showing signs of breakdown (it becomes sticky and dense), or when the plant is just too big and unstable for the container.

With gentle tapping, a root ball should slip out of the pot "en bloc" (Fig. 1). If the soil falls away from all the roots, the plant is not ready to be stepped up. If there is nothing but white roots and no soil, you've waited too long. When repotting into a larger pot, you should have ample new potting mix below the old root ball, at least 10 cm. I mix a small amount of slow release fertilizer or blood meal into the potting medium in the bottom of the new pot. Never put fertilizer directly in contact with the exposed roots when repotting. Next, place the root ball into the container carefully, taking care not to break it apart. Teasing or separating the roots during repotting is not necessary. Next, vibrate or shake the pot to encourage the new soil to enter into the root crevices, and tamp the soil down adequately around the old root ball, taking care not to cause a direct blow to the roots. Add additional soil, as needed. One should leave 3–5 cm of watering space above the soil line.

Water the repotted palm promptly. I find that a "triple watering" (fill the pot to the top with water, allow to drain down to the surface, and repeat two more times) is adequate for small to medium sized palms. Larger pots may need four or five applications to adequately saturate the soil.

Repotting outdoor palms is best performed in the spring or early summer, a time when the plants and their roots can grow optimally. Seedlings and smaller plants may benefit from an antitranspirant (antidesiccant) spray after repotting. Most seedlings want to be in filtered light when young, especially after being repotted. If they require sun, acclimatize them gradually after repotting. Be aware that some palms such as *Dypsis decipiens*, *Bismarckia nobilis*, and most *Brahea* are known for setbacks after repotting. Root damage is probably the number one cause of mortality during repotting.

Potting Soil

There are as many potting mixes as there are growers. No single mix is ideal for all growers. An ideal soil will offer a substrate for the roots to stabilize, provide a source of water and oxygen, and offer nutrients for growth (Fig. 1). Good drainage is also desirable for most species. In

1. Left, a fast-draining potting soil composed of sand, organic wood material, perlite, and peat moss. Note that it appears very light and airy, making it ideal for most palms in containers. Right, a well-established rootball on a container-grown palm ready for repotting.

surveying many growers in southern California, I found the soil component common to most growers' mixes was coarse sand. Otherwise they were as different as night and day. Most growers also used peat moss and perlite. Mixes varied from quite complicated formulas to something as simple as "one half peat moss, one half perlite." Mixes high in peat moss, when allowed to dry out severely, actually contract and become nearly impossible to wet again. Dolomite (lime) may be necessary to counteract the acidity of organic materials.

Any mix must offer support for the plant and simultaneously good drainage. Drainage is increased by adding perlite, peat moss, pumice, or coarse wood chips. Additional topsoil, decomposed granite and fine sand slow drainage. Larger specimens and arid loving species tend to prefer the heavy (slow-draining) mix. Seedlings and tropical species like a lighter (fast-draining) mix. Reusing old potting soil is not recommended.

Watering and Water Problems

Container grown plants tend to be more subject to drying out. Always apply water until water comes out of the drainage holes. Re-watering is performed when the top centimeter or two of the soil is once again getting dry. Dry or hot conditions require more frequent watering. Moist or cold conditions usually require less frequent applications. Fixed watering programs without plant inspection invariably lead to problems.

A major difference between container plants and garden plants involves the potential for salt build-up in the containers. Most palm enthusiasts use either water supplied by their municipality or well water. Both usually contain dissolved salts that, along with applied fertilizers, can result in salt build-up in the soil over time. This condition is especially common with palms grown as house plants. Affected plants just look sickly, perform even worse than expected, and demonstrate a slow general decline in their appearance. Build-up can result in leaf tip discol-

oration (burning) and eventual death if not corrected. A simple soil salt meter with metal prongs can be inserted into the damp soil to measure soil salinity. The simplest meters usually read "safe" or "danger." Leaching the pot with repetitive and generous amounts of water may help drain out unwanted salts, especially if one uses rainwater or distilled water. Drastic measures would include barerooting and repotting into fresh potting soil. Avoidance of this problem includes applying generous amounts of water on a regular basis and a regular leaching program prior to the salt buildup. Also, one must carefully use fertilizers and meter the salt content at regular intervals.

Fertilizers

To understand fertilizers, one must understand what fertilizer is and does. Fertilizer is a substance that gives nutrition to the palm for growth of the leaves, trunk and roots. It may be derived from an organic source (blood meal, bone meal, manure, etc.) or inorganic (chemical fertilizers). Its major components (major nutrients) are nitrogen, phosphate (phosphoric acid), and soluble potash (K_2O). The concentration of these components is given as the N-P-K ratio. Palms generally like a ratio of approximately 3:1:3, such as 18-6-18 or a similar formula.

Minor nutrients (microelements) are the elements necessary in trace amounts yet still very important to overall palm growth. These include such things as iron, manganese, magnesium, copper, zinc, boron, and molybdenum. The minor elements may be part of a fertilizer formula or can be used separately.

Organic fertilizers (except for steer manure) are slower acting and have less chance of burn. Regular chemical fertilizers typically are faster with greater likelihood of burn. Slow release chemical fertilizers diminish but do not eliminate this risk of plant burn. Soluble fertilizers can be quite efficient but require strict adherence to manufacturer's directions. Fish emulsion is a soluble organic fertilizer and thus reduces chance of burn. Customized combinations of such things as blood meal, quick and slow release fertilizers and microelement agents can be quite successful and workable.

Three good rules to follow regarding fertilizers are: 1) follow the manufacturer's directions; 2) do not use them too aggressively; and 3) never fertilize dry containers. Palms usually do not die from too little fertilizer but they die quite quickly from too much. Also, when broadcasting granular fertilizers, take care not to throw fertilizer into the crown of a small plant.

Amounts used and frequency of fertilization depend on the fertilizer used. A new seedling is still dependent on nutrition from its seed and has small, chemically fragile roots, so care must be taken to avoid overaggressive fertilization. An older palm in a container can tolerate recommended dosages of fertilizer. Year around fertilization is safe in tropical areas; however, in areas where cold winters are a factor, fertilizers should not be given after early fall. Winter applications of microelements may serve to replenish these compounds while the plant is inactive and after the rains have leached the soil. Foliar applications of very dilute fertilizer can be used to "green up" the foliage but should not replace applications to the soil.

Sun, Shade, and Humidity

In general, most palms prefer full sun but there are definite filtered light and shade lovers. Seedlings of sun loving species may need a year or two of filtered light before they are ready for full sun exposure. Also, as outdoor humidity lessens, many species tolerate less direct sun. Therefore, a palm which tolerates full sun in a coastal environment (i.e., *Rhopalostylis sapida*) may need sun protection in a drier, hotter inland area. In contrast, *Brahea armata* loves dry, hot conditions and does not thrive in tropical areas.

Cold Protection

Overhead protection or canopy offers two kinds of protection. First, it protects from the hot sun. Secondly and more importantly, it provides some shelter from exposure in cold winter areas. This protection can be accomplished by overhead shade cloth or naturally with fast growing species such as *Caryota*, *Archontophoenix*, *Syagrus*, or *Ravenea*. Overhead canopy (synthetic or natural) can offer as much as 5°C (10°F) protection from winter's cold. If you experience cold nights, locate the containers where the early morning sun will warm the plant. Cold protection can also be accomplished by placing plants close to the house or a structure. Antitranspirant sprays (synthetic) and other applicants may also give some degree of protection from cold.

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Indoor Palm Culture

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Most palms purchased in garden centers have spent the first part of their lives being grown in greenhouses as fast as possible with high light and lots of fertilizer. They are then shipped from the grower to the nursery and finally purchased and taken home. Poor palms! What an ordeal! To help them recover from shipping shock and adjust to life indoors, first check the soil level. Does it cover all the roots and appear to be of good quality? If not, add a little extra soil or repot it. Then, allow the palm to become slightly dry and instead of watering once, drench the soil to flush out excess fertilizers and soluble salts. Water thoroughly three times in a row, allowing 5–15 minutes between irrigations. Lastly, clean all the leaves and inspect for insects. Treat if any are found. After the soil and foliage drip dries, the plant is ready for its special place in your house.

Best indoor palm growth will occur with the brightest indirect light available. A south- or north-facing window provides good indirect light; south and west windows should be shaded by outdoor trees or a lightweight curtain to protect the palm from direct sun which might scorch leaves.

The ability of palms to adjust to indoor light is related to the amount of light they received in commercial production. Consider that most plants have been raised in lush tropical greenhouses with partial shade and high humidity. Newly purchased houseplants adapt slowly to new surroundings and low interior light. Place new plants in an area with bright indirect light for a few weeks, then, move them to lower light areas. As the palm grows new leaves they will be larger than the old ones and adapted to lower light.

Watering Procedures and Tips

Most palms should be thoroughly watered when almost dry. To be certain that the root ball is completely saturated, use a shallow saucer and allow water to drain through the soil and fill the saucer. Leave extra water in the saucer to be absorbed by the palm.

If a palm is allowed to dry completely or is not thoroughly watered, wilt may occur. A just-wilted palm can often be revived without damage if the root ball and pot are soaked for several hours. If the plant stays wilted for too long, you may not be able to revive it. If a palm is watered too often, it may develop root rot that will also result in wilt or death. If a palm appears to dry out every few days, either: 1) the pot is too small for the root system and the palm should be repotted, 2) the palm is not being thoroughly watered, or 3) the root ball has become loose in the container. Resettle the palm into the pot by gently pushing the soil down. Repotting may be necessary to correct this problem.

If you live near fresh water springs or lakes and have wonderful water, use it. Alkaline or "hard" water will slowly kill any plant. Occasional leaching of salts with deionized or rainwater will help prevent salt damage.

Fertilizing Indoor Palms

Most indoor palms are very slow growing and live in low light. Consequently, these palms require very little plant food. Under low light, feed at $^1/_4$ rate 3 times per year. Under medium light, feed at $^1/_4$ rate 6 times per year. Under very bright filtered light, feed at $^1/_2$ rate 6 times per year. Use a houseplant fertilizer with a balanced nitrogen-phosphorous-potassium ratio, such as 20–20–20. Slow release fertilizer may be used; follow the above low dosage recommendations. It is always better to under-fertilize than to over-fertilize. Too much plant food can cause burned tips, injured roots, and eventual decline and death of the palm. Use leaf color as a guide: bright green leaves indicate good fertilizer levels, but if leaves become slightly yellow, apply a very weak dose of a plant food.

Soils

Many palms are not too particular about soil as long as it is well drained and rich in humus. If you do not like to formulate your own mix, use a

1. An elegant houseplant, *Rhapis excelsa* in a decorative pot is tolerant of low light levels.

good quality soil purchased at the garden center. A sandy soil usually should be avoided because it quickly dries out and easily sifts out of the pot. A clay soil retains moisture and may cause root rot. Bark is often too porous. A well drained mix should allow water to move slowly through the pot. If water stands on top of the soil and takes over 5 minutes to drain through, replace the soil with a lighter mix (one with more perlite or sand).

Pots

Either plastic or clay pots can be successfully used for most palms. Clay pots are porous and breathe, but they also can absorb as much water as the plants. Extra water left in a saucer will prevent the clay pot from robbing moisture from the soil and palm.

The soil level should cover all roots and, if the palm is multi-stemmed such as *Rhapis,* the base of the canes. Otherwise, roots dry out and may die. Sphagnum moss or decorative gravel can be used to top dress the soil.

Pests, Rot, Tip Burn, and Other Grim Subjects

Proper culture prevents most plant problems. The most common indoor pests are scale, spider mites, and mealybugs. Each time you water your palm, take a few minutes to look for a possible insect infestation, and treat it immediately since most insects reproduce very quickly and can kill a plant in a very short time. If you suspect a problem and are not sure what kind of creature is attacking the palm, or how to eliminate the pest, take an infected leaf to your local garden center for advice.

Burned, brown tips are usually caused by over-fertilizing, improper watering, or continuous use of alkaline (hard) water. Badly burned, black tips (in which the burn spreads up the leaves at a fast rate) can indicate a boron or fluoride build-up or root rot. Check the roots. White or light brown roots suggest a healthy palm; red, pink, or black means root rot; dark brown roots may indicate an overdose of boron from a fertilizer or a fluoride build-up from a water supply. Use only distilled or deionized water until new leaves emerge green and healthy. If you find black, soft roots, root rot is in progress. To save the palm, you must remove affected roots, repot into a well-drained soil, and drench with a root fungicide. Another warning sign of root rot is a wilted palm with soggy, wet soil. Another signal is severe tip burn.

Occasionally, brown round spots will appear on leaves. Remove badly damaged leaves, and treat the palm with a leaf fungicide. Exposure to afternoon sun or very high light may cause burn on leaves. Occasionally, leaf splotch or burn can be caused by strong insecticides sprayed in hot weather.

If your indoor palm suddenly begins to produce new leaves that are "frizzled" (twisted and undersized) and dried out, then the palm is probably suffering from a trace element deficiency. A dash of fish emulsion or other organic material will usually correct this occasional problem, or use a balanced micronutrient fertilizer.

Recommended palms for indoor use

The following list of palms are old favorites and are perfect for new indoor palm enthusiasts; all do well in low to high light. Many other

species will adapt to indoor conditions, but the species below are the best for beginning a collection.

Chamaedorea elegans, also called "Neanthe bella," is a small palm quite suitable for low light and dish gardens. Inexpensive.

Howea forsteriana, commonly known as Kentia Palm, has graceful upright feathery leaves. Expensive, but elegant.

Rhapis excelsa, known as Lady Palm, has been a popular indoor palm since the early 1700s. This clustering fan-leaf palm is available in sizes from 1–12 feet (30–400 cm) tall. Expensive, but easy to grow and long-lived.

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Greenhouse Culture

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Greenhouse culture is a means of providing a plant with an improved growing environment to enhance its growth and survival. There are heated greenhouses that maintain a minimum temperature. There are cold frames that use only passive solar heat. There are even greenhouses that cool the air. All greenhouses are an attempt to give the plant optimal growing conditions and to control and stabilize the environment.

Greenhouses are used for seed germination, vegetative propagation, maximizing growth, creating "tropical" environments, commercial production of plants, and just for fun. For propagation, one wants to maintain good humidity, adequate warmth, and less than full sun. For maximum growth on a palm from a hot, dry climate (e.g., *Bismarckia*), one would want a dry greenhouse with good light, very high temperatures and very little humidity. For high elevation forest palms, such as *Geonoma*, one would want a cooler greenhouse with a narrow temperature spread and high humidity. Thus, there is no simple formula or set of rules will apply to all greenhouses.

Temperature

A well constructed and efficiently operated greenhouse controls and stabilizes the temperature. A must is mounting several "high-low thermometers" to monitor temperature. The most important goal is to maintain a minimum temperature during cold weather. I find that a minimum of 10°C (50°F) allows me to grow most palms.

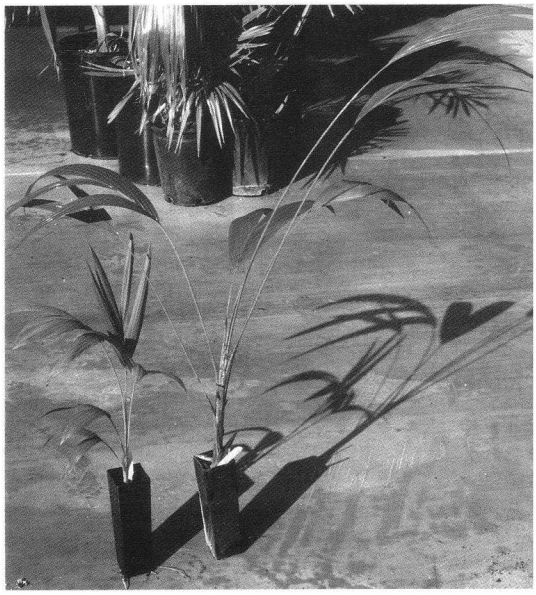
Regarding maximum temperatures, there are very few species that need temperatures in excess of 33°C (90°F). Certain genera, such as *Brahea, Bismarckia, Nanorrhops,* and *Washingtonia,* like temperatures even higher, but these are the exception. *Chamaedorea, Howea, Lepidorrhachis, Hedyscepe, Geonoma, Rhopalostylis, Asterogyne,* and many mountain species will succumb when faced with such extreme high temperatures. To avoid exceeding such maximum temperatures, one can use cooling apparatus, intake and exhaust fans, interior air circulation with water mist, and overhead sun protection in the form of shade cloth or white paints.

Light

Sunlight can be quite intense in the greenhouse. Too much light will produce faded, yellow and sometimes burnt leaves on the palm. Too little light produces green but stretched out and unstable plants that lack vigor (Fig. 1). Use shade cloth or paint the roof with water-based white paint to reduce the light intensity.

Humidity

Humidity should be maintained at about 50–60% for most species. Too little humidity leads to leaf desiccation, frequent watering requirements, red spider and other pest infesta-



1. The seedling palm on the left is grown with adequate light. The seedling on the right is stretched and weak, a casualty of insufficient light.

2. A well-grown palm in a greenhouse (*Colpothrinax cookii*). The plant is growing in a soil-less mix, in a standard black plastic pot, with adequate drain holes. Note, however, some salt build-up is visible along the soil surface and around the drain holes. The pot is elevated on a metal bench, perforated to allow water drainage and air circulation. The greenhouse floor is easy-to-clean concrete. (Photo K. Maidman)

tions, and overall poor performance. Too much humidity makes the greenhouse slippery with algae and slimy and sooty molds and may encourage rot on arid palm species. Humidity can be raised by spraying the greenhouse walkways with water on a regular basis or by using electronically controlled misting devices. Adequate air circulation can help overcome some of the algae/mold problems associated with too much humidity.

Air Circulation

Greenhouses have two types of fans: 1) thermostatically controlled exhaust fans that cool the greenhouse by blowing out hot air and passively pulling in cooler outside air, and 2) fans that circulate air within the greenhouse. In small greenhouses, temperature sensitive hydraulic devices can open vent windows at the top of the house. Interior circulating fans, however, are important regardless of greenhouse size. Typically they are set to operate 30 minutes on and 60 minutes off in any given part of the greenhouse.

Benches

Placing plants on benches gets them above the colder ground temperatures and helps them get more air circulation (Fig. 2). Benches also make plant inspection easier and lessen weed problems.

Potting Soil for the Greenhouse

Comments on potting soil are similar to those discussed under Container Plants, but in the greenhouse one has to make sure soil drainage is good because of the higher humidity. Drainage is increased by adding perlite, pumice, peat moss or chunky bark material. In time, however, the bark and peat moss that you added to increase drainage will decay and slow the drainage. When soils break down, repotting into fresh soil is needed.

Watering

All the rules regarding watering described in the article on Container Culture still apply in the greenhouse. However, because of higher ambient temperatures, pots may dry out more quickly in the greenhouse, especially during a hot dry summer. During the winter, especially if the greenhouse is "closed up," pots stay wet much longer. Watering will also be affected by inside humidity levels, air circulation, and the soil formulation.

Fertilizer

The greenhouse is the perfect place to use a fertilizer injector system that injects soluble fertilizer of any N-P-K ratio directly into the irrigation system. Unfortunately, there is potential for unsightly salt buildup on the foliage if the fertilizer is sprayed.

There are also very good alternatives to injector systems. Granular or soluble, organic or chemical fertilizers can also be used in the greenhouse. Bloodmeal is good for greening up leaves and carries little risk of burn. It does, however, have an unpleasant odor.

Pests

Palms are surprisingly pest free; however, any insect that can attack a palm will do so more voraciously inside the greenhouse. Infestations typically spread more rapidly in a greenhouse. The most common insect pathogens include aphids, scale, mealy bugs, and spider mites. When introducing new material into the greenhouse, make sure it is free of pests. Preventative practices which can reduce problems include: spraying down the foliage, adequately spacing the plants, ensuring good air circulation and humidity, avoid overheating the greenhouse, removing dead leaves and debris, and treating problems as soon as they occur. For any given pest problem, it is best to consult your local nursery or garden center for the appropriate pesticide available in your locality. Always follow manufacturer's instructions and use appropriate protective gear. Prophylactic use of fungicides as a soil drench on new seedlings is advocated by some growers.

Pruning

As palms grow faster in the greenhouse, more attention must be placed on pruning dead leaves. Always use clean equipment. Leaves are removed when they are unsightly and detract from the palm's beauty. Do not remove healthy green leaves as these leaves are providing photosynthesis and nutrition for the plant.

Weed Control

It is imperative to control weeds on the ground and in the containers so that they do not overwhelm your greenhouse. Most growers hand weed before the weeds have a chance to flower and seed. Plastic ground covers can be used to prevent weed growth on the pathways and under benches.

Moving Plants Out of the Greenhouse

Whether you are a grower or a customer purchasing plants from a greenhouse, acclimatization outdoors is of critical importance. There are three things to consider when moving a plant out of the greenhouse: sunlight, temperature, and humidity. Of greatest risk is the outdoor sunlight. Your palm has typically had less than full sunlight in the greenhouse. Higher humidity levels have also protected its foliage. The most common mistake is to take a sun-loving species from the greenhouse and plant it directly into full sun. This invariably gives some degree of leaf burn which can be avoided by gradually moving the plant into sun over a two to three month period. On first removing the palm, put it in shade. Every two to three weeks, progressively move it into a little more sun. Some species are more tolerant of this move, but caution is definitely in order. If a greenhouse plant is destined for filtered light, the acclimatization process can be shorter.

Cold damage can be avoided by not moving a plant out during cold weather. Unaccustomed cold can be just as devastating as sun. Make sure any threat of frost has passed. You can tell cold burn from sun burn in that the former is a more universal brown or faded look and will invariably hit the new leaf spear or newest tender foliage. The foliage will also look somewhat wilted and weak with time. Horizontally oriented leaves are more susceptible to cold damage than vertically oriented, mature leaves. Sun burn is on sun exposed areas only. Antidesiccant sprays may prevent some cold damage.

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Landscaping with Palms: Destroying Paradigms

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All too often, palms are bought on impulse and "designed" into the landscape the same way. Palm plantings can fail to enhance a site, because new palms are often planted anywhere there is room to dig a hole! Buyers should take time to make notes on light requirements, height, spread, and speed of growth. Palm plantings must follow basic horticultural requirements, but the design rules below are more flexible and be guided by your taste and site:

1. Never plant a palm centered on some feature of a building (e.g., a window, doorway, or bare wall).
2. Consider the spread when leaves are at "people level."
3. Never plant palms to suggest a gracious avenue unless you have a gracious avenue.
4. Use large and massive palms with a small house to frame it and blend it into the property.
5. Plant medium or larger palms 3 m (10 ft) or more from a house.
6. Never plant large palms, especially the self-pruning kind (e.g., *Roystonea*), over parking areas.
7. Never plant medium, tall, or massive palms under power lines.

1. Palms in a small garden, including *Coccothrinax*, *Calyptrocalyx*, and *Areca*.

2. *Aiphanes minima* on a pedestal.

8. Never plant palms with similar leaflet size together unless there is a large difference in mature heights.

Palms used as framing elements can be solitary, massive types (*Phoenix canariensis, Copernicia baileyana, Borassus* spp., *Roystonea* spp.) or medium species used in groups (*Syagrus, Archontophoenix, Sabal, Wodyetia, Livistona*).

Although not usually considered shade trees, palms are excellent as high shade. Plant them in staggered height groupings to block the early or late sun. Put that kind of slanting light to work by using understory palms with colored new leaves (*Areca, Pinanga, Gronophyllum, Chambeyronia*) to catch the sunlight. Create a garden-within-a-garden using palms around a small patio (Fig. 1). Orchids, bromeliads, and vines can be established on the trunks. Select palms with a spread of around 4.5 m (15 ft) so that falling leaves will not dislodge the epiphytes. *Sabal* species can support vines such as climbing palms or *Bougainvillea.*

Small-crowned palms (*Ptychosperma, Thrinax, Coccothrinax*) provide privacy when planted as staggered height groupings. Many palms can be used to hide unsightly views. Most clumping forms work nicely, and smaller species (*Chamaedorea cataractarum, Serenoa repens, Areca vestiaria*) can be planted on mounds.

To create a curved stem on a single-trunked species, plant the palm in an inclined position, 15° from vertical. Only young palms can be induced to curve. Straight-trunked species growing in a group should have their crowns separated vertically by planting the shorter individuals one-half to one full crown height apart.

People look out of windows, so place an interesting specimen (*Beccariophoenix, Licuala peltata* var. *sumawongii, Aiphanes, Kerriodoxa,* or *Areca* with colored leaves) in a beautiful pot where it can be seen from inside the house. Spotlight it at night! Put potted palms on pedestals rising above other plants in your garden (Fig. 2). Some slender-stemmed species can even be trained as an espalier!

Discard your old ideas. Challenge your imagination. Palms are the ultimate gardening element!

Palms, 43(2), 1999, pp. 73–76

Nutrition and Fertilization of Palms

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There are approximately 16 elements considered essential for normal palm growth and development. Fortunately, only a few of these elements are routinely deficient in palms and they will be the focus of this discussion.

Palms grown in pots are primarily susceptible to nitrogen (N) deficiency. In all species, N deficiency appears as a uniform light green to yellow discoloration of the foliage (Fig. 1, top). Plant growth will also be reduced. Palms grown in pots should be given fertilizers with a ratio of about 3 nitrogen: 1 phosphorus: 2 potassium. Since N is readily leached through all soils, slow release N fertilizers are the most effective products.

Most native soils in the tropics have very low nutrient holding capacity and the most widespread deficiency on palms growing in them is usually potassium (K) deficiency. K deficiency symptoms vary among species, but usually include yellow, orange, or necrotic (dead) spotting on the oldest leaves. This spotting is usually accompanied by necrotic tissue starting along the margins (not the tips) of the leaflets (Fig. 2, upper left). K deficiency appears as a bronze or orange discoloration of the older foliage in species such as *Dypsis lutescens*. Entire older leaves may appear dead or frizzled, yet the petiole remains alive. As this deficiency progresses, the entire canopy may become discolored, the trunk diameter will taper, and the palm may die. K deficiency is best treated with sulfur-coated potassium sulfate.

The second most common deficiency in landscape palms is magnesium (Mg) deficiency. It also appears first on the oldest leaves, but as broad yellow bands along the outer margins of the leaf. The centers of these leaves remain distinctly green (Fig. 2, upper right). Slow release Mg fertilizers such as dolomite or magnesium oxide are excellent for treating this disorder in acid (pH below 7.0) soils, but are ineffective on alkaline soils. For these soils, soluble materials like magnesium sulfate (epsom salt) are effective, but must be applied at least monthly if heavy rainfall or irrigation are present.

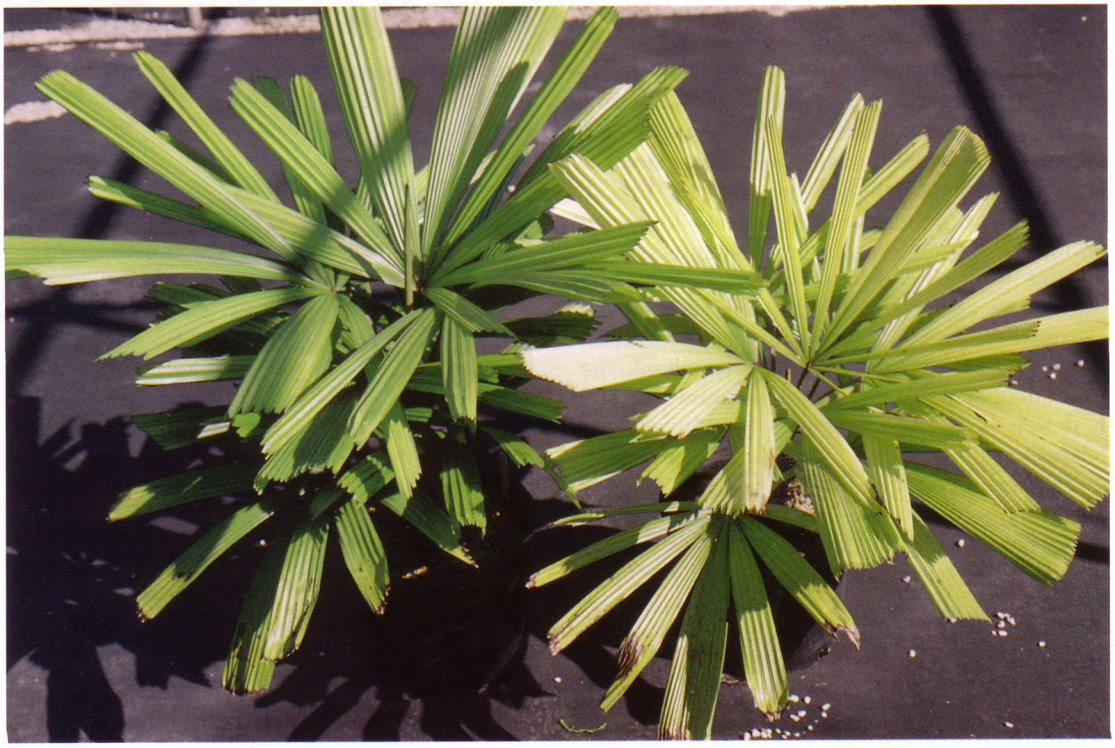
In alkaline soils, manganese (Mn) deficiency is a common problem on some species. This is often called frizzletop, since the new leaves emerge with small, necrotic, and curled leaflets (Fig. 2, lower left). Earlier symptoms include longitudinal necrotic streaks on otherwise yellow new leaves. This deficiency is quickly fatal to affected palms, but can be treated in early stages with manganese sulfate.

When palms are planted too deeply or are grown on waterlogged soils (including poorly drained potting soils), they often produce yellow new leaves (Fig. 1, bottom). In some species these yellow leaves are covered with pea-sized green spots. This is iron (Fe) deficiency and it is

Some common nutrient deficiencies and palms most susceptible to them.

Pot culture
- N deficiency
  - all species of palms
- Fe deficiency
  - *Licuala* spp.
  - *Rhapis* spp.

Landscapes
- K deficiency
  - *Cocos nucifera*
  - *Dypsis lutescens*
  - *Elaeis guineensis*
  - *Roystonea regia*
  - *Syagrus romanzoffiana*
- Mg deficiency
  - *Phoenix canariensis*
- Mn deficiency
  - *Acoelorrhaphe wrightii*
  - *Elaeis guineensis*
  - *Syagrus romanzoffiana*
- B deficiency
  - *Cocos nucifera*



1. (Top) Nitrogen deficiency of *Chamaedorea elegans*. (Bottom) Iron deficiency of *Licuala spinosa*.

2. (Upper left) Potassium deficiency of *Hyophorbe verschaffeltii*. (Upper right) Magnesium deficiency of *Phoenix roebelenii*. (Lower left) Manganese deficiency of *Syagrus romanzoffiana*. (Lower right) Boron deficiency of *Heterospathe elata*.

caused by poor soil aeration, not by a lack of Fe or even high soil pH as is the case for broadleaf plants. Correcting the soil aeration or planting depth problem is far more effective than Fe fertilizers in preventing or treating this problem.

One last deficiency problem that affects palms in the humid tropical regions of the world is boron (B) deficiency. It is similar to Mn deficiency in that new leaves emerge stunted and necrotic and death of the bud can follow (Fig. 2, lower right). In *Cocos nucifera,* this deficiency produces triangle-tipped new leaves, or even a series of triangles within a single new leaf. Boron deficiency is best treated with boric acid or sodium borate (borax).

All nutrient deficiencies are much more easily prevented than treated once they occur. Application of a low release palm fertilizer having a ratio of 2 or 3N:1P:3K:1Mg plus micronutrients every three months should prevent such problems from occurring. A typical rate would be about 1 Kg of this fertilizer for every 10 sq.m of canopy area. In drier climates, lighter and less frequent applications may be adequate.

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Transplanting Large Palms

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Relocating large palms demands appropriate sized equipment, trained staff, and respect for the delicate nature of the palm crown.

Moving large, established palms inevitably means severing live roots. Until an adequate root system redevelops, a palm must sustain itself on water and starch stored in its stem. Simply put, successful mature palm relocation is a race between root re-establishment and stem storage depletion. Eliminating stress prior to transplanting has a direct influence on success rates.

The first step in moving a palm is pruning the roots, either mechanically or manually. The root ball is dug 26–60 cm (10–24 in.) from the trunk. The second step is lifting the palm out of the ground with hoisting equipment. The hoisting equipment varies from cranes in urban salvage sites to front-end loaders affixed with pipe booms in field sites (Fig. 1). Undersized equipment may have difficulty in lifting large specimens, with resulting rough handling and possible stem fracture. The irrigation furrows in field nurseries and groves may also present a fracture hazard if the loader operator is apathetic or unaware of the impact of sudden jolts on the palm crown.

Dead or damaged roots are likely sites for pathogen activity and should be shaved from the root ball. A rounded, sharpened shovel is commonly used. Likewise, inflorescences and infructescences must be removed, as they divert water and nutrients from root regeneration. Leaves are either completely removed (as in *Sabal palmetto*) or bundled and tied (as in *Phoenix dactylifera*).

Large palms are usually moved on flat bed trucks. Desiccation of the crown at highway speeds will be lessened by covering the load with shade cloth. Water must be applied to the root ball every few hours, so that the root ball does not dry out completely. Once again, the fragile nature of the crown makes it a likely candidate for fracture should the road be rough and the crown left unsupported. Survival is enhanced when palms are dug, transported, and installed without delay.

Holes should be excavated and back fill prepared before the palms arrive at the site in order to prevent lengthy delays leading to additional crane charges and root ball desiccation. The palms are positioned in the planting holes and back fill is added to the hole. The root ball should be buried at the same depth at which the palm was growing. Palm root balls are sometimes buried too deeply in an attempt to achieve a uniform installation; however, the urge to bury the rootball too deeply may be curbed by realizing that columnar uniformity, having been addressed by the Romans some time past, can hardly be considered a design innovation.

With the palm set at the proper grade and back filled, it is watered and staked (when necessary). Staking should avoid wounding the stem. In applying water to the soil, we must remember that we are not providing water to the palm (it is relying on stored water). We are simply creating a zone in which roots can re-establish. Too much water encourages the development of air-carrying roots at the expense of nutrient-carrying roots. Too little water hinders root growth. Potentiometer readings at several root zone depths are invaluable in maintaining the proper moisture level. The crown should be untied only after roots begin to regrow.

Post-transplant Problems

1. Root regrowth is noted, but upon untying the leaves, the juvenile portion of the crown falls to one side. Likely cause: crown fracture during removal, transport, or installation. Although the palm may recover, the risk of pathogen infection is high and the fracture site will inevitably be visible as a constricted area in the trunk.

2. Roots fail to develop, and the crown begins

1. A pair of *Phoenix dactylifera* is hoisted as a single specimen, using a boom on a front-end loader.

to die from the bottom (oldest leaves) up. Likely cause: storage reserve depletion, insufficient water and starch. The palms are too small or under stress prior to relocation.

3. Several juvenile leaves near the spear wither and die, with the remaining leaves appearing healthy. Likely cause: Transplanting damage to water conducting tissue of the developing leaves. This kind of damage may be seasonal, occurring when palms are moved while actively growing. Fortunately, the damage is not life-threatening.

4. Lower leaves collapse while still green, leaves in the middle of the crown die below developing inflorescences, but younger leaves appear healthy. Likely cause: emergent inflorescences aborting and decaying in the crown. Decay in the crown is serious, and the dead inflorescences should be removed immediately. A copper-based fungicide should be applied to the affected area.

Moving large palms is an activity best left to professionals. With proper care before, during, and after relocation, even large palms can be successfully transplanted, giving clients the appearance of an established landscape in a very short time.

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Centerfold: Palms in cultivation at the Montgomery Botanical Center, Miami, Florida. (Photo by J. Dransfield)

Palms, 43(2), 1999, pp. 81–84

Palms in the Tropics

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Never before have so many different palms come into the marketplace as now. This overabundance of variety has contributed to a resurgence of interest in growing palms worldwide and also has confused newcomers to the field of tropical palms! Much work has to be done with such basics as selecting desirable forms of new incoming species for horticulture and promoting them in the marketplace.

Fortunately there is a huge choice these days of smaller and compact species from countries such as Madagascar, Papua New Guinea, Indonesia, Philippines, New Caledonia, Mexico, and Panama. These are plants that are quite content to grow permanently in pots. Many of the newer introductions are understory dwarfs, and some can truly fit in the palm of your hand, such as the Madagascar *Dypsis louvelii, D. mocquerysiana,* and *D. thiryana* or the Mexican *Chamaedorea tuerckheimii* and *C. sullivaniorium,* not to mention the many miniature species of *Licuala, Iguanura* (Fig. 1), and *Pinanga* coming in from Thailand and Indonesia.

Inevitably the time will come when you will want to change the palm you planted to another position. Various species of *Livistona* (Fig. 2), especially *L. chinensis* and *L. rotundifolia* var. *luzonensis,* make very good subjects for transplanting. All of the Ptychospermatoid genera, including *Ptychosperma, Ptychococcus, Veitchia* (including *Adonidia*), and *Wodyetia,* can tolerate transplanting extremely well, as can some species of *Areca* such as *A. triandra* and *A. catechu.* Most of the regularly cultivated robust *Dypsis* spp. from Madagascar and the Mascarene genera *Dictyosperma* and *Hyophorbe* are well known transplant subjects, as are species of *Phoenix* and the ubiquitous *Cocos nucifera, Elaeis guineensis,* and *Rhapis excelsa.* Some lesser known but equally tough species are *Heterospathe elata, Actinorhytis calapparia, Pritchardia pacifica, Phoenicophorium borsigianum,* and *Cyrtostachys renda.* Also *Pinanga* spp., such as *P. coronata* (*P. kuhlii*) and its allies, are very resilient to transplanting, as is *Iguanura wallichiana* and its many forms and varieties. All of the *Roystonea* and *Sabal* species transplant well, as do the cocoid genera, especially *Syagrus* and *Butia* species.

The ubiquitous *Roystonea* spp., and to a lesser extent *Elaeis guineensis,* are losing favour in Asian landscapes, because they are too large, too dirty (dropping leaves), and demand too much water and maintenance. *Wodyetia* is now establishing itself to fill this niche, and its popularity is beginning to peak throughout many Asian countries especially Thailand, Malaysia, Indonesia and, of late, Singapore and Philippines. Favorites such as *Cocos nucifera, Dypsis lutescens, D. leptocheilos, D. decaryi, D. madagascariensis* (*D. lucubensis*), *Rhapis excelsa, Ptychosperma macarthurii, Syagrus romanzoffiana,* and *Phoenix roebelenii* continue to enjoy success, throughout much of Asia, although in many places along the southeastern coast of Australia the latter two (along with *Cocos nucifera*) have been effectively banned from planting by local municipalities as their falling fruits and leaves are deemed hazardous.

Many Asian countries have yet to embrace their own native palms for landscaping use, with the exception of *Cyrtostachys renda.* Instead the fascination for planting exotics still remains such that *Licuala grandis, Ptychosperma macarthurii,* and *Dypsis lutescens* are almost over-used. It is pleasing to see palms such as *Johannesteijsmannia* spp., *Licuala peltata* var. *sumawongii* (*L. elegans* of hort.), and *Iguanura wallichiana* varieties becoming more commonplace. *Arenga pinnata* and *A. westerhoutii* are under-used, perhaps because of their gargantuan sizes and haxapanthic habits. *Caryota* species are still used but sparingly. In Thailand, much has been made of promoting the endemic *Kerriodoxa elegans* in the landscape, and it is starting to catch on. Favorites continue to be *Phoenix sylvestris* (and its hybrids), *Copernicia prunifera, Wodyetia, Syagrus schizophylla, Livistona rotun-*

1. Future trends in tropical palm horticulture include *Licuala mattanensis* (upper left), the compact form *Areca catechu* (upper right), the yellow form of *Adonidia merrillii* (lower left) and the many species and forms of *Iguanura*, including *I. polymorpha* (lower right). (Photos by S. Zona)

2. *Livistona rotundifolia*, shown here with ripe fruits, is one of the easiest tropical palms to transplant. (Photo by S. Zona)

difolia var. *luzonensis*, and *Ptychosperma* spp. In the Philippines native *Pinanga* and *Livistona* species and some of the spectacular *Heterospathe* species such as *H. scitula* and *H. philippinensis* are starting to gain acceptance as palms for the home garden, although exotic imports hold the balance of power in public landscapes. The Philippines has a reputation for its development of horicultural forms of *Dypsis lutescens* (dwarf or variegated mutants), *Hyophorbe verschaffeltii* hybrids, a chartreuse/yellow form of *Adonidia* (*Veitchia*) *merrillii* (Fig. 1), and compact forms of *Areca catechu* (Fig. 1). All of these have found favor not just in the Philippines, but are exported to neighbouring Asian countries where they are now gaining popularity.

In Australia, particularly Far North Queensland, native palms, such as *Archontophoenix*, *Wodyetia*, and *Ptychosperma* spp., are much cherished and are often found in private gardens and in public landscapes. Exotics such as *Ravenea rivularis* and *Dypsis decaryi* are losing popularity because of their low resistance to pests. In New Caledonia a groundswell of interest and support for growing the indigenous palms unique to the island is building. Some easy to grow species, such as *Chambeyronia macrocarpa*, *Cyphophoenix elegans*, *Burretiokentia hapala*, and *Kentiopsis oliviformis*, are gradually finding a place in public plantings and private gardens. It is an irony that many of New Caledonia's palms are more popularly cultivated abroad than they are at home.

Over the last few years, particularly with Madagascar beginning to be opened up by seed traders and merchants, palms such as *Beccariophoenix*, *Ravenia glauca*, *Dypsis lastelliana*, *D. decipiens*, and *D. onilahensis* are becoming more common in the landscapes. Papua New Guinea has contributed a myriad of *Cayptrocalyx*, *Ptychosperma*, and *Licuala* species over the last few years. Many, such as *Calyptrocalyx hollrungii*, *C. albertisianus*, *C. polyphyllus*, *C. pachystachys*, and the polymorphic *C. elegans*, are becoming more sought after and used in plantings. *Ptychosperma hentyi* (from New Britain), *Heterospathe micrantha*, *Sommieria elegans*, and *Caryota* sp. "zebrina" (from Irian Jaya) are now attracting much attention in the palm collector's world and general horticulture. Strong efforts are being made to popularise and promote Indonesian palms, such as *Salacca magnifica*, *Areca catechu* (yellow variant), and *Siphokentia beguinii* for landscaping, as well as *Areca vestiaria* (red crownshaft forms) and *Licuala mattanensis* (*Licuala* sp. "Mapu") (Fig. 1) for interior gardens.

A new trend is emerging, however, and that is to put in smaller sized palms (many of them understory types) with emphasis on variety that can be attractively displayed in smaller sized plots, for gone are the days of sweeping lawns and acreages with space to fill. As we hurtle towards the new millennium people are becoming increasingly urbanised and our gardens are correspondingly becoming 'down-sized.' The good news is we shall have a multitude of compact palms coming into cultivation that will suit these lifestyles and situations.

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Palms in Mediterranean Climates

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The Mediterranean Climate takes its name from the Mediterranean Sea, which warms quickly because it is almost closed. Water temperature in winter does not drop below 13°C (55°F), while in summer in some places, it surpasses 30°C (86°F). The result is a very particular climate where summer is hot and dry, and autumn ushers in a warm and wet rainy season. Winter is mild with good showers, and spring commences as temperatures slowly rise. The Mediterranean climate varies greatly according to rainfall, from 200 mm to 1 500 mm annually, and consequently, we have to consider different kinds of Mediterranean climates. These climates are extremely variable with some very wet years and some particularly dry ones.

Mediterranean climates are not common because of the very special conditions involved: proximity to both sea and mountains. Such climates are found at elevations below 700 m and less than 250 km from the sea. Five areas in the world have Mediterranean climates. The first is, of course, the Mediterranean basin where the climate type is found from 28°N to 45°N and from 18°W to 42°E. Within these limits, annual rainfall decreases eastward and southward with drier summers. The second area is California, from Cape Mendocino south beyond San Diego, the coastal mountains, the northern and central California plains, and the western ridge of Sierra Nevada mountains. The third area is coastal Chile, from south of Concepcion (38°S) to north of Valparaiso (32°S). The fourth area is the Cape Province in South Africa, from Cape Town eastward to Knysna (34°S, 23°E) and all along the west coast of the South African Republic. The last area is southwestern coastal Australia, from Esperance (34°S, 122°E) to Geraldton (29°S, 115°E).

In Mediterranean climates, cold temperatures are rare and, in some locations, frost is unknown, a condition which should allow one to grow quite a large number of palm species. On the other hand, due to the latitude (between 30° to 45°), the sun is not very high in winter. Therefore, temperatures do not rise high and quickly enough during the day, especially in the higher latitudes, to make it possible to grow lowland tropical palms. In summer, if the temperature is perfect for palms, the lack of water creates a climate that is the exact opposite of tropical climates. Since most palms come from summer rainfall areas it is necessary to give ample watering in summer, the quantity depending on the rainfall of the area.

Although cold is generally not a problem, these areas are not far enough from the Poles to be protected from occasional cold spells. In such cases, the damage may be significant on some palm species. After such a trauma, treatment with fungicide is even more necessary in order to prevent the rapid spread of disease in the winter rainy season.

Another important phenomenon in Mediterranean climates is the winds. Whether they are the Santa Ana in California or the Mistral in western Europe, their strength can be even more damaging than some tropical ones as they dry everything in their paths. There is little one can do, but if water is available in great quantity, one may spray plants when the wind blows to raise the level of humidity in the air.

Planting and transplanting require following some special rules. Like everywhere else planting has to be done during the warmer months, but in some locations, summer is not the best period. The absence of rain lets the soil dry out completely, especially on slopes with well-drained soils, such as granitic soils, and on lands which have not been cultivated (therefore irrigated) for a long period. If you plant in May and June, the ground is not yet dry, and it is easier to keep the newly planted palm moist. October is also a good time to plant because it is less hot but still warm and is the beginning of the rainy season.

You should have the pH of the water and soil analyzed if you have any doubts about their alkalinity. Even though palms are quite tolerant, they may suffer from an extremely high level of lime

The best palms for Mediterranean climates may be classified in four groups depending on their drought resistance.

Group 1. The best palms are obviously those growing in Mediterranean climates: *Brahea armata, B. edulis, Chamaerops humilis, Jubaea chilensis, Phoenix canariensis, P. dactylifera, P. theophrasti, Washingtonia filifera,* and *W. robusta.*

Group 2. Those from arid zones are good but may need protection from the rain during winter: Other *Brahea* spp. and palms from dry areas in South America, such as all *Trithrinax* spp., *Butia* spp., most *Syagrus* spp., especially those growing in cerrado vegetation (see Henderson, A., G. Galeano, and R. Bernal. 1995. Field Guide to the Palms of the Americas. Princeton Univ. Press).

Group 3. Those from temperate oceanic zones or from medium altitudes in tropical zones will need to be watered during the summer months and young plants should be protected from the sun. In this group are all *Trachycarpus* spp., *Sabal* spp., *Parajubaea* spp., and *Ceroxylon* spp.

Group 4. Those which are very adaptable: *Livistona* spp., *Archontophoenix* spp., the common species of *Chamaedorea* (see Hodel, D. 1992. Chamaedorea Palms: The Species and Their Cultivation. Allen Press, Lawrence, KS.).

and develop nutrient deficiencies. Fertilization should be given with slow release products at least three times a year, viz., in March when the weather starts to warm up, in June to have the best growing season possible during summer, and in October to allow the plant to store the food it cannot draw from its roots during the winter months when the soil temperature is too low. The amount depends on the species and the soil conditions but will follow the general ratio of 3–1–3, along with one part magnesium plus micro-nutrients.

Pests and diseases may be problems where there is a great concentration of plants, especially if elementary sanitation rules are not respected. In Mediterranean climates the problems and their solutions are the same as elsewhere, but they still depend more on the actual areas than on the climates. There are special pests and diseases which are more commonly found on palms in Mediterranean climates. They are often increased by overwatering during the hottest months. Date palms (*Phoenix dactylifera*) are frequently affected by *Graphiola* in the wetter Mediterranean climates. *Fusarium* is a more problematic disease on *Phoenix* species, especially on dates, and has killed many palms in the southern border of the Mediterranean sea. This disease has spread in the recent years due to the demand for large palms from infected areas imported for landscaping. *Phytophthora, Ganoderma, Gliocladium,* and rachis blight have been spreading in the last twenty years in the Mediterranean region.

Growing palms in Mediterranean climates is no more difficult than elsewhere if you keep in mind the rule dictated by nature: recreate as closely as possible the climate of the plant's habitat. This method does not mean you have to pamper your palm too much; just good care is the rule.

←

1. Four outstanding palms for Mediterranean climates. *Brahea edulis* (upper left). *Jubaea chilensis* (lower left). *Phoenix canariensis* (upper right). *Jubaeopsis caffra* (lower right). (Photos by S. Zona)

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Palms in Subtropical Climates

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In the transition zone between the tropics and the temperate zones are conditions for growing an amazing diversity of palms. This zone of mild climates, the subtropics, extends north from the Tropic of Cancer and south from the Tropic of Capricorn with varying outer limits between 30° and 40° latitudes around the world. This temperature range and seasonal rainfall pattern define palm growing in the subtropics. This discussion focuses on the humid parts of these middle latitudes that are characterized by long, warm to hot summers and mild winters. The humid subtropics experience rainfall throughout the year, but they are distinctly seasonal with a moist, humid summer and a comparatively dry winter. Summer high temperatures at 29–35°C (85–95°F) and winter low temperatures of 2–10°C (35–50°F) are typical. Parts of the subtropics also experience infrequent freezes. This climate does, however, allow for an unusually wide range of palms from equatorial to temperate regions. The species that do not thrive in this range are typi-

1. A new planting with mulch to conserve soil moisture and suppress weeds.

2. Cold sensitive palms are grown in the subtropics by taking advantage of microclimates. *Gulubia costata* survived winter lows to −3°C (27°F) in an area at Fairchild Tropical Garden sheltered from wind by tall trees and dense shrubbery.

Outstanding Palms for the Subtropical Landscape.

All tolerate full-sun and a range of cultural conditions, with special needs and exceptions as noted: AD-deficiencies in alkaline soil, AL-best in alkaline soil, C-cold tender, M-requires ample moisture, sh-shade before establishment, SH-prefers/requires some shade. An asterisk (*) indicates that other species within the genus are also recommended.

Name	Ornamental Considerations
*Archontophoenix purpurea** AD	reddish-purple crownshaft
Balaka seemannii SH	small specimen plant
Beccariophoenix madagascariensis AD	long, bold leaves
Bismarckia nobilis	bold form and color
Borassus aethiopum M	large and stately
Carpentaria acuminata M	attractive red fruit
Chambeyronia macrocarpa M	red new leaves
*Chamaedorea ernesti-augusti** SH	small-scale specimen
Chuniophoenix hainanensis SH	small, fan-leaved clumping
Coccothrinax crinita ssp. *crinita**	long fibers on trunk
*Copernicia baileyana**	strong form
Cocos nucifera C	for warmest subtropics
Dictyosperma album	for tropical effect
Drymophloeus beguinii M,SH	bold leaf texture
Euterpe edulis sh	drooping leaflets
*Dypsis decaryi**	unusual crown form
Gastrococos crispa	strong form
Guihaia argyrata SH	short; clumping
Heterospathe elata C	graceful spreading leaves
Howea forsteriana sh	for cool subtropics
Hyophorbe lagenicaulis	bottle-shaped trunk
Kentiopsis oliviformis	elegant form
Kerriodoxa elegans	grand palmate leaves
*Licuala grandis** SH	undivided round leaves
Lytocaryum wedellianum SH	fine texture pinnate
Pinanga coronata M,SH	pinnate-leaved; clumping
*Pseudophoenix vinifera** AL	bottle-shaped trunk
*Ptychosperma elegans**	very adaptable
Raphis excelsa	fan-leaved; clumping
*Roystonea regia**	large and stately
Satakentia liukiuensis C	burgundy crownshaft
Schippia concolor AL	large white fruits
Siphokentia beguinii SH	irregularly divided leaves
*Syagrus amara**	for tropical effect
Thrinax morrisii AL	silver leaf underside
Veitchia arecina C	striking in groups
Washingtonia robusta	tall and stately
Zombia antillarum	unusual spiny sheaths

cally palms of the deep tropics and the cool high altitude rainforest and temperate regions.

The subtropics are often termed mild in climate but the temperature range can affect the placement and care of palms in the landscape. Planting for example is commonly done in the spring so that the plants are established during the summer heat and rain before the winter low temperatures. A sheltered position is required for the most tropical palms such as *Marojejya*, *Cyrtostachys*, and *Pigafetta*, which are marginal palms for the subtropics. As in temperate climates, palms are covered with burlap or other temporary shelters during extreme winter temperatures. The effects of summer temperatures are dealt with in the placement of palms and attention to water needs.

Water is one of the most important concerns in the subtropics. While there are palms that tolerate dry periods with no help once they are estab-

lished in the landscape, most perform better with supplementary watering, and many palms require it. Palm growers consider the natural environment of a species for guidelines. Palms of the deep tropics and shade-loving palms of forest understories such as *Geonoma, Clinostigma,* and *Pinanga* often need regular irrigation in the subtropics. In general, tropical palms will respond to watering with faster growth rates. Mulching is also beneficial as a means of conserving water. Mulching around palms contributes to soil moisture, aids in water penetration, and helps moderate soil temperature.

Many palms of typically dry habitats can be grown well in the subtropics. Examples are *Chamaedorea* (Mexican species), *Coccothrinax,* and *Gaussia.* The exceptions, while difficult to generalize, are palms intolerant of both the heat and moist conditions. In Miami, Florida, *Jubaea, Trithrinax,* and *Trachycarpus* are examples of palms that do not thrive because of this combination.

Fertilizing helps maintain the health and vigor of palms that must adapt to different climates and soils. In particular well-fertilized palms are better able to combat the effects of winter low temperatures that weaken many palms, making them more susceptible to disease and pest problems. The range of fertilizers and practices defies generalizations, but regular application of a balanced complete fertilizer is recommended as a basic program. Local growers and agricultural agencies can provide the fertilizer recommendations for your specific soils.

Palms have few pest and disease problems in the subtropics. Common insect pests of palms such as scale insects, mealy bugs, palm aphids, banana moths, and other Lepidoptera species can be controlled and do not seriously harm the plants. A few pests and diseases are chronic problems and cause fatalities. Lethal yellowing and ganoderma are incurable and spreadable diseases that have resulted in tremendous losses in ornamental palms. In areas where they occur growers should avoid using susceptible palms in the landscape. Native palms offer resistance to pests and disease as well as tolerance of less than desirable temperature, water, and soil conditions. A recommendation for minimizing losses is aiming for diversity. Native species can be the staple landscape plants that require little care and free a palm grower to experiment with riskier introduced species.

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Palms in Temperate Climates

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The bizarre nature of the idea of growing palms outside in colder climates is probably the thing which attracts most people to it. Surprisingly there is a good number of species from which to choose, and with a little common sense and care, we can achieve results which are every bit as satisfying as those of our colleagues in the tropics. Additionally the effect can be even more exciting since it is so unexpected and so unlikely.

While there are many 'hardy palms,' they can be mainly categorized into three groups according to their climatic requirements. Firstly, those palms that are extremely hardy to cold but which grow slowly if there is little summer heat. Examples are *Rhapidophyllum*, some *Sabal*, *Nannorrhops*, *Trithrinax campestris* and *Serenoa*. Secondly, those which while needing protection against low temperatures, grow very well in cool summers. These include *Ceroxylon*, *Rhopalostylis*, *Parajubaea*, *Washingtonia* and *Arenga* among many others. Finally the third group contains the most reliable species and certainly the best for the beginner. These palms are those which combine the desirable attributes of the other two groups, that is, they are extremely hardy to cold but they also grow well in our often barely mild, temperate summers. We are fortunate to be able to number *Trachycarpus*, *Chamaerops*, *Butia*, *Jubaea* and some *Brahea* as the hardiest in this group.

Cultivation techniques for our temperate palms are in general identical to any others, and most hardly palms, with the possible exception of a few odd species such as *Guihaia* spp. or *Trachycarpus nanus*, are among the easiest to grow of all palms. They all require suitable soil, appropriate nutrients, and an adequate supply of water. An idea of where the palm originates from will provide clues as to its requirements. Palms from desert-like and other dry, open areas grow best in a heavier, open, sandy or gritty soil with perfect drainage and a low humus content. Species from humid forests will require a lighter, humus-rich soil and will benefit a lot from heavy mulching. The pH of the soil plays only a minor role for nearly all temperate palms. All require an abundance of water during periods of growth and providing this can dramatically increase the speed with which the palm grows. *Trachycarpus fortunei* for example has been reported as growing a foot of trunk per year when heavily watered and claims of twice this are probably not exaggerated. On poor and dry soil, it will struggle to stay alive and can remain in a semi-dormant state for years.

Like the more tropical species, all temperate palms benefit greatly from regular applications of a suitable fertilizer throughout the growing season which, whether organic or inorganic, should be high in nitrogen, potassium, and magnesium and should contain all necessary trace elements. A foliar feed with potassium in autumn is a good idea to harden off your palms for the winter.

One of the benefits of our temperate climate is the general absence of pests, and while our colleagues in the tropics have to worry about scales and mites, thrips and mould, we can relax about these issues as they are rarely a problem; any pests that do occur are generally wiped out by the following winter's cold.

Positioning a palm, especially if considered marginal for your climatic zone, can play a most important part in its ability to survive the winter months without damage. As frost usually is the most limiting factor, choosing the warmest places in your garden can make all the difference. Particularly good microclimates can generally be found in the sun-facing sides of buildings, walls, evergreen trees etc. and on sloping

1. *Sabal minor* (top). *Trachycarpus martianus* (bottom). (Photos by S. Zona)

The 12 Most Cold-hardy Palms
Rhapidophyllum hystrix
Nannorrhops ritchiana
Sabal minor (Fig. 1, top)
Trachycarpus takil
Trachycarpus nanus
Trachycarpus fortunei
Trachycarpus wagnerianus
Trachycarpus princeps
Serenoa repens
Jubaea chilensis
Chamaerops humilis blue form
Trithrinax campestris

A Personal View of The 12 Best Specimen Palms for Temperate Climates
Jubaea chilensis (plant now for your grandchildren!)
Dypsis decipiens
Parajubaea torallyi
Brahea armata
Trachycarpus princeps
Trachycarpus wagnerianus (very wind tolerant)
Trachycarpus latisectus
Trachycarpus martianus (Fig. 1, bottom)
Butia yatay
Sabal uresana
Arenga engleri
Dypsis onilahensis

ground, where cold air can move away and does not collect. In many areas, however, wind can be more of a problem than cold, especially if near the coast, and fan palms in particular can be battered by winter winds to the extent that they look more dead than alive. Shelter from the prevailing wind is thus of great importance and this should be taken into account early on when planning the exotic garden. Consider that wind in winter usually also brings that nasty cold weather and will add to potential damage by its chill factor.

Some hardy and half-hardy palms (*Ceroxylon, Rhopalostylis, Arenga*), prefer shade from the sun, and shade can be doubly beneficial since shady spots often also provide protection by overhead trees from both cold and wind. *Chamaedorea* species, such as *C. radicalis* and *C. microspadix* which are both extremely hardy to cold and incidentally much under-used, also fit into this category. Being small understory palms, they can receive optimum protection from frost by being positioned under other, taller, plants.

As enthusiasts become more confident of the ability of their palms to withstand cold and the other rigors of winter, so new species are being tried and rated for their performance. While it is true to say that there are in fact rather few palms for those marginal climates, providing even the minimum of protection during the coldest periods dramatically increases the number that can be grown. Temporary shelters built with styrofoam, bubble plastic, reed mats, burlap, plant fleeces etc. are quick and easy to erect but very efficient and will protect your plants from those few frosty freaks in otherwise agreeable temperate-zone winters. It is good advice to protect your plants only in those periods of extreme cold which make it absolutely necessary and keep them exposed to the elements as long as possible.

An occasional failure will not put off the dedicated hardy palm enthusiast and it is, after all, the results of pure experimenting that has enabled us to come such a long way from the days when the first *Trachycarpus* to arrive at the Royal Botanic Gardens, Kew was planted in the tropical palm house there. The increasing number of chapters of the I.P.S. that are devoted to hardy palms is an indication of just how popular this particular branch of horticulture is becoming.

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Palms in the Landscape: Culture Basics

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There are few groups of landscape plants that offer the beauty and charisma of palms. Whether you are new and starting your first garden or an experienced collector just "adding one more species," there are basic data that will make your planting much more successful.

Getting the Right Property

If you have not yet purchased or leased your home, search out the perfect location for growing. Find the warmest area in your locality and make sure you have good sun exposure. If you are in a cold area, find property on a ridge or hill to promote cold drainage. Ask prospective neighbors if it freezes. Look for successful growth of palms in that neighborhood. Investigate water quality, soil quality, and drainage as well. And finally, pick a property large enough to support your present and future palm needs.

Before You Begin Your Garden

It is advisable to have a plan before you put in your first palm. Determine planting density desired, pathway location, need for retainer walls and improvements, and work areas. Dig a few holes just for the purpose of examining the quality of your soil and for checking drainage. If your soil is of poor quality, import new soil or begin amending soil before planting. If drainage is bad, amend your soil with sand and install leach lines in over-moist areas. If possible, install your irrigation system prior to planting. Also, create your own home "nursery" and gradually accumulate species that you wish to plant eventually.

Haphazard planting gives haphazard results. Plant species in the appropriate locations. Palms are unusual in that you can predict the plant's eventual size and probable rate of growth. A large clumping palm will obscure smaller species planted behind it. A *Phoenix canariensis* right next to the house will most likely need removing later. A spiny species next to a walkway would be dangerous. By knowing your palms and what they will become, you can avoid these problems. Remember to plant sun-loving species in locations that will not be shaded as surrounding plants grow.

Plant fast-growing palms to establish shade and the resultant canopy for other palms. Rapid growing species such as *Caryota, Syagrus,* and *Archontophoenix* will quickly grow overhead and produce a canopy, which is aesthetically pleasing because it gives a third dimension of height to your garden. More importantly, it provides a protected environment below that enables you to introduce shade-loving species. A well formed canopy may be the single most important thing you can do while creating a palm garden. The areas under the canopy are warmer in the winter, have less wind, hold more humidity, and create a "rain forest" appeal. Many genera, such as *Geonoma, Chamaedorea* (Fig. 1), and understory *Dypsis* species, cannot survive direct sun, especially at a young age.

Acclimatizing Your Palms

If your palm is from a greenhouse, shade structure, or imported from a more tropical area, acclimatize it before planting. Such plants must cope with lower outside humidity, cooler temperatures, and more intense sun. Any of these changes can be a problem for your palm, even if it is sun-loving. Acclimatization from the greenhouse into full sun should be done gradually over a two to three month period (or more) for most species and preferably between spring and fall. Start in shade. Gradually increase the exposure to sun every two to three weeks. If you notice any burn (faded, then brown areas) on the sun exposed foliage, return the palm to more shade. An alternative method is to plant the palm in filtered light and then allow it to grow into the sun.

1. A shade cloth canopy installed to protect a collection of *Chamaedorea* species growing in the ground at the Orto Botanico, Naples, Italy. (Photo S. Zona)

The Best Size to Plant

In most climates outside the tropics, a plant with some size has a better chance of surviving, especially if it is a species that is marginal in one's locality. A general rule might be "the bigger the better," but budget limitations may apply. I would recommend planting acclimatized plants of at least one-half meter in height. Larger plants seem to tolerate better the shock associated with transplanting. Very durable species will most likely survive regardless of the size of the palm. It takes a palm about 12 months after planting to start looking good. During its first six months, existing leaves may yellow or age. "Post Greenhouse Shrink" (subsequent leaves being shorter than old leaves) can be seen in almost any size of plant and results from loss of the optimal greenhouse environment. This is also seen with plants taken out of shade structures. Plants will reestablish their leaf length with time as they adjust to their new environment.

When to Plant

Outside of the tropics, the optimal time to plant is after the risk of cold weather has passed. If you live in a very mild climate, you can probably plant anytime from late winter to late fall. If you choose to plant just before cold weather arrives, make sure that you are using fully acclimatized specimens, preferably with at least one full year of outside culture prior to planting.

Drainage

Almost all species of palms prefer good drainage. Heavy subsoil or clay may have very poor drainage. An experimental half meter deep hole dug in a representative area of your garden will teach you a lot about your soil, water patterns, and drainage. First, you will learn the depth of your topsoil and the difficulty of digging in your soil. Second, you can have the soil tested by a soil lab for pH and nutritional status. Third, you will discover the effectiveness of your watering and can make any adjustments as needed. Fi-

2. Palms staked for stability at Fairchild Tropical Garden, Miami, Florida. Note that the stakes are not nailed directly to the trunks. (Photo S. Zona)

nally, and most important, you can test the drainage. After normal rainfall or watering, dig a hole a half meter deep and wide. Quickly fill this hole with water and time how rapidly the water totally disappears. With excellent drainage the water will be gone within one hour. Good drainage would take several hours. Adequate drainage would take 6–12 hours. With poor drainage, the water remains for 24 hours or more.

If your garden falls into the "poor drainage" category, you can predict that some species will have problems unless you plan ahead. You may have found that, in digging your hole, you came to a clay or heavy substratum. It may be this layer that is holding stagnant water below the ground. If this layer isn't too thick, you can utilize heavy metal bars or a jackhammer to break up the layer prior to planting and thus promote drainage. An alternative technique is digging underground diversion channels from hole to hole using gravity to divert water downward. One can also mound plants (with or without constructed walls) above the water table.

If your problem is heavy clay topsoil causing drainage problems, consider repetitive amendments of sand and coarse organic material. Over the years this will promote better surface drainage.

Planting on slopes presents a drainage problem of sorts. Slopes discourage water from getting to the palm's roots. Solutions include slow emission drip irrigation, adequate water wells, or mulching to slow the downward movement of applied water.

Soil

Soil is of paramount importance in your garden's success. Ideal soil pH for palms is about 6.0 to 6.5. Alkaline water will slowly raise the pH of soil. Test kits can be purchased to check the pH. If you are importing soil for your garden, buy the highest quality soil blend available.

Any prepared soil purchased for the garden, especially if used for backfill, will have to be compacted prior to planting. Freshly prepared soil mixes have air mixed into the blend. Also,

the soil's organic material will decompose over the years. Your garden's soil surface above the newly imported soil will actually begin to sink with time. Therefore, compact the soil heavily with professional tampers and heavy watering and allow time for the soil to settle. If deep layers of imported new soil are being used, one may wish to actually build up the garden installation level above the final desired level. It would not be unusual for a rich soil blend to compact 20% over five years.

Planting a Palm

When planting into native garden soil, most growers recommend amending the soil used to pack in around the root ball. Dig the hole at least twice the size of the palm's container. To the removed soil, add organic material and possibly sand to encourage new root growth into the soil. An acceptable ratio would be two parts organic material, three parts native soil, and one part sand if needed. Place your mix into the dug hole and compact it. Put the palm still in its container into the hole and check the planting height. The base of the trunk in the pot should match the garden soil level. Remove the palm from its container and gently set the root ball into the hole. Add soil mix around the rootball half way up the hole, compact the soil, and water. Finish filling the hole, compact again, top off the soil, and water very thoroughly. Make sure enough water has been given to penetrate the rootball and new mix all the way to the bottom of the hole. It takes a surprising amount of water on the first watering. It may be best to let the garden hose run slowly for 20 minutes, gradually moving it around to each side of the plant. Also, if you have planted in a windy area or the plant seems unstable, stabilize the palm with one or more stakes, being careful not to attach the stake directly to the stem with nails as diseases can enter through nail wounds (Fig. 2). Stakes can be removed when the palm demonstrates stability on its own.

Antidesiccant sprays applied to the foliage or tying leaves into a bundle for weeks or months can help prevent desiccation prior to the establishment of new roots. I recommend the use of commercial antidesiccant (antitranspirant) sprays. These sprays literally coat the leaves with a thin water soluble layer of polymer material that prevents moisture loss through the leaves.

After planting, anticipate watering again in a day or two. Spray down the leaves occasionally. New soil preparations may repel water and need frequent initial watering. In the first several months, never allow the soil to dry out completely; however, avoid overwatering as this may discourage root growth or even cause rot. Repeat antidesiccant sprayings can be used. Tied up crowns should be released within one or two months. A small temporary shade structure utilizing shadecloth and stilts can be constructed above a planted palm to protect it from direct sun if no pre-acclimatization was done. Immediate fertilization is not needed on newly planted palms. In six to eight weeks begin a regular fertilization program.

Watering

Two factors are involved in watering. First is the volume of water given. Most growers like heavy watering at lesser intervals. To know if you are giving an adequate volume, dig an exploratory hole and confirm that the water is penetrating deeply into the soil. The other factor, watering frequency, depends on ambient temperature and humidity, drainage patterns, soil type, volume delivered, and plant needs. Watering frequency is increased with higher temperatures, lower humidity, quicker drainage, looser soil types, smaller volumes of delivered water, and water-loving species. There is no recommended frequency for watering. You must inspect the soil. Most growers will water when the superficial soil is becoming somewhat dry to the touch.

Water delivery techniques vary from hand watering to sophisticated computer driven sprinkler systems. Computerized systems do save time and can conserve water by eliminating the need to turn off valves. Drip systems can be effective, especially on slopes. Broadcasting type sprinklers are the most commonly used but are the least efficient and often leave dry areas.

Another specific watering problem is when you get water "theft" from older, larger adjacent plants or competing lawns and ground covers. These plants will actually steal available water from your new palm. This is particularly important when you plant a palm among larger trees. There is little you can do for this besides giving extra amounts of water and fertilizer to needed areas. Cut lawns and groundcovers back several feet away from your planted palms.

Adding an inch or two of organic mulch directly on top of the garden surface will enrich

and add acidity to the soil, decrease water requirements, help with weed control, and make the garden look nicer. It will also break down and gradually improve drainage. Organic material such as aged fir, redwood or pine shavings, shredded leaves, or aged "stable litter" (shavings with horse manure) work well for this. Nitrogen-based fertilizer may be added to the mulch to offset nitrogetn consumption that accompanies the decay of the mulch. Avoid mulching with leaves from trees such as *Eucalyptus* that give off toxic chemicals. Before mulching is a good time to apply fertilizer to the soil. Do not mulch over the crown of a small palm.

Fertilizer

Correct application of fertilizer gives nutrition to the plant to optimize growth. Incorrect usage of fertilizers kills or weakens the plant. Always read and follow the manufacturer's directions. Also, never fertilize garden soil that is dry. Fertilizer on dry plants can cause chemical burn. Avoid throwing fertilizer into the crown of a small plant. Distribute the material around the base of the palm, roughly matching the shadow on the ground from the overhead leaves. It may be best to work the fertilizer into the top few inches of the soil.

There are organic and chemical fertilizers. Organic materials such as blood meal, processed sea kelp, fish emulsion or various manure preparations are usually available. Organic fertilizers offer some microelements not available in standard fertilizers. The undesirable odor of these fertilizers can be lessened if they are placed under your layer of mulch. Application rates vary, but three times a year is usual.

Manufactured chemical fertilizers are either quick release, slow release, or somewhere in between. Quick release preparations are available to the plant after several waterings. Consequently, they carry more chance of plant burn, whereas the slow release preparations help prevent burn. The latter are either 90-, 180-, or 360-day release. They have a polymer barrier around the fertilizer pellet to slow its release. Both types of fertilizers come as granules and are quite easy to spread in the garden.

An ideal fertilizer would be one with the N:P:K ratio of 18-6-18 (or similar ratio) with added microelements such as iron, magnesium, and manganese. With any fertilizer, follow the manufacturer's direction on application rates and do not overdo it.

Special Problems

There are as many special problems in growing palms as there are growers and localities. A very common and yet avoidable problem (through planning) is what to do when a sun-loving palm gets shaded out by adjacent plants growing above it. The only solution is to get sun to the palm by overhead pruning of other plants or transplant the palm to a sunny location. Another frequent problem is protecting a palm from cold exposure. Establishing an overhead canopy, planting near the house, and using antitranspirant sprays may all give palms some cold protection. Continually running overhead irrigation has been used to prevent plant demise during brief freezes. Dubious methods of cold protection include ground heating cables, temporary overhead plastic roofs, smudge pots, and warm water baths for the plant's roots during the coldest periods.

Damage from sea water spray is another problem. It has been observed in southern California that *Ravenea rivularis* does very poorly within a few blocks of the ocean. *Howea forsteriana, Brahea edulis, Cocos nucifera, Washingtonia robusta* (not *W. filifera*) and *Rhopalostylis sapida* all do well in ocean front areas. High wind areas present a unique problem. Strong winds shred pinnate and fan leaves alike. The solution is to use species that have stronger leaves or leaflets. *Brahea, Washingtonia, Chamaerops,* and *Butia* do well in strong wind, whereas *Pritchardia, Roystonea, Licuala* and *Chamaedorea* do poorly. Strong winds with concomitant dry conditions commonly seen in southern California can desiccate many delicate species. Microenvironments offering more moisture can be created by mulching, frequent spraying of the foliage with water, overhead misting devices on timers, and overhead canopy formation to offer shade, trap humidity, and provide protection from wind.

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Pruning Palms

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Unlike many woody broad-leaved trees and conifers, which often need regular pruning to maintain esthetic quality, overall structure, and flower and fruit production, palms require little or no pruning to achieve and maintain optimal growth and presentation in the landscape. Pruning broad-leaved trees and conifers involves removal of growing points, such as shoot tips, buds, and sometimes even whole branches. In contrast, pruning palms is mostly relegated to removal of individual whole leaves or flowerstalks. Rarely does pruning a palm involve removal of a growing point, and only then is it used to remove stems or basal suckers from species with multiple or clustered stems. Indeed, removal of the growing point of a palm stem will usually kill that stem.

Palms are normally pruned to: 1) remove unwanted leaves; 2) remove unwanted flower- and fruitstalks; 3) remove unwanted stems of multiple-stemmed species; and 4) reduce leaf area during transplanting.

Leaf Removal

Palm leaves are normally removed once they have completed their natural life span and are functioning at a much reduced level or are dead. Such leaves are older and in the lower part of the crown, have changed from a normal green color to yellow or brown, and often persist on the stem, lending an unsightly and untidy appearance to the palm. Leaves might also be removed if they are heavily diseased or insect infested or are simply blocking the view of an important or attractive feature of the trunk or plant. Leaves and leaf bases killed by frost can be removed since they might trap moisture and promote rot of the apical growing bud, slowing recovery or even leading to death of the plant.

Some palms, such as king palms (*Archontophoenix cunninghamiana*), areca palms (*Dypsis lutescens*), and royal palms (*Roystonea* spp.), are considered self-cleaning since their old, dead leaves usually fall away cleanly and neatly on their own. However, other palms, such as the California and Mexican fan palms (*Washingtonia*), are well known and often highly prized for their conspicuous, handsome "skirt" of old, persistent leaves.

Remove unwanted leaves neatly and cleanly with a sharp saw or clippers as close to the stem as possible taking care not to damage the stem. Avoid tearing off leaves or leaf bases since this practice might damage the stem, leaving unsightly permanent scars or wounds where insects and diseases can enter. It might be necessary to undercut the base of the petiole of large leaves prior to making the top cut to prevent tearing of the remaining leaf base or trunk. Normally, remove only dead or dying leaves; avoid removing healthy green leaves. Remove diseased leaves but avoid removing leaves showing nutrient deficiencies since such removal might accelerate the deficiency problem. It is a good practice to clean all pruning tools with a solution of one part household bleach to nine parts water prior to pruning each palm since potentially fatal diseases are easily spread on pruning tools.

Flower- and Fruitstalk Removal

Flower- and fruitstalks are normally removed once they have completed their natural life span and are dead. They may also be removed just after emergence and before flowers and fruits form if fallen flowers or fruits would pose a nuisance or hazard. Remove unwanted flower- and fruitstalks as described above for leaf removal.

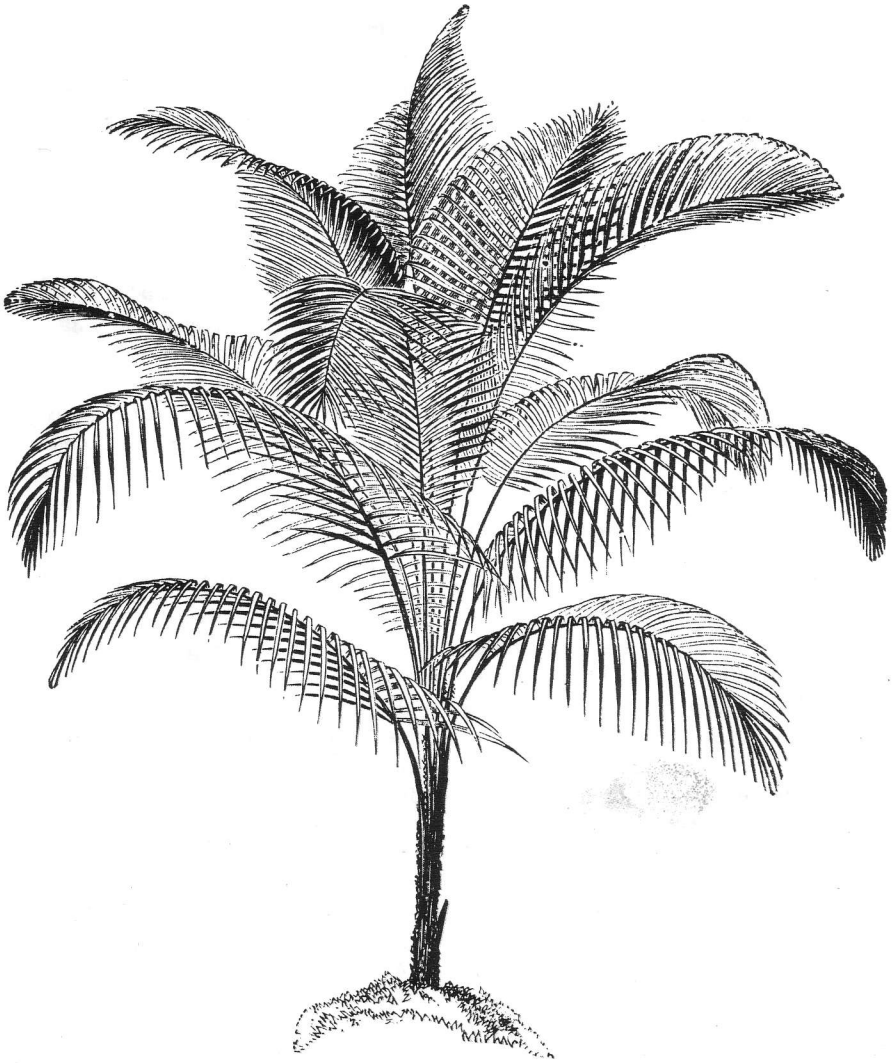
Stem Removal

When left to grow naturally, many multiple-stemmed species, such as Mediterranean fan palm (*Chamaerops humilis*), Everglades palm (*Acoelorrhaphe wrightii*), and saw palmetto (*Serenoa repens*), will form a solid, dense, impenetrable, mound-like mass of foliage lacking in any character. Selective removal of some stems will open up the clump, giving it some character

and bringing to view stems often attractively clothed with persistent leaf bases or other handsome features. Of course, one might desire a solid, dense mass for screening out noise, wind, and dust or to block an unsightly view. Do remove stems of a clump that have grown too tall, that pose a hazard, or that have died after flowering and fruiting, such as those of the clustered fishtail palm (*Caryota mitis*). Remove stems as close to the base as possible taking care not to damage remaining desired stems.

Leaf-Area Reduction for Transplanting

Although relatively little is known about digging and transplanting palms, it is standard practice to reduce leaf area by one-half to two-thirds during transplanting to reduce water loss until new roots have generated. Such leaf-area reduction is achieved by removing entire leaves from the lower part of the crown and/or cutting back or removing parts of leaves throughout the crown.



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HORTICULTURAL COLUMN

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Welcome to the Horticultural Column. This column is intended to be a service to IPS members and a way to allow us to share our observations and horticultural techniques and problems with our fellow members.

I don't think I've ever visited a palm garden or collection without learning something new, and I'm sure you will agree that nobody knows everything and everybody knows something. Our hope is that members will want to share what they know; whether it is their enthusiasm for a favorite species that they feel deserves more attention as an ornamental, or comments on any kind of cultural practices, pruning, watering, fertilizing, etc. Tell us which plants and methods have been successful for you, better yet tell us which plants and methods have been unsuccessful for you, and save us some trouble.

I invite any members with horticultural questions about palms to submit them to me via e-mail (Bernard.Peterson@gte.net). E-mail makes much of this communication easier, but it is not necessary to have e-mail to participate. Regular mail works just fine. I certainly do not know the answer to every question myself, but I can find a source that does. I hope to hear from you soon.

Q. I was wondering what is it about palms that makes transplanting them allegedly more difficult. Do palm roots recover more slowly than the roots of other woody plants (for example, *Ficus*), or do palms have a more sparse root system such that any damage kills a higher percentage of the root system? Scott Stewart, Ohio.

A. Some palms are among the easiest of large trees to transplant. *Syagrus romanzoffiana* can be dug up and moved as easily as any large plant that I have ever encountered. As a general rule palms with pinnate or feather-shaped leaves are easier to transplant than those with palmate or fan-shaped leaves. There are some exceptions, however. It is often the case when transplanting palms with fan leaves, that mature trees are more likely to survive than younger ones.

The root system of a palm is altogether different than those of dicotyledonous trees and conifers. An individual palm root is the same diameter throughout its length. Smaller rootlets emerge from its sides. Absorption takes place in the tip of the root and its rootlets. There is an area at the base of a palm's trunk which can produce new roots throughout the tree's life, so a given root is not necessarily a permanent part of the palm. In contrast, a seedling dicot begins with roots which gradually increase in diameter and length and branch in order to fill the needs of the growing tree. When the "permanent roots" of dicots and conifers are confined in nursery pots they can grow in tight circles that can cause serious problems later in the tree's life; palms with their "non-permanent roots" and their ability to grow entirely new roots do not have these problems.

The existing roots of palms have been found to have a limited ability to branch and regrow once they have been cut in the process of transplanting. The ability to branch and regrow roots varies from one species to another and, in some cases, with the distance from the trunk that the cut is made. It is not surprising that a relatively high percentage of the roots of the very easy to transplant *Syagrus romanzoffiana* are able to branch and resume growth as long as they are cut more than 15 cm from the trunk. For the more difficult to transplant *Sabal palmetto*, virtually none of the cut roots are able to branch and regrow regardless of how far from the trunk they are cut. Since the cut roots have little ability to function, the newly transplanted palm's survival depends on the formation of entirely new roots at the base of the trunk. Nowadays when *Sabal* palms are transplanted the roots are cut very short and all of the foliage is removed to compensate for the loss of the roots. The same procedure has been tried a few times on difficult species, such as *Copernicia alba* and *Livistona decipiens*, with similar success.

I think it is possible to transplant any palm species successfully, although some may require special techniques or even machinery. Palm transplanting is best done, especially on difficult species, at the beginning of the warm season, to allow prompt and prolonged growth to aid in the palm's recovery.

Q. I am a palm grower from the Dominican Republic trying to grow date palms for the first time. Do you have information on the propagation of date palms from seeds? Yarina Montas Bravo.

A. I assume that you are referring to *Phoenix dactylifera*, the date palm which produces the edible dates. The date palms that are planted in groves in the American southwest and the Middle East are propagated either by separating the suckers or offsets that are found at the base of the parent tree, or by tissue culture. Since dates grown from seed can be either male or female, and one cannot determine which sex they are until they are old enough to flower, they are not usually propagated by seed.

If you wish to grow dates only for their appearance, then they can be easily grown from seed, as can all species of date palms (*Phoenix*). The seeds contained in the dates at the local supermarket work just fine. Plant them in pots that are from 15–20 cm deep. You can plant many seeds in each pot and separate them after their first leaf is fully grown and the second one has just begun. Date palms require sun, so they should not be grown in a shady spot even while small. Dates grow best when the soil is moist, but they will suffer from foliar fungus diseases if their leaves become wet too often, or if the air is too humid. Drip irrigation is very useful when growing this palm, and they should respond well to a good quality palm fertilizer. The Arabs say of the date palm that they like their heads in the fire [sky] and their feet in the water.

If you are growing these palms as ornamentals only, I would suggest that you consider growing *Phoenix sylvestris*, or Indian Date, instead. It is rather similar in appearance to the date palm, but here in central Florida at least, it is more resistant to foliar fungus diseases.

Q. How long can a *Bismarckia* be kept in a container? Everything that I have read on the subject says to put it in the ground, but I cannot do that at this time. What can I expect if I keep it in a container? Will it grow more slowly? What size container should be used? Will Abel, California.

A. *Bismarckia nobilis* grows well in containers and some nurseries produce fair-sized specimens in pots as large as 200 gallons. Being in a container will probably slow the plant's growth somewhat, but if you occasionally repot it into a larger container there should be no permanent problems. If a *Bismarckia* is kept in, say, a 15 gallon pot for too long it may begin to push itself up out of the pot simply by forming a greater mass of roots than the pot can contain. If this happens, you will have to trim some roots before repotting even if you use a larger pot. Eventually you can work your way up to growing it in a 25 or 30 gallon pot. If you use a larger container, you will need a forklift or other equipment to move the palm.

Q. A neighbor got carried away with a chainsaw while trimming a *Phoenix* palm. He cut off all of the leaves. What are the chances of recovery, and when would be the best time to transplant it? I live near San Francisco, where it is wet and about 50–60°F (10–16°C) at this time of year. Phil Stob, California.

A. The first thing to do is to keep that chainsaw away from your neighbor! The *Phoenix* will recover from its encounter with the chainsaw, especially if left where it is and cared for, but I get the impression that it is unloved in its current situation. As for transplanting it, I hope that you will not attempt this until the beginning of the warmest part of the year.

Incidentally, there is a fatal disease which affects some *Phoenix* spp. in California and now in parts of Florida too. It is *Fusarium* Wilt and can be transmitted from one tree to another by pruning saws. Pruning saws should be thoroughly sterilized after trimming one tree and before moving on to trim another. Since chainsaws cannot be adequately be sterilized, I recommend that they not be used.

Q. I work in a school library, and my students are doing research on trees. We have not been able to discover how to tell the age of a palm tree. Can you help us out? Charlynda Marckese, Illinois.

A. Palm stems do not have annual growth rings like those of most other kinds of trees. As a palm grows it adds a new section of trunk on top

of the trunk it already has; for each new leaf that grows from the top of a palm a new section of trunk is added. We can see the units of construction by looking at the trunk of a Queen palm (*Syagrus romanzoffiana*), for example. On the trunk are rings or leaf scars, which are also called nodes. Each node is a place where a leaf was attached. The spaces between the leaf scars are called internodes. To determine the approximate age of the palm, one must first observe how many leaves per year the palm produces. Different species produce leaves at different rates. A Queen palm produces about eight leaves per year. To determine the palm's age, you must count the number of leaf scars and existing leaves that it has and divide by eight. Add about three years for the early stage of the palm's life before it was old enough to have a trunk with leaf scars, and you will have an approximate age for the palm. Not all palms produce visible leaf scars. For these palms, you must observe the increase in trunk height over a number of years and use this observed growth rate to estimate the age of the palm.

Back cover

A sight to warm the heart of any palm propagator: flats of newly germinated seeds. See pp. 56–59. (Photo: Bill Langer)