duced in the 19th Century and very early 20th Century. They are usually highly resistant to black spot and powdery mildew. They are also well-adapted to high temperatures, humidity, and rain. They make large bushes with relatively few trunks arising from the bud union. Flowers are large, usually quite double, and are borne singly or in small clusters. Tea roses should be pruned only in the spring, and then, as little as possible.

Chinas. The China roses, descendents of *R. chinensis*, are similar to the Teas in their excellent disease resistance. They make dense, twiggy bushes, with clusters of smaller, less double flowers than the Teas. Many of the China roses will grow well on their own roots, although plants grafted to 'Fortuniana' may be more vigorous and productive.

Noisettes. This class originated in Charleston, South Carolina, in the 19th Century, from a cross between a China rose and the musk rose (*R. moschata*). Later, they were crossed with Tea roses. So the early cultivars tend to be large shrubs with clusters of small flowers; more recent cultivars tend to behave as climbers, and they usually have larger flowers, borne in smaller clusters. While the class is diverse, most varieties are highly disease-resistant.

Bourbons. Many members of this class could not be considered to be low-maintenance types in Florida, in that they are susceptible to black spot and/or powdery mildew. But there are a few members of the group which are disease-resistant.

Conclusions

Growing roses in Florida is different from other areas of the United States, but one can be successful by following a few rules:

- Purchase appropriate scion varieties—disease resistant and heat-tolerant.
- Unless a variety is known to do well on its own roots, buy plants grafted to 'Fortuniana' rootstock. On alkaline soils, 'Fun Jwan Lo' rootstock is recommended.
- Water and fertilize adequately.

Literature Cited

McFadden, S. E. 1956. Comparison of 'Happiness' rose production on four rootstocks. Proc. Fla. State Hort. Soc. 69:368-370.

McFadden, S. E. 1962. *Rosa fortuneana* compared with other rose rootstocks grown in Florida. Proc. Fla. State Hort. Soc. 75:497-500.

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PHYTOPHTHORA BUD-ROT OF PALMS IN SOUTH FLORIDA

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Abstract. **Phytophthora bud rot is one of the more common diseases encountered in palms in wet tropical climates. In Florida more than 30 palm species are known to be susceptible, in addition to more than 30 non-palm species. The causal organism is *Phytophthora palmivora*, a soil-borne fungus in the water-mold group. Synonyms include *P. faberi* and *P. theobromae*. It occurs naturally in South Florida, and can be spread in soil, on gardening tools and equipment, on plants, and probably in storm water. The symptoms, in order of occurrence, include 1. the bud only falls over, 2. the bud has a foul odor, 3. the spear-leaf rots at the base, and 4. is easy to pull out, 5. the oldest fronds look OK, even after the bud has rotted, 6. the oldest fronds turn yellow, then brown, then collapse, and finally, 7. they fall off on their own. If these symptoms are noticed, specimens should be brought to a Plant Disease Diagnostic Clinic for confirmation of the cause. Symptomatic palms probably cannot be saved, but adjacent asymptomatic palms can be treated with Aliette, Banrot, or Subdue as directed on the label, and have a good chance of surviving.**

Diseases caused by *Phytophthora* species on various palms include seedling blights and damping-off; trunk, crown and root rots; leaf spots, blights, and petiole rots; nut drop; and apical, bud, or heart rot followed by death of the plant. This paper covers only Phytophthora bud rot of mature palms. Other fungal species have been reported to cause bud rots in palms, often as secondary infections in the last stages of disease development, just before death. These include *Botryodiplodia, Chalara* (*Thielaviopsis*), *Colletotrichum*, and *Fusarium*. *Phytophthora* bud rot is one of the more common diseases encountered in palms in wet tropical climates. Palm species which are reported to be susceptible to *Phytophthora* are listed in Table 1. Other susceptible species are listed in Table 2.

Causal Organism. Probably the most common species of *Phytophthora* causing diseases of palms is *P. palmivora*. Synonyms include *P. faberi* and *P. theobromae*. This is a soil-borne fungus in the water-mold group. It occurs naturally in South Florida, and can be spread in soil, on gardening tools and equipment, on plants, and probably in storm water. The fungus enters the palm through wounds, and causes the disintegration of the bud or growing point at the top of the palm.

Occurrence. *Phytophthora palmivora* is distributed worldwide in tropical and warm temperate regions with high rain-

Table 1. List of palm species reported to be susceptible to *Phytophthora* (Alfieri et al., 1994; Chase and Broschat, 1991; Meerow, 1994).

Archontophoenix alexandrae	Alexander palm	*Elaeis guineensis*	African oil palm
Arenga spp.	Dwarf sugar palm	*Howea forsterana*	Kentia palm
Borassus flabellifer	Lontar palm	*Livistona rotundifolia*	round leaf fan palm
Brahea armata	blue hesper palm	*Neodypsis decaryi*	triangle palm
Brahea edulis	Guadalupe palm	*Normanbya normanbi*	Queensland black palm
Butia capitata	pindo palm	*Pinanga insignis*	
Chamaerops humilis	European fan palm	*Phoenix canariensis*	Canary Island date
Carpentaria spp.	Carpenteria palms	*Ptychosperma macarthuri*	MacArthur palm
Chamaedorea elegans	parlor palm	*Rhopalostylis* spp.	shaving brush palm
C. erupens	bamboo palm	*Roystonea elata, R. regia*	Florida, Cuban royal palm
C. seifrizii	reed palm	*Sabal* spp.	Cabbage/palmetto palm
Chrysalidocarpus lutescens	Areca palm	*Syagrus romanzoffiana*	queen palm
Coccothrinax argentata	silver palm	*Trachycarpus fortunei*	windmill palm
C. crinita	old man palm	*Trythrinax acanthocoma*	spiny fiber palm
Cocos nucifera	coconut palm	*Washingtonia filifera, W. robusta*	petticoat palm, Washington/Mexican fan palm

Table 2. List of species (excluding palms) reported to be susceptible to *Phytophthora* (Alfieri et al., 1994; Chase and Broschat, 1991; Meerow, 1994).

Acer rubrum	red maple	*Ficus benjamina*	weeping fig
Ardisia spp.	coral- and marl-berry	*F. carica*	edible fig
Beaucarnea recurvata	ponytail palm	*Hedera canariensis, H. helix*	Algerian, English ivy
Buxus microphylla	little-leaf boxwood	*Illicium* spp.	anise
Carica papaya	papaya	*Lagerstroemia indica*	crepe myrtle
Carissa spp.	Natal plum	*Liriope* spp.	lily turf
Catharanthus roseus	periwinkle	*Morrenia odorata*	latex/strangler vine
Cattleya spp.	orchid	*Peperomia obtisifolius*	peperomia
Citrus aurantium	sour orange	*Persea americana*	avocado
C. x paradisi	grapefruit	*P. borbonia*	red bay
C. sinensis	sweet orange	*Philodendron scandans oxycardium*	Philodendron
Cornus florida	flowering dogwood	*Photinia* spp.	redleaf photinia
Cucurbita pepo	cucumber	*Pittosporum tobira*	mock-orange
Dieffenbachia spp.	dumb-cane	*Poncirus trifoliata*	wild orange
Dracaena reflexa	reflexed dracena	*Syzigium paniculatum*	brush cherry
Epipremnum aureum	golden pothos		

fall. The fungus is most active during the warm, moist part of the year. In Florida it shows up in the spring and summer, but may also be reported during our cooler, drier winter, especially at sites where it was active earlier, but not noticed until winter.

Symptoms and Diagnosis. By the time the symptoms are noticed, it is probably too late to save the infected palm. However, it is important to diagnose the problem as quickly as possible in order to take steps to save other susceptible palms in the planting. The symptoms to watch for, in the order in which they usually occur, include the following. 1. the *bud only* falls over, 2. the bud has a foul odor, 3. the spear-leaf rots at the base, and 4. is easy to pull out, 5. the oldest fronds look OK, even after the bud has rotted, 6. the oldest fronds turn yellow, then brown, then collapse, and finally, 7. they fall off on their own. If these symptoms are noticed, specimens should be brought to a Plant Disease Diagnostic Clinic for confirmation of the cause. Pull out the spear-leaf or cut off the top of the palm. (The infected plant will die even if you don't cut off the top. Your efforts are aimed at protecting asymptomatic plants.) It is best to bring in the specimen as soon as the symptoms are noticed. As plants die from any cause, opportunistic organisms may invade the tissues. This can lead to an incorrect diagnosis of the cause of death.

Chemical Control. Earlier published recommendations (Meerow, 1994) stated that good control of *Phytophthora* could be accomplished by a soil drench or a foliar spray of appropriate chemicals (see Table 3). (Foliar applications will translocate to the roots, and soil drenches will reduce populations of the fungus in the root zone.) Since the immediate problem involves the infection and possible death of the bud, thus the whole plant, it would be better to drench the bud and spray the foliage. In addition, all asymptomatic palms in the vicinity should be treated. The stumps of palms which have not been removed and which are suspected of having died from *Phytophthora* infection should also be treated.

Prevention and Treatment. If you suspect that a palm in your care is infected with *Phytophthora*, what should you do? And what do you tell the owner? The following suggestions may be useful in treating infected palms and suppressing spread of the pathogen to healthy palms in the vicinity. 1. Submit a specimen to a Plant Disease Diagnostic Clinic for confirmation.

Table 3. Fungicides, frequency of appl, and method of appl recommended for treating *Phytophthora*.

fungicide:	**Aliette** (fosetyl aluminum)
rate:	follow label directions
frequency:	every 3 months for one season
method of appl:	can be applied foliar, root dip, drench, trunk spray or paint, and chemigation
fungicide:	**Banrot** (ethazol + thiophanate methyl)
rate:	follow label directions
frequency:	2 applications, 6 months apart
method of appl:	apply as a drench
fungicide:	**Subdue** (metalaxyl)
rate:	follow label directions
frequency:	2 applications, 6 months apart
method of appl:	can be applied foliar, root dip, drench, trunk spray, and chemigation

2. Treat palms showing symptoms by spraying the leaves and drenching the bud. Such palms may or may not benefit from treatment. 3. Treat susceptible palms in the landscape. 4. Treat other susceptible species in the landscape. 5. Treat the stumps of palms which have not been removed, and which are suspected of having died of *Phytophthora* infection. 6. Remove infected nursery stock, potted or field plants, as soon as possible. 7. Destroy all above-ground parts of landscape palms killed by *Phytophthora. Do not chip* and *do not use* as a mulch. 8. Do not leave dead palms in the landscape. This could result in spread of the spores. 9. Any palms later transplanted to the site should be treated to suppress infection through roots damaged in transplanting. 10. Re-treat all plants as in Table 3. 11. Avoid injury to the trunks or roots of all palms.

Literature Cited

Alfieri, S. A., Jr., et al. 1994. Diseases and disorders of plants in Florida. Bull. no. 14. Florida Dept. Agriculture and Consumer Ser. 1114 pp.

Chase, A. R. and T. K. Broschat. (eds.). 1991. Diseases and disorders of ornamental palms. American Phytopath. Soc. Press, St. Paul. pp. 21-24.

Meerow, A. W. 1994. Betrock's guide to landscape palms. Betrock Information Systems, Hollywood, FL. pp. 129 and 133.

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THE HISTORY AND MANAGEMENT OF LETHAL YELLOWING IN COLLIER COUNTY

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Abstract. **Lethal Yellowing (LY) is a deadly (mycoplasmlike organism) disease that kills coconut and thirty-six other known species of palms. The list of susceptible palms continues to grow every year as more research is conducted. LY first appeared in Collier County in October 1974 and again in 1980 and 1989. Through aggressive educational programs and inoculations of oxytetracycline, the LY disease was suppressed. A fourth infestation was identified in January 1998 as result of the annual county Medflight helicopter survey of palms. Perimeters of inoculations have been established, plus aerial and ground surveys are being conducted every three months. Collier County and the City of Naples harbor the largest remaining population of 'Jamaican Tall' coconuts in Florida. The success of managing the LY disease is a direct result of partnership established between Collier County and City of Naples governments in 1974.**

History of Lethal Yellowing in Collier County

Southwest Florida is geographically located in a sub-tropical climatic zone. The coastal regions of Collier County, Naples, and Marco Island harbor the largest remaining population of 'Jamaican Tall' coconut palms in Florida. An estimated 80,000 coconut palms are growing in Collier County.

The Lethal Yellowing (LY) of coconut palms (*Cocos mucifera* L) first appeared in Key West in 1956. Within three years, 75% of the coconut palms were killed. By 1971, the disease had spread from the Florida Keys to South Miami. LY killed an estimated 95% of the coconut palms in the greater Miami area in seven years (Donselman, 1978). In October of 1974, three cases of LY were identified in Naples, three on Marco Island, and one in East Naples of Collier County. Two more LY palms were confirmed in Naples during the following several weeks from ground surveys.

Shortly after LY appeared on main land Florida, mycoplasmlike organisms were observed through electron microscope research. This led to chemo therapy tests, resulting in the use of the antibiotic oxytetracycline hydrochloride for palm treatment (McCoy, 1972). Collier County became a good model for testing the effectiveness of an inoculation program supported by local government agencies.

The Florida Department of Agriculture's Bureau of Pest Eradication and Control provided the leadership in educating the public, training government employees in inoculation techniques, and performing the one hundred yard radius buffer inoculations adjacent to known LY cases. The Collier County Commission and the City of Naples Council appropriated funds for antibiotics and ordinances requiring diseased palms to be removed and disposed of by burial. Inoculations were mandatory and the program was managed by the Collier County Extension office. After four years of inoculations and no new LY case, the Collier County Commission decided to suspend the mandatory inoculations.

The next out break of LY disease occurred in March 1980 in Naples. Three coconut palms were identified and immediately removed. One hundred yard radius buffers were established in which coconuts received a triple dose (three grams) of oxytetracycline. The City of Naples inoculated all other city owned coconut palms (3,500) with the single dose of antibiotic every four months (McCoy, 1974). The inoculation of private palms was not mandatory. However, through good public information and education of home owner associations, the majority of the coconut palms were inoculated. The inoculation program continued for three years with no new LY cases appearing. Once again the inoculations were suspended and no new LY cases appeared until 1991.

Interestingly, Lee County, north of Collier County, had several cases of LY show up near Ft. Myers Beach in 1987. The Lee County Commission decided not to fund buffer zone inoculations and publicly announced that people should inoculate their palms but that it was not mandatory. The City of