

KERALA, the land of coconuts, is facing an economic threat due to a complex malady of this crop. Nearly one-third of the seven lakh hectares under coconut crop in the state is affected by devastating root (wilt) disease known in vernacular as 'Kattuveczhcha' or 'Veruchceyal'. The disease is almost a century old. It is reported to have been first detected in 1882 after heavy floods in three isolated pockets of Central Kerala in Kottayam and Alleppey districts. It has spread in all directions and has at present reached up to Trichur

like appearance to the leaves. This disease is generally severe during the monsoon periods.

The Problem

Nature and Cause. The two diseases of coconut have drawn considerable attention since 1934. The root (wilt) disease is pathogenic. The contagious nature of the disease was indicated by its reproduction artificially on coconut seedlings grown in soil from disease-free area incorporated with roots of diseased palms.

ROOT WILT DISEASE PROBLEMS AND PERSPECTIVES

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district in the north and Trivandrum district in the south. Recently the disease was observed in two villages in Kanyakumari district of Tamil Nadu.

Palms of all ages are affected by this disease. It is debilitating in nature but not fatal. It gradually reduces the yield of nuts, ultimately rendering the palm nearly barren. A conservative assessment of the loss is approximately Rs 300 million annually. Within the root (wilt) disease affected tract, nearly 20 per cent of the palms develop a secondary fungal disease, namely the leaf rot (*Bipolaris halodes* Drechs). Usually leaf rot occurs on root (wilt) disease affected palms but rarely it develops in healthy palms. Superimposition of this secondary malady leads to rapid deterioration of the palms causing more than 50.0 per cent reduction in yield.

Symptoms. An unusual bending or ribbing of the leaflets commonly referred to as flaccidity in the middle whorl of leaves that extends to the outer whorl. Yellowing and abnormal drying of leaflets along the margins of older leaves generally occur. Drying of the inflorescences from tip downwards, shedding of buttons and immature nuts also set in adult palms. Roots show extensive rotting, hence the disease is also referred to as 'Veruchceyal'. Gradual reduction in number and size of leaves and nuts and deterioration in quality of copra render the palm uneconomical.

Leaf rot disease is characterised by rotting of the tender shoot from the tip downwards. The rotted portions later dry up and are blown away giving a fan-

Soil conditions also appear to have some important role in the incidence of disease. Although the disease is prevalent in all types of soil from the lateritic hill



Healthy coconut palm

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Coconut palm affected by root-wilt disease

ranges to the sandy coastal tract, the spread of the disease is more favoured by high water table. The disease spreads faster in loose sandy, sandy loam and alluvial soils than in laterite soils. Incidence of the disease along banks of rivers and canals in the outlying border areas at the foothills leads to further spread downstream. However, spread of the disease in the upward direction has also been observed in the plains—from the bunds of paddy fields of the gardenland. Occurrence of healthy pockets and individual palms within the disease-affected tracts and sporadic outbreaks of disease in healthy areas are baffling instances.

During the early period, the disease was attributed to the damage caused to the root system by the fungus *Botryodiplodia theobromae* Pat. Later investigations however revealed that *B. theobromae* was innocuous and that two other fungi *Rhizoctonia solani* (Kuhn) and *R. bataticola* (Taub) Butl. were found to be constantly associated with the rotting of roots. These organisms, considered to be weak pathogens, are capable of inducing root rot under conditions unfavourable to the palm.

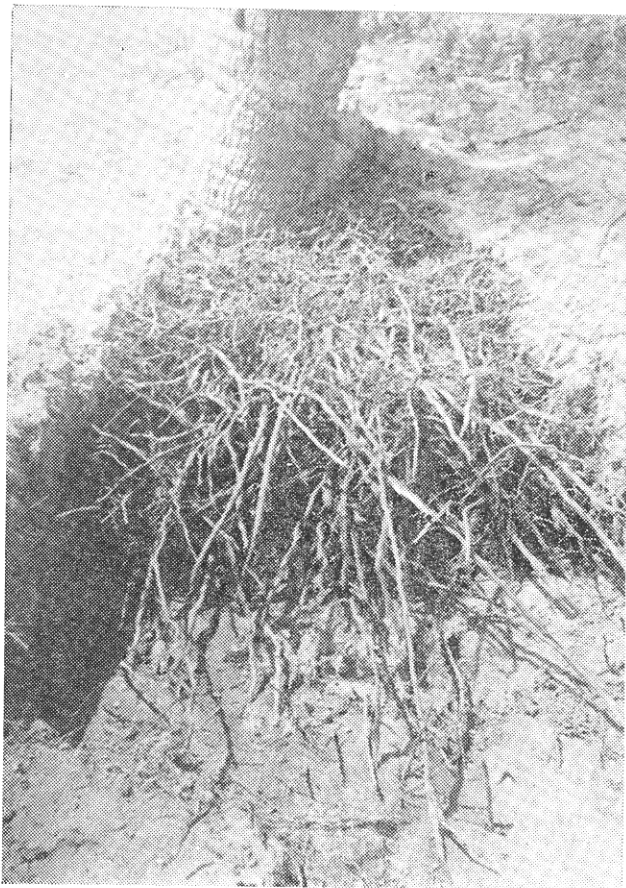
Investigations initiated in 1952 indicated the possible association of a virus or virus-like pathogen in the development of disease. Presence of this pathogen in the sap of the diseased palms and in the soil substrate has been observed. The pathogen is also suspected to be

transmitted by an insect, *Stephanitis typicus* Dist., commonly known as banana lace wing bug. Intensive studies to determine the nature of this pathogen are under way. So far, presence of typical virus particles was not detected in the tissues of diseased palms. An earlier observation indicated the association of a strain of 'Tobacco mosaic virus' with the disease. This was later observed to be present in healthy palms also. Electron microscopic studies, serological tests and infectivity trials conducted later proved that tobacco mosaic virus is not implicated in rot (wilt) disease.

Rotted roots of diseased palms were found to harbour a bacterium, identified as *Pseudomonas* sp. in large numbers as compared to that of healthy palms.

Several genera of plant parasitic nematodes, including three known virus vectors *Xiphenema* sp., *Longidorus* sp. and *Trichodorus* sp. as well as the burrowing nematode *Radopholis similis* were observed in the root zone of coconut.

Possible role of the biological agents—fungi, bacteria, and nematodes—either singly or in conjunction or in succession in the development of disease is being investigated. Besides the biological agents, studies on the effect of nutrient factors on the disease indicated that the soils in the disease-affected areas are low in nutrient status. On the other hand tissue analysis revealed



Root system of healthy palm



Root system of diseased palm

accumulation of major nutrients (nitrogen, phosphorus and potash) and low status of secondary nutrients (calcium and magnesium). Imbalance of nutrients particularly k/mg was noticed. Further detailed studies failed to reveal any consistent variation in the major and secondary nutrient status, whereas among the minor nutrients, zinc and molybdenum were lower. Iron, boron and manganese were also found to be limiting in leaf tissue. The healthy palms of the disease-affected tract have similar pattern of nutrient composition as disease-affected palms and are distinctly different from healthy palms of disease-free areas. Imbalance of nutrients increased with severity of disease.

Considerable derangement in physiological and biochemical activities of the palm occurs with the onset of disease. These include loss of permeability of roots, reduction in absorption and translocation, increase in respiration, fall in total phenol and a concomitant increase in polyphenol oxidase system. Indications of the presence of a toxic principle in the root sap of diseased palms were also observed.

The problem of root (wilt) disease thus presents complex situation, wherein more than one biological agent and perhaps nutrients also are involved. Which ever be the primary cause the initial reaction of the palm appears to be at the root level which progressively leads to major alterations in its physiology and ultimately culminates in the disease. Development of the secondary fungal infection, that is leaf rot disease, only in 20 per cent of the root (wilt) disease-affected palms

suggests that the physiological aberrations are not of a uniform pattern. It is reasonable to presume, in the light of the above facts that more than one factor is involved in the disease and depending on the complexity of the factors the disease syndrome is variable.

Perspectives

The coconut crop being perennial and the root (wilt) disease slow, debilitating and non-lethal, there is hope for improvement or rejuvenation by adoption of management practices coupled with plant protection measures. Agronomic trials conducted at the CPCRI Regional Station, Kayangulam, with varying doses of fertilizers showed that application of 3 kg NPK fertilizer (8:8:16) per tree per year with 50 kg of green manure (sunhemp grown *in situ*) and 0.5 ton lime per acre increased the yield of diseased palms by four nuts per tree per year while that of comparatively healthy palm increased by eight nuts during the same period. On the other hand, in the absence of manuring and cultivation, reduction in yield to the extent of 11 nuts per tree per year occurred.



Coconut palm with root (wilt) and leaf rot diseases

In general, due to eradication of badly diseased palms and adoption of manuring as indicated above, the average yield of palms at the Research Station Farm remains steady (35 to 40 nuts per tree per year) although the disease showed a progressive increase during this period (1950-1970). Control of leaf rot disease from 33 per cent to 8 per cent was achieved by spraying the palms thrice a year (April-May; August-September and December to January) with 1 per cent Bordeaux mixture.

Results of mixed farming trials conducted during 1970-75 when the fodder crops, namely Hybrid napier, *Stylosanthes gracilis*, *Pueraria javanic* and *Centrosema pubescens* were grown as intercrops under irrigated condition, and when milch animals were maintained, suggest beneficial effects. Both the main crop and subsidiary crops were manured and the animal wastes were also recycled. Yield of coconut crop increased by 28.0 per cent. Foliar yellowing was controlled but the typical disease symptom, namely flaccidity increased. Improvement in the fertility status and microbial population of soil was observed. The net profit from 1.3 ha of coconut garden increased by Rs 2,494 per year.

Attempts to improve the crop by the use of better planting material as well as to locate disease resistance

were initiated in 1951 with 'West Coast Tall' palms. These were later extended to include indigenous dwarfs and cultivars. None of the materials has proved to be resistant. A significant observation made from this trial is that the progenies of healthy parents from a disease-free area are less susceptible to the disease (78.0 per cent) and give higher yields (50 nuts per year) as compared to the apparently healthy (88.0 per cent diseased, 45 nuts per year) and diseased parents (100.0 per cent disease, 30 nuts per year). Similarly the hybrid Dwarf \times Tall has been found to be good planting material (11.6 per cent disease and 71.0 nuts per year).

The extensive root growth of the palm, complexity of the suspected causal factors of the disease and possibility of spread through soil render control of root (wilt) disease almost impossible. Until such a time the primary causal agent or factor is pinpointed and an effective protective measure evolved the only practical solution lies in living with the disease while taking the best out of the crop. Utilization of the best available planting material, adoption of better management practices including regular plant protection measures to check the incidence of secondary diseases will go a long way in maintaining the productivity of coconut palms in Kerala at an economic level.

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