Bursaphelenchus cocophilus

Introduction

Bursaphelenchus cocophilus (Cobb) causes red ring disease of palms. This disease was first seen in coconuts in Cedros, Trinidad in 1905. It is now wide spread in the Caribbean and Latin America wherever coconuts are cultivated.

Identity

Authority : Cobb, (1919)
Classification
Kingdom : Animalia
Phylum : Nemata
Class : Secernentea
Order : Aphelenchida
Family : Aphelenchoididae
Genus : *Bursaphelenchus*
Species : *cocophilus*
Synonyms : *Aphelenchus cocophilus* Cobb, 1919; *A.* (*Chitinoaphelenchus*) *cocophilus* (Cobb, 1919) Mico- letzky, 1922; *Aphelenchoides cocophilus* (Cobb, 1919) T. Goodey, 1933; *Chitinoaphelenchus cocophilus* (Cobb, 1919) Chitwood in Corbett, 959;*Rhadinaphelenchus cocophilus* (Cobb, 1919) Goodey, 1960.
Common name: Red ring nematode.

Signs & Symptoms

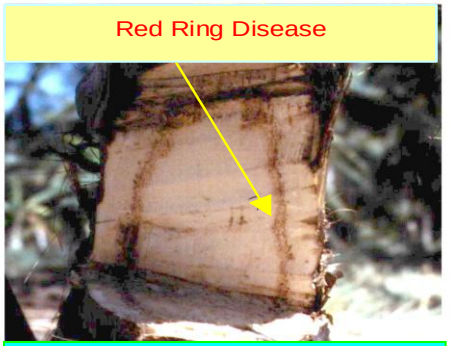

Fig. 1: Vertical and horizontal cuts through trunk of coconut to reveal the typical "red ring", the primary symptom of " red ring" disease of palms caused by *Bursaphelenchus cocophilus*
Photo Credit: **Dave G. Hutton**

A ring of discoloured tissue is the most characteristic symptom of red ring disease of coconut and other palms (Fig.1). Trees are normally susceptible to the disease for two years before and after they come into bearing. Older and younger trees generally exhibit a high degree of resistance. Infected trees show yellowing, usually of the lower leaves, starting at the tips of the pinnae and progressing towards the leaf base. The yellowing is followed by browning and the leaves eventually die. The yellowing and browning spread to other leaves and the tree dies between six and 16 weeks after the first appearance of symptoms. Shedding of green nuts of all sizes takes place with or slightly in advance of leaf discoloration and sometimes is the first symptom of disease. Shedding of open and unopened flowers and partial withering of branches of the inflorescences may also occur. Trees with infected roots show drooping leaves and drooping bunches of coconuts, the nuts often falling prematurely. The advanced stages of infection may be associated with putrefaction of the soft tissues of the stem and base of the central

column of unexpanded leaves and sometimes the tree breaks off at the neck. Infested roots change colour from white to yellow, pink, dark yellow or red-brown, and their bark sloughs off. Although the classical red ring symptom occurs in most infected stems, solid red pith has been observed in infected trees in El Salvador.
A toxin produced by the breakdown of coconut tissue may be associated with the disease. A toxic principle caused wilting in tomato (*Lycopersicon esculentum*) and in three small palms (*Ptychoraphis augusta, Licuala spinosa* and *Thrimax morissi*) which were used as indicator plants. Water uptake of infected coconut palms was markedly less than that of healthy trees and showed that the xylem vessels of infested trees are occluded.
B. cocophilus also causes little-leaf disease of coconut and oil palm in Surinam and Guyana. The disease is characterized by leaves being reduced in size and standing stiffly upright; pinnae are short, wiry and necrotic terminally; yellowish suberized patches appear on leaf bases and petioles and older leaves turn yellow to grey. The disease was produced experimentally in oil palm and in the wild palm, *Mauritria flexuosa*. It has been reported from some of the same areas as red ring.

Morphology

Female: Body about 1 mm long and very slender (a = 60-96), arcuate to nearly straight when relaxed; cuticle thin, marked with transverse straie 0.6-1 μ apart; lateral fields with four incisures and a faint median line, suggesting a fifth incisure, occupying 0.25 of body-width; deirids and phasmids absent. Lip region smooth, high, anteriorly flattened with rather straight sides, slightly narrower than body; head framework prominent, sclerotized. Spear 11-13 μ long, attenuated, knobbed at base but knobs may be obscure, especially on immature specimens; anterior part less than half spear length and sharply pointed. Propcorpus elongate-cylindrical; median bulb oval, usually about twice as long as wide, with prominent valve-plates just posterior to centre; dorsal oesophageal gland orifice midway between anterior margin of bulb and valve plates. Oesophageal glands overlapping intestine dorsally, usually obscure. Vulva slit-like appearing as an open C in ventral view, slightly overhung by a wide, thick dorsal lip; posterior lip is also thick and heavily sclerotized. Vagina thick-walled, slightly curved as it leads inwards to a distance of about 0.5 of body-width. Anterior gonad well developed, outstretched; oocytes in a row. Postvulval uterine sac elongate, extending about 0.75 of vulva-anus distance, often with a few large spheroid sperms. Rectum about 1.5 anal body-widths, distinct. Tail elongate-subcylindrical with a rounded, unstriated terminus, 10-17 anal body-widths long.
Male: Body ventrally arcuate, more strongly curved in tail region. Head, spear and oesophagus as in female. Testis single, anteriorly outstretched, with spermatogonia in a row. Spicules paired, small, dorsal limb 9-11 μ long with an elongated rounded apex and ending distally before the central limb whose distal end appears to recurve to join the dorsal limb so that the entire spicule appears notched distally; the ventral element has a distinct rostrum proximally, and appears to be connected to the dorsal limb through a transverse bar with a central hole for passage of nerves. No gubernaculum, but dorsal wall of spicule pouch is thickened to form an apophysis. Tail strongly curved ventrally (may form 1.5 circles), subcylindrical in anterior half, then conoid to a pointed terminus. Bursa (or caudal alae) terminal, prominent in dorsal or ventral view (not easily detectable in lateral view as it does not project beyond tail contour) with finely striated margins enveloping distal 0.4-0.5 of tail.

There are two pairs of distinct ventro-submedian papillae near base of bursa and a pre-anal pair, about 0.5 of the spicule length anterior to cloaca.
Larvae: Larvae have high dome-shaped heads, not offset from body. Tails of second- and third-stage larvae have conoid or sharply mucronate tips and those of fourth-stage larvae have dimorphic tips; in female larvae they are rounded, as in the adult, and in male larvae sharply drawn out.

Biology & Ecology

The most characteristic symptom of infection of coconut by *B. cocophilus* is the presence of a red or orange-red ring of tissue about 3 cm wide at about 2.5 cm below the stem surface, hence the names red ring disease and red ring nematode. At first, scattered dots about 1 mm in diameter are seen which eventually coalesce and form the ring of discoloured tissue**.** In coconut roots, *B. cocophilus* attacks cortical tissues and in stems and leaves it invades intercellular spaces and sometimes cells. In stems, the nematodes are present up to about 2.2 m above the soil line, greatest numbers occurring 15-30 cm below the upper limit of infestation; 10g of infected stem tissue may contain 50,000 and more nematodes. In the upper part of the stem, the nematode is inter-cellular, but in the lower part cell disintegration occurs, leading to the formation of cavities containing many larvae. Adult nematodes and eggs occur in greatest numbers in the crown of the trees; adults are sometimes found inside the red ring of the stem, but are more numerous at the edges, especially the inner edge. The 9-to-10 day life cycle of the red ring nematode is one of the shortest reported for plant-parasitic nematodes.
Pieces of infected coconut tissue placed on the soil resulted in the initiation of red ring disease, suggesting that the nematode could survive and migrate in soil. Movement in soil was favoured by high moisture, consistent with the finding that trees are more easily infected in the wet season and greater disease incidence occurs in swampy, low-lying areas. The nematode did not survive in soil for more than two to three days. Artificial infection of seednuts and young seedlings of coconut with about 4,000 *B. cocophilus* did not produce the red ring disease in grown plants, but nematodes introduced into the stem through auger holes produced disease symptoms in 21 to 28 days. There is strong evidence that the palm weevil, *Rhyncophorus palmarum*, is the principal vector of the red ring nematode; a strong correlation between the seasonal abundance of the weevil and the incidence of red ring was obtained in one instance. Ants, spiders, and other types of weevils are also reported as being vectors. Palms that are infected and dying from red ring disease give off a chemical that attracts *R. palmarum*. Weevil eggs laid in the crowns of these palms hatch and the larvae bore down the bole picking up nematodes while completing metamorphosis. The weevil larvae themselves can do considerable damage to palm trees. It was shown that large numbers of *B. cocophilus* larvae entered the body cavity of the palm weevil larvae either through the mouth or the spiracles. The nematode persisted without change or multiplication, throughout the metamorphosis of the insect. On emergence of the adult females, large numbers of nematodes are located in the region of the ovipositor. These females are attracted to wounds and cuts in the trunk of other palms, and the nematodes are injected into the soft tissues of the coconut tree when the insect deposits its eggs. Only 16% of the weevils in infested areas contained nematode populations large enough to incite the disease. There is a possibility that some other weevil or beetle pests of coconut and other palms might play a minor role as vectors of red ring disease.

Nematodes can also be transmitted from one tree to another by root contact, and also by tools used to cut down infected trees.

Dispersal /vectors

Rhyncophorous palmarum L. the palm weevil is the vector of red ring disease.

Management

Chemical Control

Since it is generally agreed that the palm weevil is the most important vector of the red ring nematode, control measures have been aimed primarily at insect control. It was reported that the incidence of red ring disease in Mexico was reduced from 10 to 1% by spraying trees with Palmoral (19.5% endrin with cumarone). Subsequently, treatment of the nematode with Nemaphos (10.5% active ingredient) resulted in 100% mortality of *B. cocophilus*. In Trinidad nematodes and weevils were controlled by using Cocosev, a locally produced formulation of ground coconut shells coated with Sevin (carbaryl), applied to the leaf axils. The fumigant Dowfume MC-2 was successfully used to kill nematodes and weevils in diseased coconut tissues. Wire-mesh baskets filled with chunks of diseased coconut tissue soaked in Lannate (0.1% solution) were placed in coconut plantations where vector and non-vector weevils were attracted by the decaying coconut tissue and killed within minutes. The baskets remained active for 10 days to three weeks. However, general widespread use of these very toxic materials is unacceptable everywhere.

Phytosanitary measures

The most useful and most important method for managing red ring nematodes is the early removal and destruction of infested palms. Aggressive phytosanitation is the best chance to halt the spread of red ring disease to nearby trees. Infested palms should be sprayed with an insecticide and then destroyed as soon as possible once the presence of red ring nematodes has been confirmed, since weevil larvae will sometimes remain in the tissues of palms that are killed with herbicide. These trees should be cut into sections and treated with insecticides, or burned.

Nematode DD-136 (*Neoaplectana* sp.) quickly destroyed adults, pupae and to a lesser extent larvae of the weevil in laboratory tests.

Host Notes

Under natural conditions the nematode causes red ring disease in the coconut palm (*Cocos nucifera*) and the oil palm (*Elaeis guineensis*), but successful artificial inoculations of the cabbage palm (*Roystonea oleracea*), gru-gru *palm (Acrocomia aculeata*), *Mauritria flexuosa* and *Maximiliana maripa* have been reported. The red ring nematode also parasitizes other tropical palms, including date, Canary Island date, and the Cuban Royal.

Distribution

The disease is now widespread in the Latin America and Caribbean regions, being reported from Grenada, Trinidad and Tobago, Barbados and St. Vincent in the West Indies and from Belize, Brazil, Colombia, Costa Rica, Ecuador, El Salvador, Guyana, Peru, French Guyana, Nicaragua, Honduras, San Blas Islands, Mexico, Panama, Surinam and Venezuela. Over 20% of coconut trees examined in Grenada were infected and thousands of unproductive infested trees were seen in St. Vincent; in Guyana, 7% mortality of trees due to this nematode was observed; 35% mortality of young coconut trees has been recorded in Trinidad, and 80% loss in a single plantation in Tobago; over a period of 10 years 35% of oil palms died in a plantation in Venezuela. Oil palms are attacked in Colombia; in Surinam, the nematode has been associated with both red ring and little leaf diseases of coconut and oil palms.

Bibliography

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WEB RESOURCE -

http://creatures.ifas.ufl.edu/nematode/red_ring_nematode.htm
http://www.nematode.unl.edu/bursacoco.htm
http://www.plpnemweb.ucdavis.edu/nemaplex/Taxadata/G145S3.HTM