Root wilt
A phytoplasmal disease of coconut in south India

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Rootwilt disease of coconut causes loss of 968 million nuts/year, 26 per cent loss in husk, 9/11.3 per cent loss in copra/oil, nut, and 60 per cent loss in yield/revenue from leaves/palm. Our scientists are developing an improved West Coast tall (WCT) palm cultivar by crossing high-yielding and disease-free WCT palms so that loss could be checked resulting in increased coconut production.

Key words: **Coconut, Fungal disease, Root wilt, South Indian climate**

ROOTWILT disease of coconut, a non-lethal but debilitating disease affecting palms of all age groups, causes loss of 968 million nuts/year. Apart from reduction in yield, it results in 26 per cent loss in husk and 9.0/11.3 per cent loss in copra/oil/nut. The leaves are also damaged resulting in 60 per cent loss in yield/revenue from leaves/palm.

The root wilt disease of coconut is contiguously prevalent in 8 southern districts of Kerala (from Thrissur to Thiruvananthapuram) covering an area of 0.41 million ha, in isolated tracts in the northern districts of Kerala and in the bordering districts of Tamil Nadu. The intensity of the disease is highest in Alleppey district (48.03 per cent) followed by Pathanamthitta (37.8 per cent) and Kottayam (36.5 per cent) districts and tapers toward Thrissur (6.19 per cent) in the north and Thiruvananthapuram (2.09 per cent) in the south.

Symptoms

The most consistent and diagnostic symptom associated with the disease is the inward beinding or rib-

Coconut palm showing symptoms of root wilt disease.

Leaf-rot disease superimposed on root wilt affected palm

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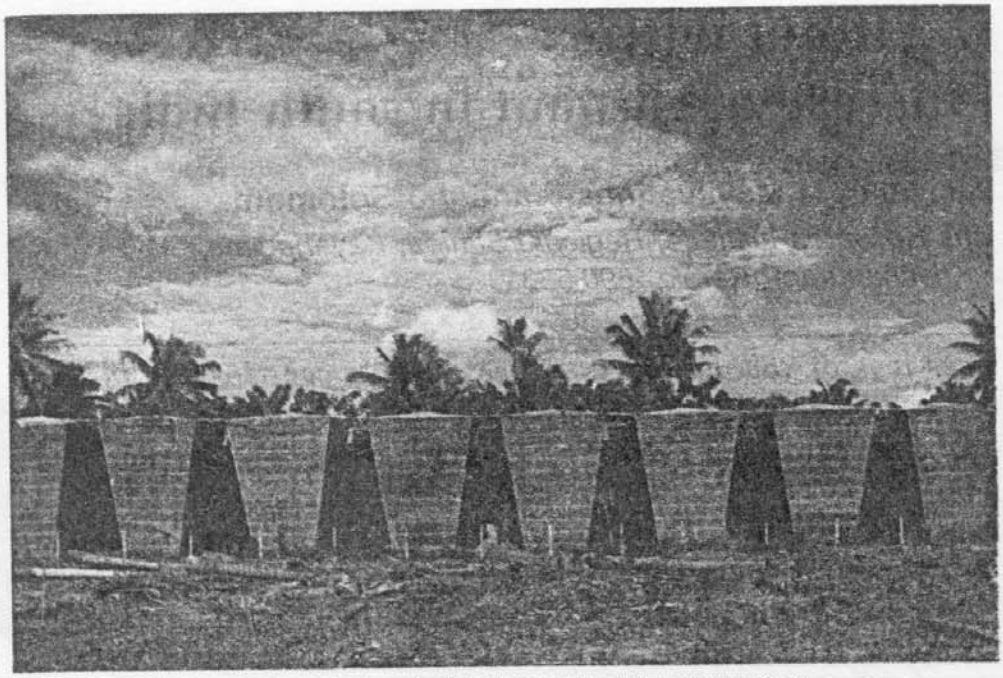


Cage erected to prove transmission of phytoplasma through insect vectors

bing of the leaflets called 'flaccidity'. The leaflets curve inwards resembling ribs of mammals. Other important foliar symptoms are yellowing of outer whorls of leaves and marginal necrosis. In young palms, below 10 years, flaccidity is the only symptom observed; yellowing and marginal necrosis are virtually absent. Based on the intensity and frequency of occurrence of these 3 major symptoms, a disease indexing system has been worked out for quantifying the severity of the disease in simple numerical expression. Besides these shedding of buttons and immature nuts, rotting of roots, reduction in leaf number and leaf area, reduction in crown size in advanced stage of disease, inflorescence necrosis, abnormal shedding of female flowers and lack of ability to produce female flowers, pollen sterility, poor quality of nuts/copra. The husk becomes thinner, less firm and shell does not properly harden, kernel thickness is uneven and the kernel does not dry normally and remains rubbery and flexible. In palms which contract the disease before the commencement of bearing, flowering is often delayed indefinitely and the yield of such palms is also drastically affected. There is an average reduction of 0.5 nut/disease index value (intensity of disease) under cultivators conditions, and 1.3 nuts/index for the younger palms under well managed farm conditions.

Leaf rot, a fungal disease, occurs superimposed on about 65% of root wilt affected palms. This hastens the decline of the palms resulting in reduction in yield.

Etiology

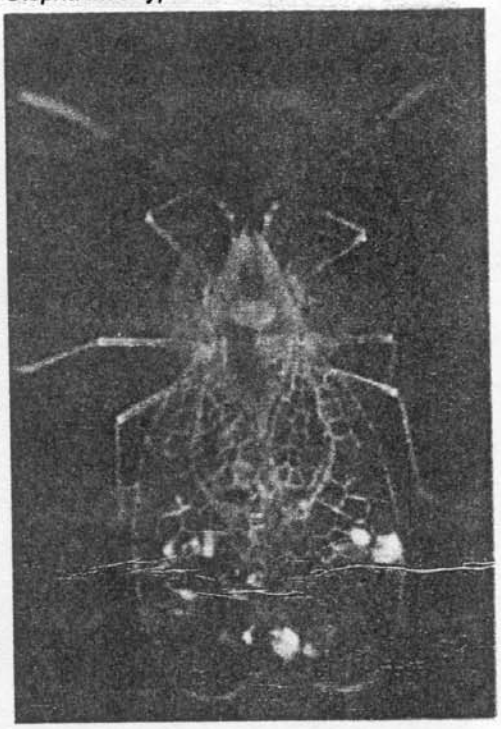
The causal organism of the disease is a phloem–bound mollicute – the phytoplasma, called as mycoplasma-like organism (MLO). Phytoplasmas are plant infecting mycoplasmas that are non-helical, non-culturable and that are transmitted by arthropod insect vectors. Phytoplasmas are cell wall less bacteria (Prokaryotes) bound by a trilamellar unit membrane and contain DNA strands varying from circular to oval and occasionally beaded or filamentous forms. The size of the coccoid forms ranges from 250 to 400 nm. Phytoplasma associated with coconut root wilt disease could not be grown in culture media in laboratory and chracterized for determining the genus and species unlike true mycoplasmas.

Phytoplasmas could be visualized with optical light microscope using histological dyes viz. Dienes stain and certain fluorechromes viz. DAPI and Hoechst 33 258 and also by electron microscopy. The organisms are frequently visualized in junctions of vascular bridges and close to the sieve plate. They are consistently present in the vascular tissues of root wilt affected palms and conspicuously absent in disease-free or apparently healthy palms.

Transmission

Conventional insect vectors of phytoplasma are leaf-hoppers, plant hoppers (Auchenorhyncha) and in a few instances by psyllids. *Stephanitis typica* (Distant) – Tingidae (Lace bug), the single major group of insects on coconut, is a vector responsible for the transmission of root wilt disease. Lace bug is prevalent in all areas where the coconut root wilt disease is prevalent. It is more abundant on diseased palms than in the healthy palms. In diseased palms, it colonizes in increasing number towards the inner leaves of the crown where active

Stephanitus typica



Proutista moesta, an insect vector.

forms of phytoplasma are in higher concentration. Lace bugs feed from phloem and picks up the phytoplasma from there. Phytoplasmas are detected in salivery glands and brain tissues of lace bugs offered acquisition and incubation period of 18 to 23 days on diseased palms but absent in bugs from disease-free areas. The lace bug feeds and breeds on coconut and completes its entire life span mostly confining to a same plant.

Besides lace bug, a plant hopper, *Proutista moesta* (Westwood) is another vector that transmits the disease. Only adults of the hopper feeds on older leaves.

Culturing

The phytoplasma is not amenable to culturing *in-vitro*, in synthetic and semi-synthetic media, and also in chick embryos. However, it can be maintained/propagated in tissue cultured explants from diseased coconut palms in certain plant tissue culture media.

Chemotherapy

Phytoplasmas are obligate parasites and are non-culturable. Pathogenicity of the organism therefore cannot be proved by conventional means. Phytoplasmas lacking cell-wall are insensitive to penicillin and are sensitive to tetracycline. Thus plants affected by phytoplasmas respond to treatment with tetracycline, resulting in temporary remission of symptoms in contrast to penicillin treated ones. This circumstantial evidence is accepted as a conclusive proof for implicating phytoplasmal etiology of the disease. In a field trial conducted for 3 years, remission of symptoms was observed in significantly higher number of tetracycline treated palms. The penicillin treated palms deteriorated over the pre-treatment condition. Although this differential chemotherapeutic response is useful for confirming the phytoplasmal etiology of the disease, it cannot be recommended as a control measure as only temporary, partial remission of symptoms could be achieved and the antibiotic needs to be repetitively administered.

Disease management

It is a non-lethal disease, therefore, the affected palms respond to ideal management. Based on intensive studies, 2 strategies were developed –
(i) for the mildly affected area, and (ii) for the heavily diseased tract. The strategy for the former is to eradicate all diseased palms irrespective of age and intensity of the disease to eliminate the source of inoculum, so as to arrest further spread of the disease.

The management strategy for the heavily diseased area include :

(i) Removal of all diseased advanced and uneconomical palms and replanting with healthy hybrid seedlings or elite mother palms.
(ii) Removal of all juvenile palms showing symptoms of the disease irrespective of its intensity.
(iii) Raising intercrops in rotation/ adopting mixed cropping/ mixed farming with recycling of organic matter.
(iv) Provision of proper drainage wherever found necessary.
(v) Growing green manure crops, preferably *Peuraria phaseoloides* in basins during April–May to September–October and incorporation.
(vi) Application of 50 kg farm yard manure/palm/year.
(vii) Irrigating palms during summer @ 250 litre/palm/week.
(viii) Application of balanced doses of fertilizers (500g N, 140 g P, 990 g K and 300 g Mg/palm/ year) in 2 splits. One–third dose to be applied during April–May and two–thirds during September–October for rainfed palms and in 4 splits during January, April, July and October for irrigated palms.
(ix) To control rhinoceros beetle, apply Sevidol (8G @ 25g/palm) mixed with 200 g river sand around the base of the spindle.
(x) For controlling leaf rot disease :
  (a) Cut and remove rotten portions of only spindle and two top most fully opened leaves.

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(b) Mix Hexaconazole (Contaf 5 EC) @ 2 ml/palm or Dithane M-45/Indofil M-45 @ 3g/palm in 1 litre water. Pour this around the base of spindle leaf.

There is need to evolve disease resistant/tolerant coconut varieties. The 63 cultivars and 32 hybrid combinations were tested and no one found to be resistant. However, the cultivar, Chowghat Green Dwarf (CGD) is found to have higher level of field tolerance. This is being currently used to cross with root wilt-free elite West Coast Tall (WCT) palms in the heavily diseased tract to obtain disease resistant/tolerant planting material. The progenies thus developed are promising with high-yield potential and disease tolerance. Besides this efforts are being made to develop an improved WCT cultivar by crossing high-yielding and disease-free WCT palms growing in the diseased tract.