# Lethal Yellowing of the Coconut

The discovery of lethal yellowing disease of coconuts in Dade County, Florida, in 1971 has prompted several reports in Miami newspapers, and a filler item in the January issue of PRINCIPES prompted a letter from the Director of Research for the Coconut Industry Board in Jamaica. This letter, followed by extracts from a letter addressed to the Editor of the *Miami Herald* on November 26, 1971, by Mr. Romney and by a news release, suggest courses of action and tell the story of the discovery of micro-organisms that appear to cause the disease.

> COCONUT INDUSTRY BOARD JAMAICA, WEST INDIES 29 May 1972

EDITOR, PRINCIPES,

I have just read page 33 of the January 1972 issue of PRINCIPES. Your article on "Coconut Disease" states the facts as they were in 1968. Subsequent to that, however, a large-scale experiment by F.A.O. Expert/Entomologist, Professor K. Heinze, attached to this Research Department has failed to substantiate the indication of a possible link between lethal yellowing disease and whitefly as obtained by Grylls in the course of his work here from 1965-1968. The finding in late 1971 of a mycoplasm in diseased coconut palms (see attached news release) eliminates for all practical purposes whiteflies as possible transmitters of the disease since mycoplasms associated with plant diseases are carried only by insects which feed in the phloem, i.e. leafhoppers.

Over the last three years, the work on this disease by the F.A.O. team and by this Research Department has covered many aspects but I refer, in particular, to the following because they are a guide to practical control measures:

- A. Large-scale experiments lasting two years in which susceptible palms in drums were transferred to the diseased area, exposed to the disease for one, two or three months and then returned to a disease-free area showed that the incubation period of these young palms (two to three years old) was 3-7 months. Other work indicated an incubation period for mature bearing trees of not less than 7-15 months. These two facts show that apparently healthy trees can have contracted the disease long before visual symptoms appear. This would suggest that cutting down and burning trees with symptoms is not likely to reduce spread.
- B. A total of 34 experiments were carried out during 1969 to 1970 in an attempt to control isolated new outbreaks. The method used was to treat approximately 4 acres around the diseased tree with insecticide on two occasions two weeks apart: in some experiments, the insecticides were applied to the crowns with a mist blower, but in most cases systemic insecticides were injected into the trunks. At the time of the second insecticide treatment, all apparently healthy palms over 1 acre around the sick palm were poisoned with arsenic and the trees died in two weeks.

The purpose of these treatments was to eliminate insect vectors and to remove sources of infection, within the limits of practicality. Approximately a year later, many of the treated sites developed new cases of disease. There were four sites where

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the disease did not re-appear, but it is most unlikely that this was due to the treatment since observations on untreated outbreaks showed that five of them also did not develop new cases. Not only were the treatments by and large ineffective but they were more expensive and more destructive than most palm owners would wish.

C. Experiments were performed with aerial application of insecticides but these had many problems including damage to the trees and interference with pollinating insects and public water supplies.

The work of this Research Department on resistance to this disease has proved conclusively the high resistance of the Malayan dwarf. Many other varieties and hybrids are on test but to date, we have no variety to supplement or replace the Malayan dwarf. I attach copies of letters from me to the Editor of the *Miami Herald* from which you may extract any information you wish. Kindly acknowledge the source of your information.

Yours faithfully,

D. H. ROMNEY DIRECTOR OF RESEARCH

### Extract from a Letter Dated November 26, 1971

"Now. . . we have ample seed thanks to foresighted planting of seed gardens 5–8 years ago. We are setting 900,000 quality dwarf seed in Jamaican nurseries this year and we export seed regularly. I note with pleasure that the Commissioner of Agriculture, Mr. Doyle Connor, is proposing very sensibly to relax the quarantine restrictions on importation of Malayan dwarf seed into Florida.

"I think that coconut palm owners in Florida can learn a lesson from our Jamaican experience, particularly over the last ten years. Mr. Donald P. de Sylva, in a letter to the editor of the Miami Herald printed on October 15, 1971, writes 'After a 2-year absence from Jamaica, I recently returned... the palm blight has spread dramatically where lush coconut farms once flourished so that parts of this area resemble the war-torn South Pacific Islands. . . The thought of the same. . . occurring on this scale in South Florida is most dismaying.' This Jamaican situation is a true portrayal of what is in store for Florida. At least we have taken action in Jamaica. Over 1 million selected Malavan dwarfs have been planted since 1968!! If we had learned our lesson a few years earlier, much of our devastated north coast would already be back into productive coconut trees.

"Not only is Jamaican Malayan dwarf seed produced with resistance to lethal yellowing in mind, but reaping and transport is well organized to ensure good germination, and all export seed is fumigated. I am not saying this as a form of advertising—I am simply emphasizing that lethal yellowing disease has to be tackled systematically and seriously. My advice to coconut palm owners would be:

- 1. Don't panic, but square your jaw for action.
- 2. Don't waste time by looking sorrowfully at dead trees, and certainly not by attempting to treat them.
- 3. After the symptoms of the diseases are confirmed—plant Malayan dwarfs.
- 4. Even if you are several miles from the disease, start planting now.
- 5. Make sure that you are planting reliable pure Malayan dwarf.

"Your division of Plant Industry Director, Mr. Halwin Jones, recommends that all new plantings of palms be restricted to the Malayan dwarf because of its resistance. Follow his advice."

## News Release from Coconut Industry Board, December 16, 1971

Scientists in the U.S. and Britain have located an organism in diseased coconut tree tissues from Jamaica which they believe to be the cause of lethal yellowing. This was announced today by the Minister of Trade and Industry, the Hon. Robert Lightbourne, at a press conference in the offices of the Coconut Industry Board, 18 Waterloo Road, Kingston.

Dr. Karl Maramorosch and Dr. B. Plavsic-Banjac at the Boyce Thompson Institute for Plant Research in New York using a powerful electron microscope have shown that tiny microorganisms called mycoplasms are present in parts taken from diseased palms and are absent from healthy ones. Almost simultaneously, independent research by Dr. Beryl Beakbane of the East Malling Research Station in England, who was also studying coconut samples sent from Jamaica, produced the same results.

The samples were selected and specially prepared for electron microscopy earlier this year by Dr. Peter Hunt of the Botany Department, University of the West Indies, Mr. Dave Romney and Mr. Hugh Harries of the Coconut Industry Board's Research Department and by Professor Kurt Heinze and Mr. Mark Schuiling of the F.A.O. team working on lethal yellowing.

#### **Plant Dwarfs**

The discovery represents the first major breakthrough in the fight to stop the widespread damage caused by lethal yellowing in Jamaica, the Minister of Trade and Industry said. But he warned that the information does not offer an immediate method of curing or preventing the disease. He urged coconut growers to continue planting of Malayan dwarf coconuts, as it might be some time before research would produce a cure for lethal yellowing disease.

Mycoplasms are tiny micro-organisms partly resembling bacteria and partly resembling viruses. Unlike bacteria, they are too small to be seen even by the most powerful conventional microscope-one thousand joined end-toend would stretch across the dot of this letter "i". They also differ from bacteria in not having a cell wall around their bodies. Unlike viruses, mycoplasms have a very variable shape being anywhere from spheres to cucumbershaped. Mycoplasms have been known to cause certain diseases in animal and man for many years but their association with diseases of plants was first demonstrated only four years ago. Since that discovery they have been found associated with over 40 different diseases of plants including aster yellows, pawpaw bunchy top disease and corn stunt.

Scientists will continue research to produce further evidence positively demonstrating the link between mycoplasms and lethal yellowing disease. Whereas most fungi and bacteria which cause disease can be grown in a test-tube and used deliberately to infect healthy test plants, the mycoplasms have not yet been handled in this way successfully. Mycoplasms can be transmitted from plant to plant only by particular insect carriers.

However, the constant association of mycoplasms with these diseases, their absence from healthy plants and the fact that they can be seen under the electron microscope in infectious insect carriers, all point to the fact that they are the cause of the diseases.

Progress on the understanding of lethal yellowing and any possible control of the disease has been frustrated in the past by not knowing what causes the disease or how it is spread. Jamaica is not alone in this ignorance. A similar or identical coconut disease is active in Cuba. Haiti, Florida and in several countries on the West Coast of Africa. By a process of elimination, many scientists have over the past few years become convinced that this disease is caused by an unknown virus or virus-like agent with an unknown insect vector which carries the disease from one tree to another-in much the same way as the malaria mosquito carries malaria from person to person.

#### **Research Value**

The finding of a mycoplasm in diseased coconuts is the first positive indication that the scientists have been thinking along the right lines. An electron microscope with all its equipment is expensive (about \$80,000) and needs experts to run it. Jamaica is fortunate to have had the use of the facilities at the Boyce Thompson Institute and at East Malling, and further work on lethal yellowing disease will be done at both places.

Research on lethal yellowing has been proceeding in Jamaica continuously since 1962. F.A.O. experts working at the Coconut Industry Board have demonstrated that the disease is air-borne and that the incubation period in young palms is about 3–6 months. Many thousands of insects have been tested as carriers of the disease: gallmites and the once-suspected white-flies have been tested and re-tested without result. Experiments have also shown that the disease cannot be transmitted by hand, despite claims that this has been done in Florida.

The Coconut Industry Board is continuing its introduction of new varieties, production of hybrids and testing for resistance and yield. The Board has also carried out, with the cooperation of properties, numerous and expensive attempts to control new outbreaks of the disease: although unsuccessful, these experiments showed the incubation period for bearing palms to be about one year. The U.W.I. Botany Department is studying the effects of the disease on the internal structure and biochemistry of coconut palms in a search for earlier symptoms than those seen by the naked eve.

The discovery of mycoplasms in lethal yellowing diseased coconut trees is a great step forward in the research. This will help the scientists considerably in their understanding of the disease. They can now stop trying to transmit the disease by hand, since this has never been achieved with mycoplasms. They will, of course, make further experiments to incriminate the mycoplasm as the cause of the disease. They will also be able to check whether resistant coconut varieties carry the mycoplasm without showing symptoms or whether they are immune.

#### Search for Carrier

Knowledge derived from the study of other plant diseases associated with mycoplasms may be applicable to lethal yellowing. For instance, all of the other plant mycoplasm diseases are known to be transmitted from plant to plant only by the activities of insects with delicate piercing mouth parts, which feed deep in the food-conducting channels of the leaf. All except one or possibly two of these diseases are transmitted by various species of leafhopper. Scientists working on the disease in Jamaica will now be able to concentrate their efforts on leafhoppers instead of spreading their nets wide to look at every insect that visits palms.

Once the insect is known it may be possible to control it in the field by biological or chemical means, and so hinder the spread of the disease, although the regular widespread use of insecticides may be dangerous and costly. Scientists may also be able to use the insect carrier to screen varieties and hybrids for resistance much more quickly, more cheaply and more effectively than the present system of growing the trees for years in the diseased area: this would help in identifying any new resistant variety, and in learning the mechanism of the inheritance of the resistance of the Malayan dwarf.

Finally, if in the future a new strain of lethal yellowing disease should start attacking the dwarf, scientists hope by then to know enough about the disease and its carrier to control the new strain.

Coconut farmers are not immediately affected by this discovery. They should continue increasingly to plant the Malayan dwarf with confidence, scientists say. The high degree of resistance of this variety has been established by many years of field trials in which it has been exposed to heavy doses of the disease. Experience has established that if farmers care for this variety properly, they can look forward to much better yields than from the Jamaica tall.

The discovery of mycoplasm does not offer any immediate method of curing or preventing lethal yellowing disease in Jamaica talls. However, the research necessary for the future of the industry is making headway and all possible sources of assistance and know-how are being brought to bear on the problem.

On behalf of the coconut growers of Jamaica, Mr. Dossie Henriques, Chairman of the Coconut Industry Board, congratulated Dr. Hunt, Dr. Maramorosch, Dr. Plavsic-Banjac and Dr. Beakbane on the success of their efforts and expressed the island's gratitude to them, the F.A.O. team and other scientists, who have co-operated with the Board's Research Department in tackling this vital problem.

## PALM BRIEFS

#### Euterpe at Iguassu Falls, Brazil

In February of 1970, on a palm collecting expedition in South America, I chanced across a very striking species of *Euterpe* which may be of particular interest.

Its habitat is on a high tropical rainforested plateau almost exactly on the common border of Brazil, Paraguay and Argentina in the Brazilian state of Paraná in the Iguassu Falls area at approximately 25° 35′ S. latitude and 54° 22′ W. longitude, a few degrees south of the Tropic of Capricorn. This is one of the few areas that harbor a tropical rain forest out of the boundaries of the tropics; (e.g. jungles of northern Burma, southern China and eastern Australia).

The soil is typical tropical red lateritic clay covered by two inches of decomposed and partially decomposed leaf debris. The forest is extremely rich in a variety of epiphytic bromeliads and Philodendrun selloum was abundant with cascading aerial roots to the ground. This plateau has considerably less atmospheric humidity and temperature than the lowland forest of the Amazon Basin, vet is not montane cloud forest as this is a grand expanse of generally flat land, dropping drastically in steps by a series of waterfalls which dwarf Niagara. From what I could glean from local inhabitants, temperatures in the colder months occasionally reach freezing.