Palms in the landscape, XIV
Phoenix: The date palms, Part 1

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PHOENIX, THE DATE PALMS, includes some of our most widely cultivated and useful palms. Distinctive and easily recognized, the genus encompasses 14 species of dwarf to massive, solitary or clustered, dioecious, armed, pinnate-leaved palms from the Old World (Barrow 1988, Dransfield et al. 2008, Henderson et al. 2006, KEW 2013). The name is derived from the Latin *phoinix*, meaning date palm or palm (Dransfield et al. 2008). The name also means purple or red, as in the color of some ripe date fruits, and is also derived from the name for people of Phoenicia, early and successful Mediterranean seafarers and traders famous for their cloths and purple dyes, who also cultivated and traded date fruits. In Egyptian mythology the Phoenix, a symbol of immortality, was a lone but beautiful bird that lived in the deserts of Arabia and northern Africa for over 500 years before consuming itself in fire, only to arise renewed from the ashes to start another long life (Hodel 1995).

Phoenix provides a diverse menu of landscape subjects, including our most imposing and regal palm, the massive *P. canariensis* (Canary Island date palm) (**Fig. 1**); our most picturesque palm, the clustering *P. reclinata* (Senegal date palm) (**Fig. 2**); one of our most readily available palms, the elegant *P. dactylifera* (date palm) (**Fig. 3**); and one of our most common and popular palms, the dainty *P. roebelenii* (pygmy date palm) (**Fig. 4**). Several other species are worthy of wider cultivation, including *P. loureiroi* (Loureiro's date palm), *P. rupicola* (cliff date palm), and *P. sylvestris* (wild date palm). *Phoenix canariensis* is one of two iconic or signature palms of southern California (the other being *Washingtonia robusta*, the Mexican fan palm) while *P. roebelenii* is one of the most popular and widely cultivated palms worldwide.

Here I provide an overview of the genus, focusing on a description and information about identification, distribution, and ecology; a summary of cultivation and other aspects of landscape management; a key to the most commonly cultivated landscape species; and individual treatments of each of the 14 species, including a description, distribution and ecology, landscape adaptation, and specific cultivation information.

Description

Phoenix encompasses a range of habits, from dwarf to massive and solitary to clustered. All but four species, *P.*

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Figure 1. (Left) ***Phoenix canariensis*** **is our most imposing and regal palm (Hope Ranch, Santa Barbara, CA).**

Figure 2. (Right) ***Phoenix reclinata*** **is forms picturesque clumps (Mission Bay Park, San Diego, CA).**

Figure 3. (Left) Because of a plentiful, uniform supply in the date orchards in the Coachella Valley, the elegant *Phoenix dactylifera* is readily available for landscape use (The Market Place, Irvine, CA).

Figure 4. (Right) The dainty *Phoenix roebelenii* is one of our most common and popular palms (University Center, Irvine, CA).

andamanensis (Andaman Island date palm), *P. canariensis*, *P. rupicola*, and *P. sylvestris*, have clustered habit and produce basal suckers or offshoots. The genus is dioecious, meaning there are separate staminate (male, pollen-bearing) and pistillate (female, fruit- and seed-bearing) plants, and pleonanthic in its flowering model, meaning once attaining maturity the palms flower and fruit indefinitely until they senesce and die. Trunks (stems) are mostly upright although they sometimes creep or, in the species with clustered habit, gracefully lean outwards. They are typically rough and covered with persistent leaf bases, sometimes for many years, significantly increasing their diameter (**Fig. 5**). When persistent leaf bases eventually fall or weather away or are skinned or peeled off, the trunk is actually more slender and typically not unattractively etched with diamond- or elliptic-shaped leaf scars (**Fig. 6**). Trunks are often supported at the base by a conspicuous mass of adventitious roots called a "root boss," which can extend for several feet up the trunk and is particularly well developed in *Phoenix canariensis* (**Fig. 7**) and *P. dactylifera* (**Fig. 8**). *Phoenix* spp. also tend to produce a proliferation of secondary roots called pneumatophores that can form an especially dense mat at or above the soil surface (Tomlinson 1990). These are thought to be an ecological adaptation

Figure 5. (Left) Trunks of *Phoenix* are typically rough and covered with persistent leaf bases, sometimes for many years (*P. sylvestris*).

Figure 6. (Center) When persistent leaf bases eventually fall or weather away or are skinned or peeled off, the trunk is not unattractively etched with diamond- or elliptic-shaped leaf scars (*Phoenix canariensis*).

Figure 7. (Right) Trunks of *Phoenix* are often supported at the base by a conspicuous mass of adventitious roots called a "root boss" (*P. canariensis*).

Figure 8. The "root boss" of *Phoenix dactylifera* spreads out for several feet in this well irrigated turf grass.

to aid in gas exchange in unusually wet conditions.

Leaves of *Phoenix* typically senesce and die but persist on the palm for many years until they fall away or are removed. Even if the blade falls away or is removed, though, the leaf base typically persists for many years (**Fig. 5**). The accumulation of persistent leaf bases in some species, like *P. dactylifera* and especially *P. canariensis*, forms a distinctive, swollen or enlarged structure called a "pineapple" or "ball" (**Fig. 9**). Typically the "pineapple" must be maintained for esthetic and safety reasons and arborists often artistically if not attractively sculpt or shape them (which see below under Pruning).

Phoenix spp. vary in the number of leaves they hold and annual production. *Phoenix canariensis* can hold well over 150 leaves and produce about 50 leaves annually while other species hold and annually produce fewer leaves. Leaves are induplicate, a rare feature for pinnate leaves among the palms, meaning that the "trough" formed by the v-shaped fold of each pinna is oriented toward the adaxial (upper) leaf blade surface (**Fig. 10**). Leaf bases are deeply split opposite the petiole and have fibrous-netted margins. True petioles are short or lacking but leaves have a conspicuous pseudopetiole where the proximal pinnae are modified into long, stiff, sharp spines (acanthophylls) (Barrow 1998, Dransfield et al. 2008) (**Fig. 11**). These acanthophylls, which are a dangerous menace to unwary passersby and arborists and others working in these palms, are unique and diagnostic for *Phoenix*.

Figure 11. (Center) True petioles are short or lacking in *Phoenix* but leaves have a conspicuous pseudopetiole where the proximal pinnae are modified into long, stiff, sharp spines called acanthophylls (*P. reclinata*).

Figure 12. (Upper right) Pinnae of *Phoenix* vary in their arrangement. Here they are regularly arranged and in one plane (*P. rupicola*).

Figure 13. (Lower right) Frequently pinnae of *Phoenix* are variously grouped or clustered and in several planes (*P. dactylifera* 'Medjool').

Figure 9. (Left) The accumulation of persistent leaf bases in some species, as here with *Phoenix canariensis*, forms a distinctive, swollen or enlarged structure called a "pineapple" or "ball."

Figure 10. (Right) Leaves of *Phoenix* are induplicate, a rare feature for pinnate leaves among the palms, meaning that the "trough" formed by the v-shaped fold of each pinna is oriented toward the adaxial (upper) leaf blade surface (*P. reclinata*).

Depending on the species, pinnae are regularly arranged and in one plane (**Fig. 12**) to variously grouped or clustered and in several planes (**Fig. 13**). In many species pinnae tend to be more regularly arranged and in one plane toward the distal end of the blade but tend to be arranged in groups and in several planes in the proximal portion of the blade. Pinnae are frequently covered to various degrees with a waxy glaucous bloom (**Fig. 14**) and lack a true midrib. Some species, including *P.*

Figure 14. (Left) Pinnae of *Phoenix* are frequently covered to various degrees with a waxy glaucous bloom, especially species from more arid areas (*P. dactylifera* 'Barhee').

Figure 15. (Right) Pinnae apices of *Phoenix* are typically rigid and sharp-pointed or even spine-tipped (*P. reclinata*).

adamanensis, *P. roebelenii*, *P. reclinata*, and *P. rupicola*, have white ramenta (scurfy hairs) along the midrib on the abaxial surface, a useful character for identification. Pinnae apices are typically rigid and sharp-pointed or even spine-tipped (**Fig. 15**). A layer of skin-like tissue called "haut" that forms on the adaxial surface of unexpanded leaves is another unique character of *Phoenix* but its function is unclear (Barrow 1998) (**Figs. 16-18**). Leaves can be held flat so that the plane of adaxial leaf blade surface is perpendicular to the vertical or they can twist or tilt so that the plane of the adaxial leaf blade surface is parallel to the vertical. Typically, whether leaves are flat or tilted is mostly constant within a species. For example, *P. roebelenii* (**Fig. 19**) and *P. canariensis* have leaves that are mostly held flat while *P. reclinata* and *P. rupicola* have tilted leaves. However, occasionally leaves of some individuals of *P. canariensis* are tilted (**Fig. 20**).

Staminate and pistillate inflorescences are interfoliar, branched to one order, and subtended by only one large bract (prophyll) (**Fig. 21**). *Phoenix* spp. are likely insect- and wind-pollinated (Barrow 1998). Pistillate inflorescences of most species tend to elongate considerably after pollination and when in fruit. This elongation of pistillate inflorescences is likely a protective and dispersal mechanism. Staminate flowers open and release pollen and pistillate flowers are receptive when their respective inflorescences are still short and held well within the protection against marauding birds and mammals provided by the stiff, rigid, dagger-like acanthophylls, which, however, do not significantly impede insects and wind. Although staminate

Figure 19. (Above) Leaves of *Phoenix roebelenii* are mostly held flat (note clustering habit, Lampang, Thailand).

Figure 18. (Below) "Haut" of *Phoenix reclinata* is tan colored.

Figure 16. (Left) The brown patches are a layer of skin-like tissue called "haut" that forms on the adaxial surface of unexpanded leaves and is another unique character of *Phoenix* (*P. canariensis*).

Figure 17. (Center) Pieces of "haut" are like thick paper (*Phoenix canariensis*).

Figure 20. Leaves of *Phoenix canariensis* are mostly held flat but here they are tilted (Chavez Ravine Arboretum, Elysian Park, Los Angeles, CA).

Figure 23. Most species of *Phoenix* inhabit arid or semi-arid regions where they grow near surface water (*P. canariensis*, Barranca de Gallegos, Gran Canaria, Canary Islands).

inflorescences elongate no farther, pistillate inflorescences mostly continue to elongate significantly after pollination. By the time fruits attain maturity the inflorescence has elongated sufficiently to hold the mature, ripe fruits well clear of the protective acanthophylls, making them easily accessible to potential dispersal agents like birds and mammals. Mature fruits range from greenish brown to yellow, orange, red, brown, purplish black, and black (Barrow 1998). Seeds are typically elongated and with a distinctive and diagnostic furrow running their length (Barrow 1998) (**Fig. 22**).

Figure 21. Inflorescences of *Phoenix* are interfoliar, branched to one order, and subtended by only one large bract called a prophyll (*P. dactylifera*, staminate).

Phylogeny

Recent DNA evidence has placed *Phoenix* in the Coryphoideae subfamily of palms, which is composed mostly of fan or palmate-leaved palms with mostly induplicate leaves. *Phoenix* and *Caryota* (bipinnate leaves), *Arenga*, and *Wallichia* are the only non-palmate-leaved genera in the Coryphoideae. Surprisingly, *Phoenix* is more closely related to common and well known fan palms like *Brahea*, *Chamaerops*, *Livistona*, *Rhapis*, *Trachycarpus*, and *Washingtonia* among many others than to most pinnate-leaved palms. The induplicate, pinnate leaves of *Phoenix* are a feature shared only with *Arenga*, *Caryota*, and *Wallichia*. However, induplicate leaves in these latter three genera arise from a different mode of development and these genera are amply distinct in their jaggedly toothed pinnae tips and hapaxanthic flowering model (trunks die after flowering).

Figure 22. Seeds of *Phoenix* are typically elongated and with a distinctive and diagnostic furrow running their length (clock-wise, upper left: *P. canariensis*, *P. dactylifera* 'Khadrawy', *P. dactylifera* 'Medjool', *P. reclinata*, *P. rupicola*).

Distribution

From the west to the east *Phoenix* ranges from the Cape Verde and Canary Islands in the Atlantic Ocean across nearly all of Africa to Madagascar, Crete, Turkey, the Middle East, the Indian subcontinent, Southeast Asia, Malaya, Sumatra, southern China, Taiwan, and the Philippines (Barrow 1998, Dransfield et al. 2008).

Ecology

Phoenix spp. occur in a variety of habitats across their wide range. Most species inhabit arid or semi-arid regions where they grow near surface water (seeps, springs, oases) or underground water (Barrow 1998, Dransfield et al. 2008) (**Fig. 23**). Indeed, in these regions the palms are reliable indicators of ground water (Barrow 1998). However, some

Figure 24. Some species of *Phoenix* inhabit moister or even wet environments, including monsoon forest (*P. loureiroi*, Kanchanaburi, Thailand)

species inhabit moister or even wet environments, including pine forest, monsoon forest (**Fig. 24**), estuarine mangrove swamp forest (*Phoenix paludosa*, mangrove or swamp date palm), and rain forest. One species, *P. roebelenii*, is a rheophyte, a plant that is restricted to moving water where it might occasionally be submerged (Barrow 1998, Hodel 1995, Dransfield et al. 2008). The genus ranges from sea level to 6,500 feet elevation (Barrow1998).

The arid or semiarid habitats of many *Phoenix* perhaps have played a role in leaf blade anatomy, especially in the position of the palisade layer of cells and abundance and position of stomata. In transverse section palm leaf blade tissue is either isolateral (symmetrical) or dorsiventral (asymmetrical) (Tomlinson 1961). In isolateral leaf blades the palisade cell layers are identical and stomata equally abundant on adaxial and abaxial surfaces. In dorsiventral leaf blades the palisade cell layer is more clearly defined on the adaxial surface and stomata more abundant on the abaxial surface. In the palm family isolateral leaf blades are nearly entirely restricted to the Coryphoideae sub family, which includes *Phoenix*, where its presence appears correlated to arid habitats (Barrow 1998). Leaf blade symmetry varies not only among genera but within a genus. Most *Phoenix* are from arid or semiarid environments and have isolateral leaf blades but four species, including *P. adamanensis*, *P. paludosa*, *P. roebelenii*, and *P. rupicola*, are from moist or wet habitats and have dorsiventral leaf blades (Barrow 1998).

Invasive species risk

Because of their colorful, often tasty fruits, which are attractive to potential dispersers, and tolerance of semi-arid conditions, the potential for *Phoenix* to become invasive is probably high. Indeed, *P. canariensis* seedlings and plants abound in unkempt and abandoned places and natural areas like streams, ravines, and flood control channels in or adjacent to urban areas throughout the coastal plains and valleys of southern California (**Fig. 25**). It is actually listed as an official invasive species of California and its use near the coast is restricted. In Hawai'i, *P. sylvestris* has naturalized in many areas, especially windward and north-shore O'ahu (Hodel 2012b) (**Fig. 26**). One would think that its dioecious nature would preclude or at least limit fruit (and seed) development and, thus, invasiveness but the easily wind-blown pollen and ease of hybridization make even isolated pistillate plants sources of potentially dispersible fruits. Thus, the invasiveness of *Phoenix* should be a criterion when considering its use in a landscape. Judicious, early removal of inflorescences would be effective in reducing the invasive risk of *Phoenix*.

Economic and landscape uses

Phoenix is immensely important

Figure 25. (Left) *Phoenix canariensis* seedlings and plants are sometime frequent in unkempt and abandoned places and natural areas like streams, ravines, and flood control channels in or adjacent to urban areas throughout the coastal plains and valleys of southern California (Vista, CA).

Figure 26. (Right) In Hawai'i *Phoenix sylvestris* has naturalized in many areas, especially windward and north-shore O'ahu, as here at Hale'iwa.

Figure 27. The date industry in the United States, which is centered in California's Coachella Valley, has been a reliable source of uniform and relatively inexpensive palms for landscape use over the last 30 years (*Phoenix dactylifera* 'Halawy', Desert Center, CA).

economically, providing food (dates, starch, and sugar); clothing (fiber for weaving); thatch; trunks, petioles, and rachises for construction and fencing; animal feed; fuel; and landscape ornament (Hodel 1995, Barrow 1998). The date industry in the United States, which is centered in California's Coachella Valley, has seen more or less stable production and bearing acreage over the last 30 years although the sale of mature date palms for landscape use has been a new development during this time (Hodel and Johnson 2007) **(Fig. 27)**. Iraq is till the world's largest producer of dates despite years of war and unrest. In their native ranges *P. dactylifera* and especially *P. sylvestris* in India are tapped for the sugary sap from inflorescences and trunks, which is fermented into an alcoholic beverage called toddy or cooked into sugar cakes. Trees tapped for toddy have characteristic zigzag scars on their trunks and one palm can produce one to five gallons of sap per day (Hodel 1995).

Of most concern to us, though, is the landscape use of *Phoenix*, which includes some of our most regal, elegant, and ornamental palms. Often unfairly maligned and frequently discounted, *Phoenix* palms can fill just about every landscape need and use. Because of a plentiful supply in the date orchards of California, *P. dactylifera* is the most readily available large species while *P. canariensis* is the most massive and stately. Both are large, tall palms and excellent as background subjects and specimens for parks, shopping centers, expansive plazas, and other large, open spaces, against buildings, or in mass plantings, especially lining avenues and boulevards in grand style (**Figs. 28-29**).

In contrast to the large, often overbearing species, there are several small, short, or nearly trunkless species, like *Phoenix roebelenii*, *P. loureiroi*, *P. paludosa*, and *P. acaulis*) that find use as foreground plants, informal hedges, small screens, borders, potted subjects, and tropical accents for our ever-diminishing small yards, residences, and other limited-space landscapes.

Intermediate-sized species, which are well suited for larger homes or smaller parks and buildings, include the clustering *Phoenix reclinata* and the solitary *P. rupicola*, the latter being arguably the most elegant and refined of the *Phoenix* (**Fig. 30**). They fill the same uses as the larger species but are simply smaller in scale.

Other than some of the more delicate, small-growing species, *Phoenix* spp. are palms to admire from a distance. Up close the mostly rough trunks and coarse leaves with dagger-like acanthophylls can give plants a harsh, unkempt appearance. They are not palms to hug although I would not hesitate to lavish such affection on a king palm (*Archontophoenix cunninghamiana*) or kentia palm (*Howea forsteriana*). The dagger-like acanthophylls are lethal weapons, instantly piercing skin and flesh to the bone of the careless admirer, worker, or innocent passerby. Some of this harshness and hazardness can be mitigated or eliminated by judicious and neat pruning of leaves, leaf bases, and acanthophylls.

Keep in mind the ultimate size of the larger *Phoenix* spp. They actu-

Figure 28. (Left) *Phoenix canariensis* is a large, tall palm, excellent lining avenues and boulevards in grand style (Stadium Way, Elysian Park, Los Angeles, CA).

Figure 29. (Right) This unidentified but well grown variety of *Phoenix dactylifera* makes a statement (11999 Harbor Blvd., Garden Grove, CA).

Figure 30. *Phoenix rupicola* is arguably the most elegant and refined of the date palms (2200 W. Holt Ave., Pomona, CA).

ally look perfectly harmless as small palms but several years' growth can turn them into virtual monsters of heroic proportions. The sheer size and mass of *P. canariensis*, for example, make it particularly inappropriate for typical residential yards and other small spaces. I have seen it as a massive giant with a 45-foot canopy spread devouring an entire front yard, completely overpowering and dominating the barely visible, cowering house behind it. This species is a palm best suited to expansive places and situations where it can be admired without living in its dominating and menacing shadow.

Cultivation and landscape management

Phoenix spp. are mostly hardy, tough, durable palms that withstand wind, heat, aridity, and dust. The species from arid and semi-arid places require little or no irrigation once established in coastal plains and valleys of California although they would need regular irrigation in the desert Southwest and dry, leeward areas of Hawai'i. All do best in full sun except *P. roebelenii*, which does best with filtered light, especially during the hottest part of the day and in the hot interior valleys and deserts.

Cold tolerance might be an issue with some species in some locations. The most cold tolerant are *Phoenix canariensis*, *P. dactylifera*, and, depending on provenance, *P. loureiroi* and *P. sylvestris*, which likely tolerate temperatures into the low 20s F before showing damage. Temperatures in the mid 20s F will likely damage *P. rupicola* while *P. reclinata* and *P. roebelenii* might sustain damage in the high 20s F or even about 30 F. The most cold intolerant species is likely *P. paludosa* but it is rarely cultivated, especially in California, so experience with it is limited.

Phoenix spp. normally will have full, spherical canopies of leaves, with nearly as many green leaves in the lower hemisphere as in the upper hemisphere, when growing in a healthy, vigorous condition. Premature yellowing or browning of lower leaves and leaf tip chlorosis and necrosis usually indicate a stressed palm and cultivation problems. Similarly,

Figure 32. From a distance yellow or yellow-orange older leaves usually indicate magnesium deficiency (*Phoenix canariensis*).

Figure 31. Potassium deficiency initially appears as orange or yellow flecking on older leaves (*Phoenix canariensis*).

a palm with a consistently reduced canopy of green leaves, where lower, brown leaves have been judiciously removed for esthetic reasons, likely has disease or other problems.

Nutrition

Like most palms, *Phoenix* spp. require relatively large amounts of nitrogen, potassium, and magnesium. They are among the palms most susceptible to deficiencies of potassium and magnesium, and specimens deficient in one or both of these elements are frequent in southern California. Symptoms of potassium and magnesium deficiencies appear first around the perimeter of older leaves but then can progress to leaves higher up in the canopy. Potassium deficiency appears as orange or yellow flecking (**Fig. 31**) while magnesium deficiency appears as a distinct yellow area or band around the perimeter of an otherwise green leaf blade (**Figs. 32-33**). Deficiency symptoms of these two elements are more frequent in turf areas where frequent irrigation and a high nitrogen fertilizer have been routinely applied with little attention given to potas-

Figure 33. Up close magnesium deficiency appears as a distinct yellow area or band around the perimeter of an otherwise green leaf blade (*Phoenix reclinata*).

sium and magnesium. Also, palms heavily laden with fruits tend to show deficiencies of these two elements. In desert areas boron deficiency is sometimes seen on *P. dactylifera*. Symptoms typically appear on newest leaves and include unopened or unevenly opened leaves (**Fig. 34**), and "accordion-", "zigzag-", and "hook-" leaf (Hodel 2012a). The regular use of a controlled-release, palm-special fertilizer, applications of mulch, and appropriate irrigation will reduce or eliminate nutritional problems.

Diseases

The most serious diseases of *Phoenix* are Fusarium wilt and sudden crown drop (Hodel 2012a). *Fusarium oxysporum*, the fungal pathogen that causes Fusarium wilt, is mostly host-species specific, and the form present in California [*F. oxysporum* f. sp. *canariensis* (FOC)] has attacked only *P. canariensis* in the landscape. However, in a study at the University of California South Coast Research and Extension Center in Irvine, my colleagues and I were able to infect *P. reclinata* and *Washingtonia filifera* with FOC. However, we have never observed these latter two species attacked in the landscape yet there have likely been ample opportunities for them to become infected because all three species frequently are present together.

Symptoms of Fusarium wilt, which is a vascular wilt disease, typically appear on older, lower leaves first; they rarely appear first in mid-canopy or higher. These leaves turn prematurely brown and wilt, leaving a thrifty-looking canopy with green leaves in the upper part and an unusually high number of dead, brown leaves in the lower part of the canopy (**Fig. 35**). Close inspection shows that leaves in the process of turning brown have pinnae on one side of the blade turning brown while those on the opposite side are still green (**Fig. 36**). Brown or black exterior streaking along the rachis and petiole is typically present. A transverse section of such a rachis or petiole would show dark vascular discoloration nearly always associated with a pink blush (**Fig. 37**). Plants of *Phoenix canariensis* that are always pruned up, have most of the lower or older leaves removed, and have a shaving-brush-like canopy, especially in highly maintained landscapes,

Figure 36. With *Phoenix canariensis* infected with Fusarium wilt leaves in the process of turning green to brown typically show one-sided death.

Figure 34. (Left) In desert areas boron deficiency is sometimes seen on *Phoenix dactylifera* and one of the symptoms is unopened or unevenly opened leaves.

Figure 35. (Right) Symptoms of Fusarium wilt of *Phoenix canariensis* typically appear on older, lower leaves first and these leaves turn prematurely brown and wilt, leaving a thrifty-looking canopy with green leaves in the upper part and an unusually high number of dead, brown leaves in the lower part of the canopy.

Figure 37. Transverse sections of leaves of Phoenix canariensis with one-sided death due to Fusarium wilt show vascular discoloration and a pink blush.

likely have Fusarium wilt because the older, lower symptomatic leaves have been removed for esthetic reasons.

There is no cure for Fusarium wilt; thus, prevention through exclusion is critical. Fusarium wilt spreads primarily on pruning tools, especially chainsaws that cannot be adequately cleaned. Movement of soil or water from around infected trees can also spread the pathogen. Thus, do not use a chainsaw to prune *Phoenix*; use a straight-edged manual or power-reciprocating saw and thoroughly brush clean the blade and then disinfect it before use on each palm by heat from a hand-held torch or soaking the blade for five minutes in a 50 percent solution of household bleach. Also, because the pathogen can remain active in the soil for at least 25 years, do not replant with another *P. canariensis* in the same location where one died from Fusarium wilt. At this time *P. dactylifera* seems completely resistant to the disease so it would be a suitable replacement species, especially staminate plants because they are more robust and have heavier canopies, making them more similar to *P. canariensis* in habit than the named, pistillate varieties (which see below under *P. dactylifera*) (Note: there is a form of *Fusarium oxysporum* that attacks *P. dactylifera* but it is confined to Africa and the Middle East and is not present in the Americas). Because of the nature of the disease and how in infects and moves within the palm, it is also impossible to certify that a specimen of *P. canariensis* is free of Fusarium wilt. Typically palms of *P. canariensis* that have never been pruned are much less likely to have Fusarium wilt while palms that have a history of regular pruning are more likely to have the disease.

The other disease, sudden crown drop, also primarily attacks *Phoenix canariensis* but has been reported on other *Phoenix*, like *P. dactylifera*, and other palms as well (Hodel 2012a). In this disease a healthy crown or canopy with several feet of trunk abruptly falls off the palm with no warning (**Figs. 38-39**). Internal decay, which is not visible externally because of an intact and otherwise normal and healthy-appearing pseudobark, is extensive at the point of trunk failure (**Fig. 40**). As the decay spreads sufficient tissue remains intact to maintain a normal, healthy-appearing canopy but as decay progresses the healthy tissue becomes insufficient to maintain structural stability and the trunk fails. The fungus *Thielaviopsis paradoxa* is frequently associated with this disease and is the likely causal agent.

Figure 40. Internal decay, which is not visible externally because of an intact and otherwise normal and healthy-appearing pseudobark, is extensive at the point of trunk failure in sudden crown drop (*Phoenix canariensis*).

Like Fusarium wilt, there is no cure for sudden crown drop and, thus, prevention and detection are critical. It is thought that chainsaws play a primary role in sudden crown drop through creation of wounds and possibly spread of the pathogen. Avoid use of chainsaws to sculpt and shape "pineapples" and skin or peel trunks because they are a powerful

Figure 38. (Left) In sudden crown drop a healthy crown or canopy with several feet of trunk abruptly falls off the palm with no warning, leaving a bare, upright trunk (*Phoenix canariensis*).

Figure 39. (Below) A healthy but heavy crown or canopy with several feet of trunk abruptly falling off the palm with no warning indicates sudden crown drop (*Phoenix canariensis*).

Figure 41. Sounding the trunk of *Phoenix canariensis* by striking it sharply with a heavy, sturdy stick can detect decayed areas not visible externally.

tool and in the hands of an overzealous worker they can inflict extensive damage to the trunk, creating gaping wounds through the pseudobark and cortex and even deep into the central cylinder. Large *Phoenix*, especially *P. canariensis*, in high-target areas and with a history of chainsaw use to prune leaves and inflorescences, sculpt "pineapples," and peel trunks, should be sounded annually to check for decay. The most likely area of the trunk that could fail and that should be a priority for sounding is the distal (upper) portion within 10 feet of the canopy, especially if this area shows evidence of chainsaw use (peeled trunks) and/or constrictions (hourglassing). The distal part of the trunk is also naturally the weakest because tissues have not yet attained maximum strength. Using a heavy stick sharply strike the trunk (**Fig. 41**). A solid, sharp but rich and resonating sound indicates healthy tissue while a dull thud indicates potentially decayed tissue. Carefully probe areas with potentially decayed tissue to determine extent of decay, if any, and then make a hazard assessment.

Minor fungal diseases of *Phoenix* include various rachis and petiole blights (caused by several pathogens including *Cocoicola*, *Dothiorella, Pestalotiopsis,* and *Serenomyces*) (**Fig. 42**), pink rot (**Fig. 43**), and Graphiola leaf spot (on *P. canariensis*, especially on palms near the coast where cooler, more humid conditions favor disease development) (**Fig. 44**) (Hodel 2012a). While these diseases can unattractively darken a petiole or rachis or make light spots on pinnae, they are typically more of a nuisance and are not a serious threat to the palm. Proper cultivation, including irrigation, nutrition, and mulch, is the best management strategy to prevent and treat these diseases. The rachis and petiole blights can sometimes cause one-sided death of leaves that could be mistaken for Fusarium wilt; however, with these minor diseases only one or two leaves in the canopy will be affected whereas with Fusarium wilt many leaves in the canopy will be affected. The fungus *Diplodia* can sometimes kill the apical meristem of trunks, especially *P. reclinata*, but it is a rare occurrence (**Fig. 45**). Again, the best solution is to provide proper cultivation.

Figure 45. While uncommon the fungus *Diplodia* can sometimes kill the apical meristem of trunks, especially *Phoenix reclinata*.

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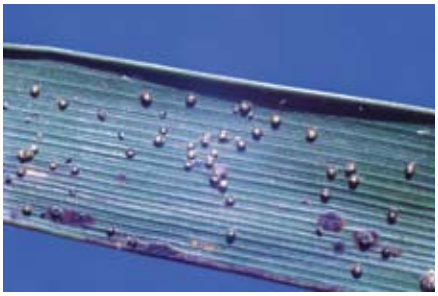
Figure 42. (Left) Minor fungal diseases of *Phoenix* include various rachis and petiole blights (*P. canariensis*).

Figure 43. (Center) Pink rot can attack most parts of the palm but is common on the leaves (*Phoenix canariensis*).

Figure 44. (Right) Graphiola leaf spot is not uncommon on *Phoenix canariensis* growing in humid conditions near the coast. The disease causes leaf spotting and the pathogen produces these small, tan fruiting bodies.



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