

DISTRIBUTION AND SYMPTOMS OF THE COCONUT ROOT WILT, THATIPAKA AND THANJAVUR WILT DISEASES AND THEIR POTENTIAL DANGER IN GENETIC TRANSFER

K. RADHA and P.K. KOSHY

INTRODUCTION

The coconut palm, *Cocos nucifera* Linn, is one of the most useful and beautiful trees of the tropics with its centre of diversity in Asia/Malanesia. The present distribution of the coconut owes more to human intervention than to the ability of the coconut to float for long periods in sea water and still germinate. The coconut palm is grown throughout the tropics, either as a monoculture in extensive plantations or as scattered plots and individual trees intercropped with other palms, trees such as cocoa, coffee, tree spices and crops such as banana, tubers, fodder grass, etc. Under these circumstances, it is host to many pests and diseases. Seventy eight species of nematodes, 173 fungi and 830 insects and mites are reported on coconut (Anon., 1979). The number of diseases that attack coconut is far fewer than the number of pests, yet their threat to cultivation is greater. There is a very great need for transfer of seeds of cultivars on a global scale for plant breeding programmes against pests and diseases and for conservation and evaluation at genetic resource centres. Coconut, today, probably has the largest number of diseases of uncertain etiology which present the gravest threat to transfer of genetic resources because of the possibility that they may be transmitted through seed or pollen. In India, three such diseases, namely, coconut root wilt, Thatipaka and Thanjavur wilts are known to occur.

COCONUT ROOT (WILT) DISEASE

Distribution. Coconut root (wilt) disease was first reported from Southern Kerala, India, about a century ago, following a heavy flood in 1882 (Butler, 1908; Varghese, 1934). In the early years the disease was recorded in three isolated locations each over a distance of 50 km. Later observations made by Menon and Pandalai (1958) showed that the disease has spread in all directions from the original foci to cover nearly 40,000 ha. A survey conducted by Gopinathan Pillai et al. (1973) on the distribution and intensity of the disease in Kerala and the adjoining area in Tamil Nadu revealed that over 250,000 ha of coconut plantations in Kerala were affected by the disease and its sporadic occurrence in two villages in Tamil Nadu. The disease was prevalent in a continuous pattern in the core of the diseased tract and scattered in the outlying borders. Subsequent surveys brought to light random occurrence of the disease towards the north over 50 km from the earlier identified border (Radha et al., 1981). Recently another pocket of disease was identified nearly 150 km farther north in the coconut growing tract of Kerala, in Perambur of Quilandy Taluk of Kozhikode district. Although the disease occurs in all types of soils and in a variety of environmental conditions, two significant observations are the presence of pockets of healthy gardens and individual palms within the disease affected zone and the heavy incidence of disease on river banks and low lying areas.

Symptom. The characteristic visual symptom of the disease is an abnormal bending/ribbing of leaflets termed 'flaccidity', yellowing of leaves and marginal necrosis of leaflets based on which a scoring system for indexing disease severity has been worked out (Menon & Nair, 1951; Radha & Lal, 1972; George & Radha, 1973). Root rot is a major symptom of the disease according to Butler (1903) and Menon and Nair (1951). Quantitative reduction in the root system with the incidence of the disease was observed by Michael (1964). However, Nagraj and Menon (1955) reported that there is no difference in the root damage between apparently healthy and early diseased palms based on the data relating to a zone near the bole. Similarly, the recent report (Anon., 1981) that root rot was not a characteristic symptom of the disease needs clarification since the observations were confined to the bole region whereas Menon and Nair (1951) recorded rotting of the roots from tip backwards even 30 inches away from the bole of diseased palms in the early stages. Further evidence on the root damage starting from the tip region has been recorded by Indira and Ramadasan (1968) and Govindankutty and Vellaichamy (1976). They observed disorganization of the vascular elements and formation of tyloses in the metaxylem in the tip region of the roots showing no outward damage, of palms growing in the disease affected area having no visual symptoms of disease. Govindankutty and Vellaichamy also reported degeneration of meta phloem and the presence of fungal hyphae in metaxylem of healthy looking roots. Sterility of pollen and necrosis of spikelets from tip downwards was reported by Varkey and Davis (1960). Shedding of buttons and immature nuts occur leading to progressive reduction in the yield of nuts, varying from 35.0 to 75.0% depending on the intensity of the disease (Anon., 1976). In many instances pitting of kernel and leathery nature of copra, thinning of the shell, discolouration of the kernel and cracking of the nut from the basal end was observed by Menon and Nair (1951).

Palms affected by the disease rarely die. But super imposition of leaf rot disease (*Bipolaris halodes* Dresch.) accelerates deterioration of the affected palm. Young palms in the bearing and pre-bearing stage are more susceptible to the disease (Menon & Pandalai, 1958).

THATIPAKA DISEASE

The disease derives its name from the village 'Thatipaka' in Razole Taluk of East Godavari District of Andhra Pradesh where the disease was first reported. The disease first appeared following a cyclone of 1949. It occurs more frequently in black alluvial and clayey soils as well as in red sandy soils subject to inundation. Isolated pocket of disease was also noticed further away in Srikakulam in low lying gardens. Prolonged drought followed by heavy rains favoured incidence of disease in 1973 and 1974. Adult bearing palms are more susceptible to the disease than young palms.

Symptom. The initial symptom of the disease is an abnormal spurt in the growth and productivity of the palm resulting in an increased production of leaves and dark green leaflets. The fronds bend abnormally from the middle and vigorous growth is followed by a decline. The rate of leaf fall increases, the petioles become etiolated and weak and lose the capacity to support the bunch. Watersoaked chlorotic spots appear on the leaflets and they become faciated. The stem tapers and becomes distorted producing small pale leaves. The size of the nut is reduced and

gradually the kernel fails to develop. The mesocarp becomes spongy and nuts become atrophied filled only with mesocarp. Occasionally longitudinal cracks develop and gumming from the stalk end also occurs. Subsequently development of inflorescence and growth is arrested and the barren palm dies.

In the initial stages of the disease prolific production of roots occurs which gradually decreases in number and size. Rotting of roots sets in and progresses with the advancement of the disease. Regeneration of new roots is poor in diseased palms (Anon., 1976a).

THANJAVUR WILT

The disease was first noticed in the coastal area of Thanjavur District in Tamil Nadu after the cyclones in 1952 and 1955. It is now prevalent all over Tamil Nadu with the exception on the Nilgiris. A disease similar to this occurs in Karnataka State and is known as 'Anabe Boga' and in Andhra Pradesh where it is referred to as *Ganoderma* root-rot.

Symptom. Wilting of the leaves from the outer whorl onwards is the characteristic symptom. The drooping leaves remain suspended for sometime and turn brown. The inner leaves also droop down in quick succession along with the bunches in their axils. The leaves produced subsequently are reduced in size and the spindle fails to unfold. Subsequently, the bud rots and the crown drops down leaving the trunk topless.

Mild bleeding on the basal part of the trunk develops in certain cases. The bleeding extends upwards with the progress of the disease and the internal tissues show discolouration and disorganisation. In the final stages of the disease the basal part of the stem gets decayed. Fructifications of *Ganoderma lucidum* occur in several instances on the trunk of diseased and dead palms. However, both bleeding and development of the brackets are not always common. In a number of cases wilting of the crown alone is manifested.

Extensive damage of the root system, reduction in the number of secondary and tertiary roots and distortion of the primary roots are typical symptoms. Affected palms show rotting of the roots leading to disintegration of the cortex and discolouration of the stele. Development of new roots is reduced.

Profuse bearing in the initial stages of disease rapidly gets reduced with the advancement of the disease. Shedding of buttons, reduction in the number of nuts and improper development of kernel also sets in. Death of the palm occurs in six months to 4.5 years (Anon., 1976a).

METHODS OF DISSEMINATION

The cause and mode of dissemination of root (wilt) disease are unknown and there is no experimental evidence for transmission through seed. However, field observations indicate that planting materials from the disease-affected areas are more prone to the disease. In view of this, it is not advisable to collect seednuts from disease-affected areas and also from areas within 200 km of a diseased locality as the disease is known to occur sporadically in areas far away from the nearest locality (Anon., unpublished).

Mode of dissemination and etiology is not clear in the other two diseases also; thus, it is safe to avoid collection of seednuts within 200 km of a diseased locality.

Movement of planting materials of other species of palms from diseased localities also needs to be restricted in view of their possible role as alternate hosts of these diseases.

QUARANTINE MEASURES

Strict quarantine measures are in vogue against movement of seedlings/seednuts from localities affected by these diseases to healthy areas within India. The present system and facilities available at quarantine stations in India are satisfactory for import of germplasm.

Import of seednuts to India from countries having lethal yellowing, red ring, cadang-cadang, little leaf, leaf scorch and bole rot is strictly prohibited.

The Central Plantation Crops Research Institute (CPCRI), Kasaragod, Kerala, India, holds a germplasm collection of 62 exotic and 32 indigenous accessions. Recently a world coconut germplasm centre has been established in the Andaman Islands in the Bay of Bengal by CPCRI. Twenty-one tall and three dwarf types collected by a team of two scientists of CPCRI with the help of IBPGR from Polynesia, Micronesia, and Melanesia group of islands have been raised in nurseries for further observations and planting in the field. This offshore germplasm centre can be a source for seed and pollen for India, Ceylon and other countries of the region. Further collections from India and outside the region are being planned. International help through FAO/UNDP/IBPGR is needed for making this venture a success.

The procedure of establishing a germplasm collection centre in an offshore island and testing only the second generation material against diseases has many advantages. (1) It offers protection to the collection against all possible pests and diseases which are known to exist in the mainland. (2) It serves as a nucleus material for screening against diseases and pests in the region. (3) It prevents the introduction of new diseases and pests to the mainland. (4) It provides a pool of promising types for use in future breeding programmes.

By collecting 125 seednuts each for every accession and after one year of incubation in an offshore island for observation, 25 seedlings could be evaluated in hot spots against pests and diseases to avoid delay in evaluation.

Practical phytosanitary coordinations relating to the introduction of coconut germplasm:

1. The importing country should determine in advance from the plant protection authorities in the source country or from I.C.O or other institution responsible for coconut cultivation the occurrence of dangerous pests and diseases in localities where the collection is to be carried out. The application to import should be processed only after getting an assurance of the absence of potential pests and diseases.

2. Source areas and palms should be selected by a team consisting of a plant protection scientist and a breeder from the importing country.

3. Never collect shed nuts which were in contact with soil for long and are in various stages of germination.

4. Harvest green seednuts from 11 to 12-month old bunch, remaining at least on

the perianth, with the help of climbers/sickles/hooks to ensure that they are from the mother palms.

5. It is ideal to collect one nut each from 100 mother palms. Because it is difficult to get harvesters who are climbers, it is suggested to collect two to three nuts each from 50–70 palms to obtain a pooled sample of 135 seednuts. Ten nuts of these may be used for nut analysis and 25 for testing in hot spots after 12–18 months under close observation in the nursery. The remaining 100 could be used for genetic resource collection.

6. After removing the calyx (perianth) and washing with soap and water, dip seednuts in a mixture of fungicide (0.1% Captan) and insecticide (0.1% Malathion) for five minutes. On drying, pack the seednuts in jute or nylon copra sacks with appropriate labelling and fumigated with methyl bromide at 40 g/m³ for two hours.

7. The nuts on receipt at the port of entry may be dehusked partially by paring at the top and bottom three sides and given a dip in 250 ppm phenyl mercury acetate plus wetter for 15 minutes (Jackson & Firman, 1982). After drying, the nuts may again be fumigated with methyl bromide at 40 g/m³ for two hours (Joseph, 1979).

8. Nuts may be sown in sterile soil contained in polybags and kept under observation for at least 12–18 months. This is specially important in view of *Marasmiellus* spp.

At present there is no information available on the microflora and microfauna of pollen and whether MLO, viroid or phytomonas are transmitted through pollen. Until such details become available it may not be safe to transfer pollen for breeding purposes.

CONTROL

All the diseases dealt with come under the category of disease of unknown etiology although the wilt/root rot diseases occurring in Tamil Nadu, Karnataka and Andhra Pradesh are suspected to be due to *Ganoderma* infection.

No effective control measure is yet available for these diseases. Nevertheless several ameliorative treatments to rejuvenate the diseased palms have been attempted, particularly in cases where the disease is debilitating.

SUMMARY

For these diseases, curative or prophylactic control measures do not exist. As such the only precaution which can be adopted is to avoid collection of seednuts/pollen from diseased localities within 200 km. International cooperation in funding the collection, maintenance and multiplication of indigenous and exotic germplasm is required as most of the coconut growing countries do not have enough available funds for this.

Locating world germplasm collection of coconut at two centres and establishing regional germplasm centres for every region will be of immense value in view of the reported occurrence of an increasing number of seed borne and other diseases of uncertain etiology.

REFERENCES

- Anonymous. (1976). Annual Report Central Plantation Crops Research Institute, Kasaragod, India, pp. 73-74.
- Anonymous. (1976a). Coconut diseases of uncertain etiology. Tech. Bull. 1.
- Anonymous. (1979). Nematodes, fungi, insects and mites associated with the coconut palm. Tech. Bull. 2: Central Plantation Crops Research Institute, Kasaragod, Kerala, India.
- Anonymous. (1981). Review of research on coconut root (wilt) disease. Central Plantation Crops Research Institute, Regional Station, Kayangulam, Kerala, India.
- Butler, E.J. (1908). Report of coconut palm disease in Travancore. Agr. Res. Inst. Pusa Bull. 9: 1-23.
- George, M.V. and Radha, K. (1973). Computation of disease index of root (wilt) disease of coconut. Ind. J. Agr. Sci. 43: 366-370.
- Gopinathan Pillai, N., Lal, S.B. and Shanta, P. (1973). Distribution and intensity of root (wilt) disease of coconut in Kerala. J. Plant Crops 1 (Suppl.): 107-112.
- Govindankutty, M.P. and Vellaichamy, K. (1976). Histopathology of coconut palm affected with root (wilt) disease. Inter. Symp. on Coc. Res. and Dev. Kasaragod. Abstracts of papers. p. 46.
- Hewitt, W.B. and Chiacappa, L. (1977). Plant health and quarantine in international transfer of genetic resources. C R C Press, Cleveland, U.S.A. 346 pp.
- Indira, P. and Ramadasan, A. (1968). A note on the anatomical derangement in root (wilt) diseased coconut palm. Curr. Sci. 37: 290-291.
- Jackson, G.V.H. and Firman, P.D. (1982). Seed-borne marasmioid fungi of coconut: Plant Pathology. 31: 187-188.
- Joseph, T. (1979). Preliminary studies on fumigation of seed coconuts. Pp. 380-385 in Proc. Placrosym II Plant Protection. Nilpals, India.
- Ke-zun, Hnang. (1980). Recommended measures for regulating the importation and movement of plants. Information Letter No. 127. FAO, Plant Protection, SEA & P. Bangkok, Thailand.
- Menon, K.P.V. and Nair, U.K. (1951). Scheme for the investigations of the root and leaf diseases of coconut palms in South India. Consolidated report of work done from 8th March 1937 to 1st March 1948. Indian Cocon. J. 5: 5-19.
- Menon, K.P.V. and Pandalai, K.M. (1958). The coconut Palm - A monograph. Indian Central Coconut Committee, Ernakulam. 348 pp.
- Michael, K.J. (1964). Studies on the root system of the coconut palm. Indian Cocon. J. 17: 85-92.
- Radha, K. and Lal, S.B. (1972). Diagnostic symptom of root (wilt) disease of coconut. Ind. J. Agric. Sci. 42: 410-413.
- Radha, K., Rethinam, P. and Kochu Babu, M. (1981). Northward march of coconut root (wilt) disease in Kerala. Indian Cocon. J. 12: 1-4.
- Rao, E.V.V.B. and Koshy, P.K. (1982). Coconut Germplasm collection in Pacific Islands. Central Plantation Crops Research Institute, Kasaragod, Kerala, India. 47 pp.
- Vaiphese, M.K. (1934). Diseases of coconut palm. Dept. of Agric. and Fisheries, Travancore. 48pp.
- Vatkey, T. and Davis, T.A. (1960) Studies on coconut pollen with reference to the leaf and root (wilt) diseases. Indian Cocon. J. 14: 1-7.