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Data Sheets on Quarantine Pests

Palm lethal yellowing phytoplasma

The vector of palm lethal yellowing phytoplasma (*Myndus crudus*) is individually included in EU Directive 77/93. Since its importance only arises in relation to lethal yellowing, it is covered in this data sheet.

IDENTITY

- **Palm lethal yellowing phytoplasma**
  Name: Palm lethal yellowing phytoplasma
  Synonyms: Coconut lethal yellowing pathogen (Nutman & Roberts, 1955)
  Taxonomic position: Bacteria: Tenericutes: Mollicutes: Phytoplasmas
  Common names: Awka disease (Nigeria), Cape St Paul wilt (Ghana), Kaincope disease (Togo), Kribi disease (Cameroon), unknown disease (Jamaica) (English)
  Jaunisse létale des palmiers, pourriture du bourgeon terminal (Haiti) (French)
  Amarilles letal de las palmeras, pudrición del cogollo (Cuba) (Spanish)
  Notes on taxonomy and nomenclature: The many common names cited above, often from the affected localities, have been used for diseases of coconuts which are all now considered to be caused by palm lethal yellowing phytoplasma. These diseases differ mainly in the hosts affected (coconut cultivars, palm species) and in their vector status (known in the Caribbean, but unknown elsewhere). Many coconut diseases of unknown aetiology are described in the older literature and records of these have been carefully appraised by Howard (1983) in his recent review. The name “bronze leaf wilt” has been used for lethal yellowing in Jamaica but corresponds to a different disease in South America. Most recently, a lethal disease of coconuts has been described in Tanzania which shows great similarity to lethal yellowing and could be due to the same or a similar phytoplasma (Schuiling *et al*., 1992).
  EPPO computer code: PALYXX
  EPPO A1 list: No. 159
  EU Annex designation: II/A1
- ***Myndus crudus***
  Name: *Myndus crudus* Van Duzee
  Synonyms: *Myndus cocois* (Fennah)
  Haplaxius crudus (Van Duzee)
  Taxonomic position: Insecta: Hemiptera: Homoptera: Cixiidae
  Common names: Pallid cane leafhopper (English)
  Bayer computer code: MYNDCR
  EU Annex designation: I/A1

HOSTS

- **Palm lethal yellowing phytoplasma**
  The main host is coconuts (*Cocos nucifera*) but the disease has also been found on dates (*Phoenix dactylifera*) and *P. canariensis*. The occurrence of symptoms similar to lethal yellowing together with the presence of phytoplasmas among collections of palms in affected areas in Florida (USA) indicates that at least 30 species of palms are susceptible to infection. The evidence suggests that nearly all the susceptible species are of Old World origin and that almost all American palms are resistant or immune. The following list of genera which include susceptible species is compiled from Harries (1977) and Howard *et al*. (1979):

  Allagoptera, *Arenga*, *Arikuryroba*, *Borassus*, *Caryota*, *Chrysalidocarpus*, *Cocos*, *Corypha*, *Dictyosperma*, *Gaussia*, *Hyophorbe*, *Latania*, *Livistona*, *Mascarena*, *Nannorrhops*, *Phoenix*, *Pritchardia*, *Trachycarpus*, *Veitchia*.

  In the EPPO region, dates are widely cultivated in Algeria, Morocco and Tunisia for fruit production. Many palm species have been introduced as ornamental trees (indoor and outdoor).
- ***Myndus crudus***
  The adults mainly feed on coconuts (*Cocos nucifera*) and other palms, while the preimaginal stages feed on the roots of turf grasses growing in the vicinity of the palms, particularly St Augustine grass (*Stenotaphrum secundatum*) but also other species (*Paspalum notatum*, *Cynodon dactylon*; Reinert, 1980).

GEOGRAPHICAL DISTRIBUTION

- **Palm lethal yellowing phytoplasma**
  The area of origin of the pathogen is not known. Howard (1983) discusses two hypotheses: 1) that lethal yellowing comes from the area of origin of coconuts in southeast Asia; 2) that lethal yellowing is Caribbean in origin.
  EPPO region: Absent.
  Africa: Benin, Cameroon, Ghana (1937), Nigeria (1917), Togo (1937). Possibly Tanzania. (Dates after country names are first records).
  North America: Mexico - Yucatan Peninsula (1978); USA - Florida, first recorded on Key West island opposite Cuba in 1937, since spreading to Key Largo (1969) and then, on the mainland, to Miami (1971) and Palm Beach (1973). Also in Texas (on *Phoenix dactylifera* and *P. canariensis*, 1978).
  Central America and Caribbean: Earliest record 1834 in Cayman Islands. Also in Belize, Bahamas (1946 and possibly for 20 years before, but no longer present), Cuba (1920s), Dominican Republic (1915, confirmed 1962), Haiti (1920s), Honduras, Jamaica (1955).
  South America: Guyana (unconfirmed).
  EU: Absent.
- ***Myndus crudus***
  EPPO region: Absent.
  North America: Mexico, USA (Florida, Texas).
  Central America and Caribbean: Cayman Islands, Cuba, Jamaica, Trinidad and Tobago. Widespread in Central America.
  South America: Northern part.
  EU: Absent.

BIOLOGY

The evidence from electron microscopy, chemotherapy and insect vector experiments shows that palm lethal yellowing is caused by a phytoplasma. Mycoplasma-like particles have been found in the sieve-tube elements of the phloem of coconut and other palms exhibiting characteristic symptoms (Beakbane *et al*., 1972; Plavsic-Banjac *et al*., 1972). Oxytetracycline treatment causes remission of disease symptoms (McCoy, 1975).

Marked differences in susceptibility to the phytoplasma are reported in coconut palms: in general, tall cultivars, e.g. Jamaica Tall in the Caribbean area, are highly susceptible, except for Panama Tall which is thought to be somewhat resistant. The tall types of palms also appear to be very susceptible in West Africa. Malayan Dwarf is notably resistant, as are Malayan Dwarf x Panama Tall hybrids.

Lethal yellowing is transmitted in the Caribbean by the cixiid vector *Myndus crudus*, which feeds abundantly on coconut leaves but is not noted as particularly damaging in its own right. Population densities of *M. crudus* are up to 40 times higher in affected areas than unaffected ones (Howard, 1980). Introduction of *M. crudus* from an infected area onto caged susceptible palms over a period resulted in the development of symptoms (Howard *et al*., 1983, 1984). Plants in cages which were protected from infestation by *M. crudus* remained healthy. Chemical control of the insect has been reported to reduce the apparent rate of spread (Howard & McCoy, 1980).

The geographical distribution of *M. crudus* in the New World more or less coincides with the known distribution of the phytoplasma (Howard, 1983), although the insect has not been recorded on some of the Caribbean islands where lethal yellowing occurs (Bahamas, Dominican Republic, Haiti). In trials, it was the only auchenorrhynchan species of several on coconut to be confirmed as a vector, but it remains possible that related or other species may also transmit the disease. The same applies in Africa, where *M. crudus* does not occur; no vector has positively been identified but the pattern of spread certainly suggests a vector. Wilson (1988a) has reviewed the status of Homoptera Auchenorrhyncha as vectors of palm diseases. A related *M. affini* is the vector of another coconut disease, foliar decay, in Vanuatu (Wilson, 1988b).

Purcell (1985) notes that *M. crudus* is a very inefficient vector of lethal yellowing, but is so abundant that a very low transmission rate is sufficient to spread the disease. He also notes that the tropical *M. crudus* reproduces continually throughout the year, and is limited by its lack of winter diapause to areas with sufficiently mild winters. This may set a northern limit for lethal yellowing (at least transmitted by this vector).

DETECTION AND IDENTIFICATION

Symptoms

In general, an early symptom is the drying up of developing inflorescences. In coconut palms the spathes enclosing the flowers become discoloured and the tips blacken. The youngest leaves next to the buds show water-soaked streaks which spread until there is a terminal rot of the growing point. After the first symptoms there is a progressive leaf discoloration, beginning with the older leaves and spreading rapidly to the younger ones. The foliage turns light-yellow and eventually orange-yellow. This symptom coincides with the death of root tips. Death occurs in *C. nucifera* about 4 months after the initial symptoms appear.

Morphology

- **Palm lethal yellowing phytoplasma**
  Typical phytoplasma particles were found in sieve tubes of infected plants. They were ovoid, elongated and filamentous in shape and were bounded by a triple-layered structure comprising two electron-dense layers with a transparent layer between (Plavsic-Banjac *et al*., 1972).
- ***Myndus crudus***
  The pre-imaginal stages of *M. crudus* are subterranean, feeding on grass roots. They have been described by Wilson & Tsai (1982). The head and thorax of the adults are pale-brown, the forewings are hyaline with pale or light-brown veins. Males and females are 4.2-5.1 mm long. Characters of the male genitalia are essential for the specific identification (Kramer 1979). In particular, the aedeagus is distinct. In left lateral view it has a long process originating in the distal half and directed ventrally and towards the head.

Detection and inspection methods

At present, there is no reliable diagnostic test for this phytoplasma.

MEANS OF MOVEMENT AND DISPERSAL

Natural spread results from the movement of the vector *M. crudus*. Infected vegetative plant material, including ornamental species, could carry the pathogen in international trade. The vector is less likely to be carried by palms, which are infested only by the actively mobile adults. Since vector efficiency is said to be low, the probability of international movement of the phytoplasma in the vector may be correspondingly low. *M. crudus* itself could possibly be moved in international trade as nymphs in soil accompanying palms, but would not then be infected by the phytoplasma.

PEST SIGNIFICANCE

Economic impact

Experience in Jamaica suggests that almost total destruction of a population of susceptible palms can occur: by 1979, an estimated 4 million coconut palms had been killed by palm lethal yellowing disease (on the island. In Florida, out of an estimated 1-1.5 million *C. nucifera* on the mainland, 300 000 had died by 1983. In the case of Florida, not a coconut-producing area, the socio-economic loss has been as a result of a destruction of an important and valuable feature of the amenity vegetation.

The vector *M. crudus* is not a major pest of palms.

Control

Control is best achieved by planting of resistant cultivars; in particular the cultivars Panama Tall and Malayan Dwarf are known to be resistant. Control of the vector *M. crudus* with insecticides is likely to limit spread. Management of the grass populations in coconut plantations has also been suggested as a means of control, since some grass species are relatively poor hosts for the nymphs of *M. crudus* (Howard, 1990). Treatment of infected plants by injection into the trunk of oxytetracycline-HCl has been shown to suppress the symptoms of lethal yellowing (McCoy, 1975). Treated plants produce new healthy growth and can be maintained without symptoms by retreatment at 4-monthly intervals.

Phytosanitary risk

EPPO (OEPP/EPPO, 1986) has listed palm lethal yellowing phytoplasma as an A1 quarantine pest, and it is also a quarantine pest for APPPC, CPPC, IAPSC and NAPPO. In the EPPO region, the most important economic crop at risk is *Phoenix dactylifera*. It has been recently seen in Texas that an outbreak of palm lethal yellowing can occur in a non-coconut-growing area (McCoy *et al*., 1980). The risk to date palm prompted the following proposal by Carpenter (1977): 'In Florida, lethal yellowing has been identified in *P. dactylifera*, *P. canariensis* and *P. reclinata* as well as in coconut and several other species of palms. No living palms or palm seeds should be moved from lethal-yellowing-infested areas to date-palm-growing areas or countries.' Movement of ornamental palms from infested areas could be just as hazardous to date-growing countries as the movement of date palms themselves, because of the possibility of spread by vectors.

There is a limited possibility that the phytoplasma could be introduced in the vector *M. crudus* (see Means of movement and dispersal), and also that the introduction of the vector would facilitate later spread. However, *M. crudus* is a tropical species which would not certainly survive in southern Europe. Lethal yellowing is present and spreads in West Africa (possibly after introduction from the Caribbean) without *M. crudus*. It seems more probable that existing auchenorrhynchan insects on palms in the EPPO region would become vectors.

Carpenter's comments on ornamental palms point to another aspect of the disease - its possible introduction into outside plantings of ornamental palms of considerable amenity value in the southern EPPO region and also, of course, valuable collections of palms under glass in botanic gardens, etc. Besides, palms are of great significance in nearly all modern indoor landscape plantings and their value to the horticultural trade is considerable. In this context it is relevant to note that large amounts of money are spent on commercial indoor plant displays in business premises, exhibitions, etc., and there is often a strong incentive to import mature plants, including palms, at considerable expense to achieve instant effects.

It should also be noted that the introduction of palm lethal yellowing phytoplasma into the EPPO region could be a crucial factor affecting the possibility of the disease extending its range on coconut in the tropics. Europe is an important source of planting material for the whole world and it would be easy for a small ornamental palm to be the means of carrying infection from a nursery or botanic garden in Europe to the Pacific area, with the probability of disastrous consequences to many people whose livelihood depends on the coconut.

PHYTOSANITARY MEASURES

In view of the difficulties of diagnosis, pre-export certification would not seem to offer adequate protection. Prohibition of import of palms from countries where palm lethal yellowing phytoplasma is present, seems the only satisfactory measure (OEPP/EPPO, 1990). Post-entry quarantine could be used in special cases.

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