Modern Coconut Management

Palm cultivation and products

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Root(Wilt)

Root(Wilt) disease (RWD) was first reported in the State of Kerala, India, after the great flood of 1882 in three independent locations, each about 50 km apart. Since then it has spread from the original foci of infection. According to a survey conducted during 1984/85, the disease was prevalent in more or less a contiguous manner in 410000 ha in the eight southern districts of Kerala. It was also observed in a few isolated pockets in the northern districts of that state and in the bordering districts of the State of Tamil Nadu (Solomon and Pillai 1991). The intensity of the disease in the contiguous diseased tract ranged between about 1.5 per cent and 75.6 per cent. The annual loss due to the disease was estimated at about 968 million nuts. RWD is non-lethal but debilitating, and palms of all age groups are affected. It was given its name by early investigators, probably because rotten roots had been observed on diseased palms. Later, the name Wilt was considered more appropriate and these names have been combined (Rawther and Pillai 1991).

The first symptom is deterioration of the spear, indicated by whitening and softening of the leaflets. These soft leaflets are whitish-brown to pale-green. Round to rod-shaped necrotic spots appear at the margins. Usually, the leaflets are rotten at their tip margins. They have inter-veinal chlorosis followed by marginal necrosis. Chlorosis starts from the tips and progresses towards the bases of the leaflets. The general yellowing and drooping of the middle and outer whorls of leaves and flaccidity of leaflets have been indicated as the most pronounced symptoms of the disease. The flattening and bending of these leaflets and the drooping of leaves give the diseased palm a wilted appearance. At a later stage, the bending of leaflets from two sides of the mid-rib give the appearance of ribs of a human skeleton (Rajagopal 1991). But the expression of foliar symptoms varies both in frequency and in association with each other, depending on the soil types and ecological conditions. Intensity of foliar symptoms also varies according to the age of the palms, yellowing and marginal necrosis being virtually absent in palms less than ten years old (Pillai and Rawther 1991). The growing point remains unaffected. In certain cases, drying up of the spathe and necrosis of the spikes extending from the tip downwards was observed. Inflorescences may grow weaker, producing fewer buttons and nuts. Buttons and small nuts may be shed. There may be a reduction in nut size, the endosperm is thinner than usual and uneven in thickness, and when dried remains flexible. Also the husks are thinner and their fibres weaker than usual. Palms affected before flowering may not flower at all.

Rotting of roots was once considered a major symptom. However, this could not be substantiated in later studies (Solomon and Pillai 1991). Notwithstanding, the uptake of water by roots of diseased palms is much less than that of healthy palms (Rajagopal *et al.* 1986). Thomas (1988) observed that the endomycorrhizal symbiosis of coconut is adversely affected by RWD.

Electron microscopic examination of juvenile tissues showed the presence of a phloem-bound MLO, but not in all cases. It is assumed that MLOs produce metabolites that influence stomatal regulation, either their closure or opening (Rajagopal 1991). In addition to reduced water uptake, the stomatal regulation plays a key role in the ultimate expression of foliar symptoms. Contrary to stomatal closure, a characteristic feature of all other yellowing diseases, RWD palms have an abnormal stomata opening with impaired regulation leading to excessive water loss, irrespective of the time of day, season or growing conditions. By two tests, the serological test using the cross absorption technique, and stomatal resistance determination, the disease could be detected 6-20 months earlier than the actual manifestation of flaccidity symptoms (Rajagopal *et al.* 1988).

Root(Wilt)-diseased palms have higher stomatal frequency than of healthy palms. Diseased palms have consistently lower leaf-water potential than healthy palms (Mathew *et al.* 1991). Imbalance of the water economy caused by a deranged root system and impaired stomatal regulation culminates in an irreversible flaccidity symptom of leaves through changes in leaf-water potential components. The disease is not lethal but is accompanied by other diseases such as fungal leaf diseases, which may result in the death of the palm. No recovery of affected palms has been recorded yet.

In general, the spread is erratic and irregular. Jump spread also occurs, with a reach of about four kilometres from the nearest source of infection. The disease occurs in all major soil types, but the spread is faster in sandy, sandy loam, alluvial and in heavy textured soils than in laterites. The disease incidence is relatively higher in water-logged low lying areas adjacent to rivers and canals.

The lace bug *Stephanitis typica* is suspected to be the vector of the disease. Transmission trials with this insect had positive results (Mathen *et al.* 1990). The lace bugs are found colonizing in increasing numbers towards the inner leaves of the crown. The number of lace bugs on diseased palms is found to be much higher than on healthy palms. A survey showed a direct correlation between the number of insects colonizing the palms and fresh incidences of the disease (Mathen 1985). In RWD palms, the nitrogen content is higher in the middle and advanced stages of the disease compared to that of healthy trees, and the accumulation is found more towards the young and expanding leaves when the disease intensity increases (Wahid and Kamalam 1988). Accumulation of nitrogen may make the cell walls thin, which is evidenced by observations that leaflets from diseased palms were thinner and their cell constituents showed a general reduction in size. A high nitrogen content of plants with the application of nitrogen fertilizers is often correlated with a heavy incidence of a number of insects. Electron microscope studies have revealed the presence of MLOs also in a plant hopper. The vectorial role of the hopper is to be assessed through a transmission experiment (Solomon and Govindankutty 1991).

All exotic cultivars tested were found susceptible to the disease with varying degrees of intensity. However, the San Ramon variety recorded significantly lower disease incidence, followed by Guam Tall and the St Vincent and Kenya Talls. Remarkably, the local West Coast Tall was found to be the most susceptible variety, followed by Java Tall (Mathai *et al.* 1991). Chowghat Green Dwarfs (CGDs) showed maximum field tolerance (over 90%) to the disease. A breeding programme apparently involving disease-resistant CGDs and selected West Coast Talls free from disease growing in diseased areas has been initiated (Jacob and Rawther 1991). Palms treated with 3 - 6 g a.i. of oxytetracycline hydrochloride clearly indicated remission of symptoms (Pillai *et al.* 1991).

In the long term, the provision of resistant varieties seems to be the only economically justified solution to the problem. An eradication programme of diseased palms followed by surveillance was started in 1971 in some districts. By 1984, the recurrence of the disease was observed only in one village where the initial disease intensity was high, indicating that the disease could be eliminated from mildly affected areas if phytosanitary measures were adopted (Radha, K. *et al.* 1985). Integrated management practices, such as fertilizing, irrigation, proper drainage, control of other diseases such as Leaf Spot, and intercropping may substantially improve yields, indicating that in the mildly affected areas one can live with the disease (Rajagopal *et al.* 1986; Rethinam *et al.* 1991).