

The Menace of Lethal Yellowing to Florida Palms

M. V. PARTHASARATHY AND J. B. FISHER

*Section of Genetics, Development, and Physiology, Cornell University, Ithaca, New York
and Fairchild Tropical Garden, Miami, Florida*

Palm trees are such a regular part of the Florida landscape that it is difficult to imagine a southern Florida landscape denuded of its picturesque palms. Yet, thanks to the lethal yellowing disease, such a possibility may be closer to reality than many people think. Most residents of Miami are already familiar with the deadly disease that has affected thousands of coconut trees in Dade County. In addition to rendering the landscape of southern Florida bleak, the disease can be expected to lessen property values by millions of dollars since replacement can cost \$100 or more per tree. Furthermore, removal of the dead or diseased palms can cost \$25 to \$75 per palm! In countries such as Jamaica where coconut products play an important role in the national economy, the disease has been particularly disastrous.

Although most Floridians may now be aware of the lethal yellowing of coconut palms, particularly the 'Jamaican Tall' variety, and the efforts of the Florida Department of Agriculture to control the disease, they may not be aware of the apparent spread of the disease to two other palms—the popular Christmas palm (*Veitchia merrillii*) and the lovely fan palm, *Pritchardia pacifica*. Many of the roads in Dade County that are decorated by avenues of these graceful palms may soon become desolate if the disease spreads. The taller *Pritchardia pacifica* appears to be more sus-

ceptible to lethal yellowing than the shorter *Pritchardia thurstonii*, a species that is also popular for roadside plantings. It is obvious that the apparent spread of lethal yellowing disease to two additional genera of palms from different subfamilies has far reaching implications for Florida palms in general.

The diseased pritchardias and veitchias exhibit symptoms that are somewhat similar to those of coconut trees affected by lethal yellowing. However, recognition of the symptoms, particularly during the early stages of the disease, is more difficult in the pritchardias and veitchias, especially since these species have not been as well observed during their stages of infection as the coconut. The first obvious symptom of the disease in an affected pritchardia is the dying of the older leaves. Discoloration can be in patches or uniform throughout the leaf. Except for the dying or yellowing of the older leaves, the tree at an early stage of infection appears healthy (Figs. 1A, B). If the tree is felled at this stage and the crown is dissected (Fig. 2), it will be seen that the tips of some unexposed inflorescences are darkened or deep brown instead of the normal pale yellow color (Fig. 3). Often these discolored tips are described as "black," but truly black tissue is usually related to physical injury, as after leaf trimming. As the disease advances, the older leaves turn brown and collapse and the younger ones begin to turn



1. *Pritchardia pacifica*. A, Crown of *Pritchardia pacifica* at an early stage of the disease. The palm looks healthy in this picture, but several of the older leaves had turned yellow-green. Some persistent dried leaves are also present. B, Same palm as in A being felled for dissection and

yellow. Inflorescences that expand at this stage of infection usually have flowers that are rust-brown and/or aborted. At this stage of the disease, the bud starts to rot from secondary infection by bacteria and the palm definitely looks sickly (Fig. 1C). Within a week or two, the bud is completely rotted and all that is left of the once graceful palm is the depressing sight of a stump with a few dried leaves (Fig. 1D).

The early stages of the disease are even more difficult to detect in *Veitchia merrillii* than in the pritchardias. The discoloration of older leaves is not as dramatic as in the coconut palm or as evident as in the pritchardias. The first clear symptom of the disease is usually the brownish "water marks" of older leaves along the margin of the pinnae or "water-soaked" streaks on the pinnae. Fruits and older inflorescences tend



2. The crown is being cut from the felled tree for dissection and subsequent investigation in the laboratory.

←

investigation of the crown. The shorter fan palms (arrow) are *Pritchardia thurstonii* that appear to be more resistant to the disease. C, A more advanced stage of the disease than indicated in A. The palm definitely looks sickly. Bud rot had begun in this particular tree. D, Healthy and diseased pritchardias by the roadside in southwest Miami. The disease has killed two palms. Arrow indicates one of many coconut trees in this area that are dying from lethal yellowing.



3. Unexpanded inflorescences of the diseased pritchardia palm shown in Figures 1A and B. The flowers in the distal part of one of the inflorescences (a) has turned black while almost all the flowers in an adjoining inflorescence (b) have become black (white arrows). The rest of the inflorescences appear to be healthy except for two that have a few isolated, blackened flowers (black arrows). Mycoplasma-like microorganisms have recently been found in the phloem of inflorescence a.

to drop off prematurely as in coconut. At this stage the older leaves, which may or may not turn yellow-brown, tend to break easily at the junction of the sheathing leaf-base and the midrib (Fig. 4A) and younger fronds tend to break within the lower region of the pinnae. Unexpanded inflorescences often have a distorted or twisted appearance (Fig. 5). Although inflorescences had not darkened in the three veitchias we examined, inflorescences have been known to darken in other individuals. As in the diseased pritchardias, bud rot follows, and soon there is nothing left but the stump as a grim reminder (Fig. 4Bb). Pritchardias and veitchias growing in the southwest Miami area appear

to be most severely affected by the disease, although a more thorough survey is needed to clarify this. The havoc caused by the disease to coconut palms has to some extent taken attention away from the plight of these equally beautiful palms.

One should perhaps be cautious with the assumption that similar symptoms always indicate similar diseases or the same disease. More work is needed to prove beyond doubt that the lethal yellowing of coconut palms, pritchardias and veitchias is the same disease. Obtaining such proof will be more difficult than might be imagined, since very little is known about the causal agents of the disease. Recent electronmicroscopic in-



4. *Veitchia merrillii*. A, A tree in southwest Miami showing early symptoms of the disease. The older leaves are broken at the junction of sheathing leaf base and midrib. It is difficult to recognize early symptoms of the disease in the veitchias. B, An advanced stage of the disease showing a veitchia palm with very few leaves (a). The older broken leaves have apparently been removed in this palm. Bud rot that sets in at a later stage of the disease has resulted in the decapitation of another veitchia (b).

vestigations in three different laboratories on the phloem of coconut palms affected by lethal yellowing in Jamaica have revealed that mycoplasma-like microorganisms are present in the sieve tubes of the diseased palms but absent in the healthy ones (Banjac, Hunt and Maramorosch, 1972; Beakbane, Slatter and Posnette, 1972; Parthasarathy—unpublished data). Although the mycoplasma-like microorganisms are currently considered as the organism most likely to be responsible for lethal yellowing, the etiology of the disease is still not clear. It is significant that electron-microscopic investigations on the phloem of the diseased pritchardia inflorescences have also recently revealed mycoplasma-

like organisms in the sieve tubes (Parthasarathy—unpublished data). The microorganisms have so far not been observed in the diseased phloem of veitchia palms, but the search continues in laboratories at Cornell University, University of the West Indies, and the University of Florida Agricultural Research Center, Ft. Lauderdale (Purdy, 1973). The similarity of external symptoms of diseased pritchardias with those of coconut trees affected by lethal yellowing, and the presence of mycoplasma-like microorganisms in both palms strongly suggest, but do not prove, that the two are affected by the same disease. The likelihood of the three different genera of palms being affected by the



5. Inflorescences of a diseased veitchia palm. Arrow indicates an unexpanded inflorescence that appears twisted.

same disease raises grave questions about the future of Florida palms in general, if the disease spreads unchecked. Several private and state agencies are very much aware of the acute problem and have initiated programs to slow down the spread of this disease among the coconut palms. Their programs include early detection of the diseased trees and cutting and burying them, and encouraging nurserymen and homeowners to plant or replace the 'Jamaican Tall' variety with resistant 'Malayan Dwarf' varieties. From October 1971 to late May 1973 the Division of Plant Industry has cut 6,687 of the 7,246 diseased coconut trees found primarily in Dade County. There are no accurate records of the numbers of diseased or cut pritchardias and veitchias according to Mr. G. Gwin, Division of Plant In-

dustry. The plight of pritchardias and veitchias, however, has not yet received much attention. Although the programs mentioned above are no doubt essential to slow down the spread of lethal yellowing, they are unlikely to completely eradicate the disease. More studies on the etiology of the disease are needed so that the causal agents can be determined beyond any doubt. Such studies, however, may be slow in yielding results because of basic deficiencies in understanding of the anatomy and physiology of the coconut palm. As Tomlinson (1972) has pointed out, for each scientist who works on a coconut or oil palm, there are a hundred scientists who work on temperate cereals and cash crops. It is difficult to transpose information obtained from such temperate plants to a tropical tree like the coconut with its

complex structure. Obviously, a crash program that includes basic research on palms is essential in combating the lethal yellowing disease of palms. To this end, preparations are underway for a research symposium on lethal yellowing to be held at Fairchild Tropical Garden this September. Details should appear in the next issue of *PRINCIPES*.

We are very grateful to Mr. Terry Fedelem and Mr. John Kyriakopoulos of the Division of Plant Industry, Miami, Florida, for their help in locating and collecting the diseased pritchardias and veitchias, and to their supervisor, Mr. George Gwin, for information on lethal yellowing symptoms.

LITERATURE CITED

- BANJAC, B. P., P. HUNT AND K. MARAMOROSCH. 1972. Mycoplasma-like bodies associated with lethal yellowing disease of coconut palms. *Phytopathology* 62: 298-299.
- BEAKBANE, A. B., C. H. W. SLATTER AND A. F. POSNETTE. 1972. Mycoplasmas in the phloem of coconut, *Cocos nucifera* L., with lethal yellowing disease. *Journal of Horticultural Science* 47: 265.
- PURDY, L. H. 1973. Lethal yellowing status report. #1 (12 April 1973); #2 (14 May 1973). Plant Pathology Dept., University of Florida, Gainesville. [A continuing series of monthly status reports.]
- TOMLINSON, P. B. 1972. Lethal yellowing of coconut—The importance of basic research. *Bulletin of the Fairchild Tropical Garden* 27: 7-12.

More on Albino Palm Seedlings

Albino seedlings of *Euterpe edulis* and *Caryota mitis* were reported in *Principes* 16: 115, 1972, but a photograph of the first was overlooked among materials on the editor's desk. It is published here with a photograph of Mrs. Buhler's albino *Caryota mitis* and with apologies from the editor.



1. Albino and normal seedlings of *Euterpe edulis* in tropical rainforest of southeastern Brazil. Photograph from color transparency by Professor Aylthon Brandão Joly. See *Principes* 16: 115, 1972.



2. Albino and normal seedlings of *Caryota mitis* from garden of Mrs. T. C. Buhler, Miami, Florida. Photograph from color transparency. See *Principes* 16: 115, 1972.