



In 1962 lethal yellowing was reported from Dominican Republic (Carter 1962) having previously been identified in Haiti (Ollagnier & Weststeijn 1961). Further sightings in Dominican Republic were reported by other specialists (Schieber 1969, Romney 1970; Schieber 1970, Schieber & Hichez Frias 1970). Another report (Maramorosch 1972) was made when samples were taken to identify the causal organism (then known as an MLO) by electron microscopy. The MLO were visualised (Karl Maramorosch, pers. comm.) but the results were not published. Nor was tetracycline treatment attempted, to identify LY by giving temporary remission of symptoms (McCoy *et al.* 1976).

From 1969 to 1986 an eradication programme was operated in seven provinces of the affected area of Dominican Republic. During that period one visiting specialist was unable to find cases of lethal yellowing (Howard *et al.* 1981), but a photograph taken in 1983 (Carlos Vargas, pers. comm.) shows a palm with typical symptoms that was recognised by visiting Jamaican and West African coconut specialists (who unfortunately did not publish any reports). In that same period, the disease continued to spread in Haiti (Timyan 1996) and was epidemic in Jamaica and Florida, where active research supported effective rehabilitation programmes based on resistant varieties and (in USA only) tetracycline therapy. The fact that LY failed to become epidemic in Dominican Republic was overlooked. This led to the assumption, locally, that the disease had either been eradicated by the quarantine measures or, more controversially, that the initial identifications by up to seven independent specialists had been wrong.

The issue came to a head when the Brazilian government placed an embargo on imports of coconut products from Dominican Republic, because quarantine regulations routinely include Dominican Republic as one of the countries in which lethal yellowing occurs. Brazil, as the ninth largest producer of coconuts in the world, was extremely anxious not to allow LY to enter that country. The entire native coconut (criollo) population of Brazil is known to be highly susceptible because it has a common origin with other named, susceptible varieties in Caribbean and Atlantic countries (Harries 1977).

### Findings

During a recent mission for FAO (Harries 1999), the presence of lethal yellowing was recognised, on the basis of visual symptoms, at Villa Gonzalez (Santiago), Dajabon (Dajabon), Luperon and Cabarete (Puerto Plata). Four samples were taken

for PCR (polymerase chain reaction) analysis at Centro de Investigación Científica de Yucatán AC, Mérida, Yucatán, México and gave positive results for LY phytoplasma (Ivan Cordova, pers. comm.). A non-LY infected control sample was also taken from a palm growing in an LY-free area at Las Garitas (Samana), which had a yellow leaf because it was touching an electric power line. This sample had a negative PCR result (Ivan Cordova, pers. comm.). Tests made on duplicate samples sent to the University of Florida, Fort Lauderdale, confirmed the four positive and one negative result (Nigel Harrison, pers. comm.).

These observations support the earlier findings of the phytopathologists and coconut palm specialists who previously identified lethal yellowing in these locations. The fact that the first case in Dominican Republic was reported at Imbert may be explainable because there is a sugar cane growing area there where Haitian field workers may have unwittingly transported vectors on fresh plant material. The provinces of Santiago, Dajabon, Puerto Plata, Santiago Rodriguez, Monte Cristi, Valverde and Espaillat, which made up a quarantine control area from 1974 to 1986, should once more be considered as potentially LY-infected areas for quarantine purposes. Symptoms of LY were not seen in other provinces visited during this mission from either the road or aerial surveys. As far as can be determined, LY symptoms have never been reported from any other provinces. Thus 23 provinces can be considered as being LY free (see Back Cover).

The other findings, one reported here for the first time, account for why lethal yellowing has not become epidemic in Dominican Republic. There is no epidemic of LY because there has been no "jump-spread" from the area of the original outbreaks into the areas where there are extensive commercial coconut plantations. This can be compared and contrasted with the situation that occurred in Jamaica when the disease appeared in the commercial coconut growing area in the east of the country after having previously been known for many years as "West End Bud Rot." When jump spread occurred, the outbreak was in a public works yard, and it was subsequently assumed to have been caused by infected insect vectors being transported by trucks carrying soil or plants across the intervening low rainfall area where comparatively few coconuts grew. This separation of the two areas by climatic and topographic conditions that restricted the natural movement of the vector, and hence the natural spread of the

2 (p. 94). Royal palms in Dominican Republic (photo J. Höpfe).



disease, can also be seen in Dominican Republic. The dry region near Monte Cristi effectively isolates Dajabon. The steep hills and deep valleys around Puerto Plata could also limit insect movement. The prevailing NE trade wind blows from the healthy to the diseased areas and hurricanes, which generally move from east to west, have yet to be implicated in any dispersal of the disease or of the leafhopper vector.

The second, and new, finding became apparent when making a survey by helicopter. At first, the survey merely confirmed the previous idea on topographic separation. For instance, there is a considerable stretch of land without any coconut palms between the infected palms near Cabarete and other coconut palms growing around Puerto Plata. As the flight continued, over the Cordillera Septentrional, it was also seen that the coconut palms growing near properties or on boundary lines were separated by ridges and valleys. However, what had not been evident, until then, was the very high number of Royal palms that grow everywhere in Dominican Republic. The Royal palm (*Roystonea* spp), along with many other indigenous American palms, are not included on lists of LY susceptible palms and may be considered to be immune to LY. [Of twenty-seven palm species that grow where coconuts may be found in DR (Jurgen Höpfe, pers. comm.), only one species from the fourteen genera listed has been recorded as susceptible (in Florida). This is the rain palm (palma de lluvia – *Gaussia attenuata*) from Puerto Rico, but not only is its relative susceptibility unknown but it is also found only in small populations in the East National Park, southeast DR]. It is suggested here that if the insect vectors acquire LY from an infected coconut palm they will spread the disease only if the next palm that they feed on is also a (susceptible) coconut. In the situation described, the next palm is much more likely to be a Royal palm (or a *Sabal* palm, or other immune indigenous palm species).

It may be that the topographic and edaphic isolation and the Royal palm "buffer effect" will continue to protect the Dominican Republic from an epidemic lethal yellowing outbreak. However, a lesson can also be learned from the situation in Mexico, where infected LY vectors are thought to have been introduced on planting material, specifically on grass, brought into Cozumel from Florida for hotel landscaping. The tourist industry in Dominican Republic is expanding rapidly, and during the consultancy visit, when in or near tourist centers, pick-up trucks were frequently seen to be carrying turf grass, young palms and other growing plants. If infected planting material has already been carried from, say Cabarete to Rio San

Juan (a journey of only about 60 km) then palms with symptoms of LY could occur within less than a year (the incubation period, during which the palm appears healthy but acts as a source of further infection is about 7 to 11 months, depending on the size of the palm and the season). Unfortunately, but not unexpectedly, the helicopter survey over Samana showed that coconuts outnumber Royal palm in that province. Under those circumstances, as in the coconut growing areas of Jamaica, any outbreak of LY disease will surely become epidemic. It is therefore essential to prevent the movement of plant material carrying potential vectors out of the lethal yellowing quarantine control area. It is also important to plant LY resistant varieties or hybrids because resistance is known to be the best, and indeed the only economically practical, form of control.

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