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PALM BRIEF

A Coconut Seed Producer's Perspective on Lethal Yellowing

1. Introduction

The writer of these notes is neither a trained agronomist nor a plant pathologist and, as a seller of hybrid coconut seed, may be regarded as being biased. The thoughts expressed here are based on common sense and his own observation of the effects of Lethal Yellowing disease ("LYD") in Jamaica, Florida and Mexico.

2. Background

LYD is a fatal pandemic disease of the coconut palm which has been present in the Caribbean for well over one hundred years. It was first described as the "unknown disease" and the earliest reported coconut disorder now believed to have been LYD was on Grand Cayman Island in 1834. The disease was named "Lethal Yellowing" in Jamaica in 1955. LYD is known to be present in Cayman Islands, Jamaica, Cuba, Haiti, Dominican Republic, Bahamas, United States and Mexico. Similar diseases exist in Africa. It attacks other palms such as Cluster fishtail, Date, Fiji fan, Princess, Pritchardia, Thurston and Windmill palms, but not the Royal nor African oil palm.

3. Symptoms

The first symptom is premature nutfall of most or all nuts regardless of age; most have a dark water-soaked area under the calyx; since nutfall and natural button shedding can have a number of different causes, this is an unreliable indicator. The next stage is the blackening of emerging inflorescences; when cut open the male flowers inside are necrotic, black or brown; no subsequent female flowers will set fruit. The leaves turn yellow, usually starting with the oldest and working upwards to the crown, then brown and dry, and finally hang down. On occasion one leaf in the crown will turn yellow first, and the leaves of some varieties omit the yellowing, instead turning brown. Death of the palm occurs about half way through the yellowing process and finally the whole crown collapses leaving a bare trunk like a telephone pole. Because a palm's most frequent expression of disease, disorder or even wet feet is the yellowing of leaves, there is always a danger that the presence of LYD will be exaggerated or incorrectly identified.

4. Causal Agent

In the early 1970's laboratories in Germany, the University of the West Indies in Jamaica, and several U.S. universities working in co-operation with the Jamaica Coconut Industry Board and Fairchild Tropical Garden in Miami, identified mycoplasma-like organisms ("MLO") as the pathogenic agents which cause LYD. Early attempts to isolate the cause which started in Cuba in 1880 for many years focused on bacteria, fungi, soil factors and viral aetiology as the likely cause. For the palm to contract LYD the MLO must enter and circulate in the phloem tissues. The action of the MLO can be arrested by regular treatments with antibiotics, but whilst oxytetracycline injections may be feasible in Palm Beach, the cost is too high for their use on a plantation scale.

5. Vector

Scientists concur that the vector is the leaf hopper *Myndus crudus* Van Duzee. Field studies and transmission experiments have provided strong evidence that *M. crudus* is a vector and probably the only

important vector of LYD. Like most insects *M. crudus* is unlikely to travel more than 500 yards in its lifetime, unless removed large distances unnaturally as by hurricane. Twelve other members of Derbidae, Membracidae and Cicadellidae families have been tested as possible vectors without positive results. An idea that has been proposed occasionally that the coconut mite, *Eriophyes guerreronis*, is a vector is highly doubtful. "There is no evidence implicating the coconut mite as a vector of this disease, and in fact, there are several lines of evidence against this motion" (F. W. Howard 1991). *M. crudus* and *Myndus* sp. exist in Central and South America but are not harmful when LYD is not present. Most grasses serve as host plant for *M. crudus*, a further argument in favor of using leguminous cover crops, which do not.

6. Spread

Professor F. W. Howard of University of Florida, one of the leading experts on LYD, describes the movement of LYD as a "jump spread." The spread is most resolute via a land mass continuously planted with susceptible palms. Mexican authorities on the Atlantic coast calculate the annual progress at 15–30 miles aided by frequent high winds; they also fear fishermen carrying coconut materials. Typically the movement of LYD is extremely slow: it took ninety years to move the length of Jamaica, a distance of less than 100 miles, and there are still stands of unaffected Jamaica Talls; it appears to have been present for fifty years in Haiti before crossing the border into Dominican Republic (1969). Transfer between land masses is similarly slow: LYD was present in Cuba at least sixty years before appearing in Key West, Florida (1936) and one hundred years before arrival at Punta Sam, near Cancun in Mexico (1981) a distance of 125 miles; it is thought to have come in grass from Florida.

7. Latin America

In Latin America LYD is present only in the three states Campeche, Yucatan and Quintana Roo in the Yucatan peninsula on the Atlantic coast of Mexico. There have been rumors in recent years that it was in Belize, Honduras and even Costa Rica. Whereas the former may be an obvious future destination, LYD has not been confirmed, and its presence in Honduras and Costa Rica has been reliably investigated and denied. Observers were probably influenced by factors described in 3 above or excited by the gravity of their "discovery." Whereas it may spread in future southwards from Mexico along the Atlantic seaboard there is no certainty that it will ever affect all coconut-growing areas of Latin America, nor in view of the slow transmittals described in 6 above that it will even invade two or more countries in this writer's lifetime (or reader's). Costa Rica has been declared to be free from LYD by its own efficient Plant Protection Service, by OIRSA, Basil O. Been, Owen Drew, among others.

8. Prevention

Plant protection services in coconut countries must restrict the ingress of coconut plant materials which originated or may have originated in an area where LYD is confirmed, unless the materials are to be used for research or breeding programmes in qualified hands. This applies especially to untreated coconuts or plants, as may be transported across borders or in fishing boats, which may be accompanied by an infected vector. Imports of planting material from unaffected countries cannot result in the introduction of LYD but should be regulated, if only for information purposes. In the risk league, embryos pose least, through pollen and seednuts, to actual plants which present most risk. Enlightened plant protection services restrict the entry of other susceptible palms from all origins (list available) thus reducing poten-

tial hosts which might contribute to future spread if LYD were to arrive. In protection of its vast areas of coconuts on the Pacific side, Mexico thoughtfully prohibits movement of planting materials across the country. NAPPO (North American Plant Protection Organization) states in its October 1989 Principles of Plant Quarantine that contracting parties shall institute regulatory or other measures only where such measures are made necessary by phytosanitary considerations, i.e., to prevent the entry and/or spread of quarantine pests, and "plant quarantine measures should represent the least drastic action available that results in the minimum impediment of the international movement of people, products and conveyances." There is no recorded incidence of LYD being transferred via seednut and Jamaican authorities state that it is "quite unlikely that the nuts can carry the disease." In spite of this the Coconut Industry Board routinely pre-fumigates with phosphine.

9. Resistance

Among widely disseminated coconuts that with the highest known resistance to LYD is the Malayan Dwarf ("MD") at 95 to 99%. F1 hybrids of MD have intermediate levels of resistance reflecting that of the other parent but tending towards the greater resistance of MD. Other coconuts with noteworthy tolerance are the King coconut and certain dwarfs from Cuba, India and Sri Lanka. Levels of susceptibility recorded in LYD induced trials are generally higher than the same palms would display under normal field conditions, e.g., MAYPAN hybrid registered 85 per cent resistance in LYD applied trials but 99 per cent in the field in Jamaica. The standard work on the subject is 'Observations on field resistance to Lethal Yellowing in coconut varieties and hybrids in Jamaica' by Basil O. Been, published by I.R.H.O. in January 1981 Oleagineux. The averages of resistance for principal talls and their hybrids with MD in that article were (percentages):

1. Talls: Panama (or Pacific) 56, Rennell 38, Jamaica (or Atlantic = West African) 10.5 percent.
2. Hybrids: MAYPAN 90.2, MAREN 74, MAYJAM 64 percent.* Subsequent estimates place the resistance of MAREN at 80 to 85 percent. Recent reports of reduced MD resistance are largely discounted by circumstances at sample sites. In the selection of hybrid coconut to plant countries which have LYD or with a genuine risk of acquiring it from a neighboring country should opt for highest resistance, and those not so threatened may rely on good resistance while choosing maximum yield potential. MD is not planted commercially because of a range of disadvantages, but is most suitable as mother palm for the production of F1 hybrids.

10. What the Experts say

SACRAC has corresponded with a number of experts in the field of coconuts and LYD. Usually the thrust of our enquiries concerned Costa Rica but the quotes which follow include both local and general observations.

10.01. "Most hybrids have levels of resistance intermediate between those of the parents, but generally closer to that of the more resistant parent. . . . The use of resistant varieties is one of the main forms of disease control." Basil O. Been, 1981, Observations on field resistance to Lethal Yellowing in coconut varieties and hybrids in Jamaica, Oleagineux.

10.02. "Research has shown that for a coconut palm to have Lethal Yellowing disease, mycoplasmas must enter and circulate in the phloem tissues. The palm subsequently sheds all nuts, the inflores-

* SACRAC sells these hybrids as MAPAN, MAREN and MAWAT.

cences become black, the fronds become yellow and the palm begins to die. The Malayan Dwarf coconut which is very highly resistant to Lethal Yellowing disease is being used extensively in Jamaica to replant areas which are affected by the disease and to establish new areas. All nuts used for producing seedlings are from trees which are in full bearing and apparently unaffected by disease. It is quite unlikely that the nuts can carry the disease." Coconut Industry Board of Jamaica, 1982, certificate.

10.03. "Lethal Yellowing disease is a major consideration only in those countries where the disease occurs. . . . Mexico should be testing hybrids now in preparation for a major replanting programme. . . . Efficient plant quarantine is the only way to prevent insect vectors or the pathogen arriving in Costa Rica in, or on, living plant material. This cannot guarantee freedom from Lethal Yellowing disease but could delay arrival indefinitely." Hugh C. Harries, 1988, Notes on coconut planting in Costa Rica.

10.04. "Whilst it has recently been introduced into Mexico this was due to characteristic lack of phytosanitary precautions. It is fairly unlikely that it will spread to Costa Rica and, if it were to spread, that it will cover the country quickly." M. de Nuce de Lamothe, IRHO, 1989, personal communication.

10.05. "In March 1971 seeds were collected from visually healthy Jamaica Tall palms and from Jamaica Talls with clear early symptoms of Lethal Yellowing and set separately in the nursery. Germination was good. In November 1971, 244 seedlings of each group were planted in a disease-free area in Kingston city and 500 of each in a disease-free area near Montego Bay. These plants were maintained and regularly observed. Up to 1981, when I left Jamaica, not one palm had shown any symptom of Lethal Yellowing. This experiment strongly supports the statement of Howard and Barrant that "there is no evidence that MLOs can be transmitted via the seed of plants." D. H. Romney, 1990, Principes.

The composition of these notes has relied much upon the following publications, in addition to those already cited: Personal communications and Lethal Yellowing: how to combat the threat to Costa Rica, Dr. F. W. Howard, University of Florida, 1989 (Article available upon request); Lethal Yellowing of Palms, Drs. R. E. McCoy, editor, F. W. Howard, J. H. Tsai et al., University of Florida, 1983, Dr. Karl Maramorosch of Rutgers University; and Annual Research Reports on the Coconut Industry Board of Jamaica.

11. Conclusion

The best control of LYD is to breed and plant for resistance, minimizing the number of all susceptible palms in its path, especially when new plantings are considered. The best cure is an educated and aware plant protection service preventing the entry of suspect or susceptible materials, well prepared and informed, able to identify the symptoms with certainty. The best hope for unaffected countries is that the spread of LYD will stop or continue to be as lethargic as it has for the past one hundred and fifty years and that its arrival, should it happen, will be greeted not with hysteria or panic, but a logical and well-planned series of sophisticated precautions and phytosanitary measures.

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