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History, Spread, and Other Palm Hosts of Lethal Yellowing of Coconut Palms

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History and Spread

The coconut palm (*Cocos nucifera*), although not native to the United States, gives subtropical Florida its beauty and charm more than any other plant. In the time the palm has been in the state, it has managed to survive many hazards, including hurricanes and urban development. However, the coconut palm's very existence now is threatened by a relatively new hazard that has proved to be even more devastating. This hazard is the disease lethal yellowing (LY) of coconut palm.

Symptoms of LY resemble symptoms of certain other palm diseases. For many years attempts to identify the causal agent of LY focused on fungi, bacteria, nematodes, viruses and nutritional deficiencies. In 1972, evidence began to accumulate that has been added to in subsequent years, so that in 1975 strong circumstantial evidence suggests that the causal agent is a mycoplasmalike organism that resembles a bacterium without a rigid cell wall. The mode of spread of this organism is still not known, but it is thought to move from diseased to healthy palms by an insect. Research is currently underway to identify the carrier(s) involved.

Lethal yellowing attacks the 'Jamaican Tall' as well as several other varieties of the coconut palm and was first reported in Jamaica near Montego Bay in 1891. By 1944, the disease was epidemic and was killing the coconut palm population along the coast at the rate of 200,000 trees per year.

Lethal yellowing remained a Carribean disease until 1955 when it was reported in Key West, Florida. Although this is the first official report of the disease in the United States, it may well have been in Key West since 1936, when 21 trees died mysteriously of a "yellowing" condition similar to LY. But after two years the disease was not observed again until 1955.

It now appears that LY is present throughout the Carribean, including the following countries: the Dominican Republic, Cuba, Haiti and the Bahamas. It has also been reported in three countries in West Africa.

During the 13 year span from 1955-1968 when LY was epidemic in Key West, 75 percent of that island's coconut palm population—or about 15,000 individual palms—were killed. By 1968, no new cases of LY had been reported in Key West and the disease appeared to have run its course. However, in 1970 LY was observed on Key Largo, almost 100 miles up the island chain. In 1971 the disease moved to Little Torch Key, and by September, 1971 it reached Coral Gables on the mainland.

Surveys conducted by the Division of Plant Industry of the Florida Department of Agriculture and Consumer Services began immediately and showed 57 infected palms within a 100 square block area of Coral Gables. Within the next 12

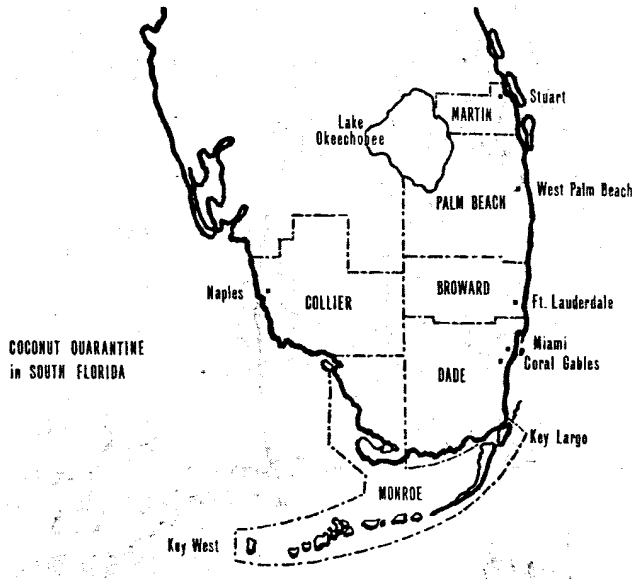

FIG. 1. Counties in Florida where lethal yellowing has been reported.

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months, the disease spread south to Key Biscayne, east to Miami Beach and north to Carol City, claiming over 1200 coconut palms. The disease continued to move up the east coast of Florida. In February, 1972 it was reported in Broward County and a year later in Palm Beach County. By August, 1974 LY was observed in Martin County and by October, 1974 it had spread west into Collier County.

At present, the six counties where the disease has been reported are under strict quarantine in order to prevent uncontrolled movement of suspected host palms out of these areas.

It is estimated that LY has already killed a third of Florida's coconut palms (200,000 trees), 70,000 Christmas palms and an undetermined number of other palm species. And the disease is continuing to spread.

Symptoms in Coconut Palms

To the untrained eye, lethal yellowing may easily be confused with other yellowing and defoliating maladies of coconut palms, including such diseases as fungal bud rot, nutrient deficiencies, insects, nematode and lightning damage. Observations over the years, however, have led to the recognition of four symptom stages for LY in coconut palms, of which at least one is definitive for the disease.

The first symptom of LY is the premature dropping of most or all of the coconuts regardless of size (Fig. 2a). This is termed "shelling" and most of the fallen nuts will have a brown or black area immediately under the calyx on the stem end.

The second stage, which is definitive for LY, is the blackening of new inflorescence tips (flower stalks). This may be observed as they break through the spathe (the structure which enclosed the inflorescence) and is quite distinctive because the inflorescence of healthy trees are a golden-yellow color (Fig. 2b & 2c). In addition to the blackened tips, almost all of the male flowers will be dead and no fruit will be set on such a flower stalk.

The third symptom stage is the one from which the disease gets its name. The fronds turn yellow, usually beginning with the older ones near the bottom and advancing upwards toward the crown (Fig. 2d). In many cases, one specific frond will turn yellow first giving a characteristic "flag" appearance. Fronds that have yellowed will die, turn brown and hang down, but tend to cling to the tree instead of falling off.

The fourth and final symptom occurs only after all the leaves have been killed, including the newly emerged spear leaf. Death of the bud occurs, followed by the falling away of the top of the tree, leaving a bare trunk or "telephone pole" (cover photo). Infected trees usually die within 3-6 months after the appearance of the first symptom.

As yet, nothing can be done to cure a coconut palm once it has been infected with the LY organism. However, several things can be done to slow the rate of disease spread. Since an infected palm may show symptoms for 3-6 months before it dies, and thereby serve as a source of inoculum for healthy palms, any palm showing LY symptoms should be removed and destroyed.

Research at the University of Florida Agricultural Research Center in Ft. Lauderdale led to the discovery that injection of the antibiotic "oxytetracycline" into the trunk of diseased coconut palms resulted in remission or stoppage of LY symptoms. This treatment can extend the life of diseased palms if the treatment is applied before fronds begin to yellow. It must be noted, however, that this antibiotic treatment does not cure the tree and the treatment must be repeated every four months or symptoms will again appear and culminate in death of the palm. (See Circular S-228, "How to treat your palm with antibiotic.)

Possibly the best bet for the control of LY lies in the planting of the "Malayan Dwarf" varieties of the coconut palm which are, as far as is known, resistant or immune to lethal yellowing. (Fig. 3). Thousands of seed nuts have been imported and planted in Key West and Stock Island and have remained disease free.

Logically, then and until research develops other alternatives, the best combination to com-

FIG. 2. Symptoms of LY in coconut palms: a) shelling, b) healthy inflorescence, c) blacken inflorescence from a LY infected palm, d) yellowing of fronds.

bat lethal yellowing is to remove any diseased tree and replace or start new plantings of the resistant "Malayan Dwarf" variety.

Other Palm Hosts of Lethal Yellowing

Until recently, lethal yellowing was believed to affect coconut palms only; however, research since 1971 has shown this to be incorrect. At the present time, 15 different species of palms are suspected of being susceptible to LY, including such popular species as the Christmas Palm (*Veitchia merrillii*) and the Canary Island Date Palm (*Phoenix canariensis*). All 15 species, including the coconut palm, are under strict quaran-

tine by the Division of Plant Industry within the six county area.

The quarantine list is based on the appearance of symptoms in diseased palms that are identical or similar to those of lethal yellowing of coconut palms. In addition, the detection of the suspected causal agent (mycoplasma-like organism) in the vascular tissues of palms thought to be infected with LY is also strong evidence, since these organisms have not been found in healthy palms. The current list of suspected hosts of lethal yellowing includes the following species; however, as new information is generated the list may expand to include additional species:

Cocos nucifera—coconut palm
Veitchia merrillii—adonidia or Christmas palm
Pritchardia pacifica—Fiji Island fan palm
Pritchardia thustonii—Thurston palm
Phoenix canareinsis—Canary Island date palm
Phoenix dactylifera—date palm
Phoenix reclinata—Senegal palm
Arikuryroba schizophylla—arikury palm
Caryota mitis—cluster fish-tail palm
Borassus flabellifer—palmyra palm
Mascarena verschaffeltii—spindle palm
Corypha elata—talipot palm
Trachycarpus fortunei—windmill palm
Chrysalidocarpus cabadae—cabada palm
Dictyosperma album—hurricane or princess palm

The widespread plantings of these palms, especially the Christmas and date palms, increase the hazard of LY to many palms now growing in Florida.

Recognition of LY symptoms in palms other than the coconut palm is difficult, because almost all of these species have not been observed adequately enough during early stages of infection to catalog symptom development precisely. The first two symptom stages of LY in these susceptible palms, are the same as for the coconut palm —that is, the premature dropping of fruit (shelling) and the blackening or necrosis of the new inflorescence.

The third symptom, which is in many cases the first obvious sign of trouble, is the discoloration of the fronds. It is at this stage of infection where the symptoms differ for individual species.

FIG. 3. Mature "Malayan Dwarf" coconut plam.

In general, frond discoloration due to LY falls into two distinct categories: those in which the fronds turn a golden-yellow before dying and those in which the fronds turn a greyish-brown. Palms in the first symptom category, yellowing of fronds, are coconut palms, talipot palms (Fig. 4), both species of pritchardia, arikury, windmill, princess and spindle palms.

The progression of symptoms is similar to that in coconut palms where the lower fronds turn a golden-yellow, but often one specific frond will turn before any others giving a "flagging" appearance. The fronds remain yellow for various lengths of time before turning brown and dying. The fronds have a tendency to break at the leaf base junction and hang down somewhat like a

collapsed umbrella. Fronds may cling to the tree instead of falling to the ground.

The yellowing usually advances from the older to the younger fronds with the spear leaf the last to turn. Once the spear leaf shows symptoms, death of the crown occurs followed by a falling away of the top of the tree leaving a topless bare trunk.

The remaining susceptible palms on the list fall into the second symptom category, browning of fronds, or fronds that develop a "dried out look." The Christmas palm or adonidia is perhaps the best example of this group (Fig. 5a). The first two symptom stages in these palms are also similar to symptom development in LY-infected coconut palms. Frond discloration is not as dramatic nor is it as easily detected in early stages of development as in coconut or pritchardia palms.

FIG. 4. LY infected talipot palm (Corypha elata) showing yellow frond symptoms.

First evidence of infection is a brownish "water mark" along the margin of the pinnae or leaflets. Browning gradually extends to the entire frond giving it a dried out appearance. As in other LY infected palms, the older leaves tend to break easily at the junction of the leaf-base and the midrib, whereas younger fronds tend to break within the lower region of the pinnae. Unopened inflorescences may have a distorted or twisted appearance. Death of the bud follows and falls away resulting in a bare topless trunk (Fig. 5 b).

In addition to the Christmas palm, the borassus (Fig. 5c), cabada, cluster fish-tail and the three species of Phoenix palms all show similar "browning" symptoms.

In summary, the suspected causal agent of lethal yellowing of coconut palms has been found in 14 other palm species, including such popular ornamentals as the Christmas palm and date palms. Each of these infected species exhibit a premature dropping of fruit and a necrosis of the newly emerged inflorescence while frond discoloration may be of two basic types—yellowing or browning.

Because there is no cure for lethal yellowing at the present time, any palm showing LY symptoms should be removed and destroyed. Replace diseased palms with the resistant 'Malayan Dwarf' coconut palm or other non-susceptible palms. Contact your county Extension office for information on suitable replacement palms.

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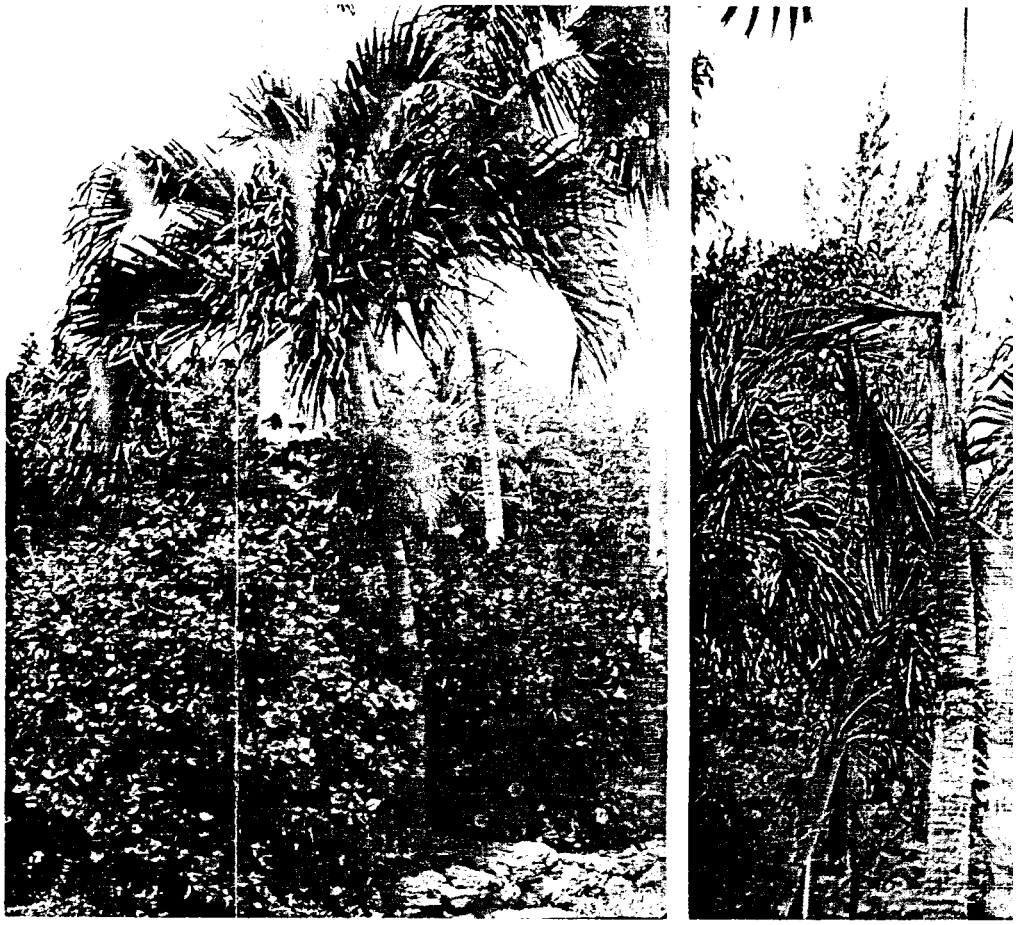

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