

DISEASES AND DISORDERS

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Oil palm, a new crop to the country is reported to be affected by a number of diseases and disorders (Kochu Babu, 1988; 1989; Kochu Babu et al. 1990). Among these, only spear rot causes considerable economic losses. Other devastating diseases like vascular wilt, fatal yellowing, sudden wither and *Ganoderma* basal stem rot reported from other oil palm growing countries have not been reported so far from India. A brief description of the diseases and disorders identified so far in India and the management strategies for seed, nursery and oil palm plantations are given in this treatise.

Seed

Spoilage of oil palm seeds by microbes occurs during storage and germination. Brown germ disease and *Schizophyllum* seed infection were observed in a few seed lots at Palode.

Brown germ disease

Brown germ affecting seeds during storage and different stages of germination is on record from several countries (Turner, 1971). At Palode losses upto five per cent have been recorded on preheated seeds. In such cases rotting of embryo and kernel was observed only on cracking of seeds. Just emerged sprouts show light brown spots on radicle causing discolouration and rotting. In most of the cases rotting extends to the micropyle and subsequently the embryo ceases to develop. Sporulation of fungi are seen on the rotten area (Fig 1). The fungi isolated from affected seeds are *Aspergillus niger*, *A. terreus*, *Penicillium* sp., *Trichoderma viride*, *Botryodiplodia theobromae* and *Rhizopus nigricans*, which are ubiquitous in their distribution as saprophytes.

Mycophagous nematodes are abundant in some seed lots which hasten the spread of infection by fungi. Brown germ occurrence can be checked by removal of the mesocarp remnants, maintenance of seed moisture levels at 17 per cent during storage and preheating. Wet seed treatment in Emisan (Methoxy Ethyl Mercury chloride) 0.1 per cent solution for 20 min. before preheating of seeds is recommended to control the rot. In the event of post



Fig. 1. Brown germ disease

emergence rot the same fungicide treatment need to be repeated.

Schizophyllum seed infection

Few seed lots with more mesocarp remnants and high moisture levels during storage showed infection by *Schizophyllum coomune*. Occurrence of this disease has also been reported from Colombia, Malaysia and Papua New Guinea (Turner, 1971; Williams and Liu, 1976).

White patches of fungal mycelium are noticed over the shell which later colonise the kernel also. Fructifications are formed at high moisture levels. Prophylactic seed treatment by dipping in emisan 0.1 per cent solution for 20 min. can prevent the infection.

Quarantine seed treatments

Methyl bromide fumigation of seeds at normal moisture content of 18 per cent affect seed germination and seedling vigour and hence cannot be used for seed treatment indiscriminately (Kochu Babu et al. 1991). However, the possibility of methyl bromide fumigation of oil palm seeds with low moisture content of 10 per cent at 75-80°F with 2 lb methyl bromide/1000 cft for 18 hrs without impairing viability, germination and seedling vigour has been indicated. The International phytosanitary seed treatments for disinfection of seeds consists of washing for 2 min in 0.2 per cent thiram plus 0.1 per cent teepol prior to preheating, during soaking after preheating, prior to despatch and on arrival at destination (Turner, 1981). Besides this the introduced seeds are to be kept under observation to spot out diseases.

Nursery

Early leaf diseases

Infection of young seedlings by species of *Glomerella*, *Botryodiplodia* and *Melanconium* are referred to as early leaf diseases (Turner, 1981). Incidence levels to the extent of five per cent has been observed in the nurseries raised in Karnataka. The symptoms caused by *Botryodiplodia* and *Glomerella* are described below:

Botryodiplodia theobromae

Small light brown spots develop on the distal portions of the leaves, which later change to dark brown. These lesions enlarge and are surrounded by yellowish halo. The entire leaf tips gets affected. Black dots (pycnidia of the fungi) are visible on the lesions. Healthy leaves coming in contact with the diseased one get infected.

Glomerella cingulata: The symptoms are different from that of *Botryodiplodia* in that lateral expansion is restricted by veins. Yellow to brown watersoaked lesions develop between veins and elongate. These lesions turn black and are surrounded by yellowish halo. The tissues at the centre dry and become brittle. Small dark dots (acervuli of the fungus) are seen in the lesions.

Clipping of the severely affected leaf portions and spraying with dithiocarbamates 0.2 per cent effectively control the disease.

Leaf rot

Stray incidence of leaf rot has been recorded in the primary nursery seedlings during the rainy period. The infection begins at the base of the spear as irregular pale olive green patches surrounded by brown zone,

which later turn dark brown before drying. The pale desiccated tissues in the centre of the lesions shred easily and become tattered in appearance. *Corticium solani* is the causal agent of this disease. Excess shade is conducive to the disease. Removal and destruction disease affected leaves and application of carbendazim 0.1 per cent are recommended for controlling the disease.

Nursery spear rot

This has been reported from the secondary nursery seedlings raised at Palode (Kochu Babu, 1990). The symptoms are quite different from the nursery spear rot caused by *Phytophthora arecae* reported from Republic of Zaire and *Fusarium* spp. reported from Malaysia.

Water soaked lesions develop in middle leaflets of spear leaves. They later become light brown and extend to the tip of the spear. When the spear unfurls, the rotten area becomes desiccated. The young leaves show distinct marginal chlorosis comparable to the spear rot in adult palms. Subsequently emerging leaves show drastic reduction in leaf size. Such seedlings need to be culled out and destroyed.

Leaf spots

In general, leaf spot incidence is not common in all nurseries where prophylactic sprays are followed regularly. *Curvularia* and *Pestalotiopsis* are the causative organisms involved.

In the case of leaf spots caused by *Pestalotiopsis palmarum* and *P. monochaetoides* large irregularly shaped orange red lesions occur in older leaves of

secondary nursery seedlings. Later these lesions become necrotic with dark grey margin and light brown centre.

Leaf spots caused by *Curvularia lunata* and *Curvularia geniculatus* were recorded on primary and secondary nursery. Small circular translucent yellow spots appear on unfurling spear and young leaves. These later enlarge and become brown with a sunken centre and yellowish orange halo. The lesions range from 3 to 7 mm in diameter. In severe cases, the lesions coalesce causing a complete die back of leaf tissues. Characteristic persistence of primary lesions within the necrotic area is noticed.

Developmental abnormalities

Leaf enations and crinkle

In the primary nursery seedlings the leaves show flaps and crinkling mainly due to temporary water deficit during the emergence of leaf. Deficiency of Boron has also been indicated in some instances. With copious watering, the symptom disappears in the emerging leaves.

Collante

Collante is a symptom associated with inadequate soil moisture condition. Though it occurs in all stages of nursery, severe symptoms are observed in the primary stage. Planting of seedlings in the field during dry weather also induces collante symptoms. In the affected seedlings the leaves fail to unfurl properly with a constriction developing in the central portion of the leaf. The veins become prominent and the leaves, rigid. In extreme cases the leaf remains as a woody spike without separation of leaflets. The symptoms are not seen in fresh leaves, when adequate watering is done.



Fig. 2 & 3. Spear rot

Diseases of adult palms

Spear rot

Spear rot associated with foliar yellowing has been recorded from the oil palm plantations in Kerala (Kochu Babu, 1989). So far this disease has not been observed in the plantations of Andamans, Andhra Pradesh, Karnataka and Maharashtra.

Yellowing of the youngest whorl of unfolded leaves is the initial visible symptom (Fig. 2 & 3). Yellowing starts from the tips of leaves and spreads mostly along the margins of leaflets. The chlorotic area later turns brown and dries up. In few cases, one or two affected leaves break at the leaf base and hang down from the crown.

At the onset of yellowing symptoms water soaked lesions are seen at the central portion of youngest spear which subsequently spreads either way and simultaneously rotting also sets in. Rotting is confined to portions about 500 cm from the meristem. The rotten tissues emit foul smell.

Yellowing or rotting does not spread to the older leaves in the whorl. The bunches produced prior to disease incidence in their leaf axils mature normally. Rotting and reduction in leaf size occur in the subsequently emerging leaves. With disease advancement rudimentary leaves even without leaflets are produced. As the disease advances, the trunk gradually tapers and inflorescences abort before emergence resulting in total loss in

productivity. The symptoms are distinctly different from diseases like crown disease, fatal yellowing, patch yellows, wither tip and spear rot-bud rot-little leaf disease complex reported from other oil palm growing countries.

Occurrence of the disease is generally found in low lying marshy places, valleys and hill slopes. The *tenera x tenera* population planted at a spacing of 5 m apart on a steep slopy land had the highest incidence of 40 per cent in plantation under Oil Palm India Ltd. About 5 per cent of the replanted seedlings in this plot also had disease recurrence during 1 to 3 years after planting.

The etiology of spear rot in India is yet to be established. The microorganisms isolated from spear rot affected palms are: *Bacillus subtilis* (Ehrenberg) Cohn, *Botryodiplodia theobromae* Pat., *Colletotrichum gloeosporioides* (Penz.), *Curvularia lunata* (Wakker) Boedijn, *Enterobacter* sp., *Fusarium moniliforme* Sheldon, *Fusarium moniliforme* var. *intermedium* Neish & Legget, *F. moniliforme* var. *subglutinans* Wollenw. & Reinking, *F. oxysporum* Schlecht, *F. pallidoroseum* (Cooke) Sacc., *F. solani* (Mart.) Sacc., *Pestalotiopsis palmarum* (Cooke) Steyaert, *Pseudomonas* sp., *Phomopsis elaeidis* Punith. and *Setosphaeria rostrata* Leonard. Among them the most consistent fungal isolates are *F. moniliforme* and *Colletotrichum gloeosporioides*. None of these fungi and bacteria were pathogenic either individually or in combinations. Macro and micronutrient status in diseased and healthy palms show no significant variation.

Electron microscopic studies with the samples from six spear rot affected palms in

the early stage of disease revealed the presence of Mycoplasma Like Organisms (MLOs) in the sieve tubes of rachillae of unopened inflorescence and submeristematic tissues (Dr. Solomon, Personal communication). Apart from the presence of the organisms, structural changes like phloem necrosis, compression of sieve cells and presence of large number of organelles in cells adjoining the vascular tissues are very much evident. However the involvement of MLOs in the etiology of the disease is yet to be confirmed through transmission trials.

In view of the uncertain etiology, roguing of affected palms and burning *in situ* is recommended at present to prevent the spread of this malady.

Bud rot

Bud rot reported to occur in all oil palm growing countries has been noticed in the plantations of Kerala, Karnataka and Andhra Pradesh (Kochu Babu, 1990). Higher disease incidence is noticed in young plantations. Rotting initiates at the basal portion of the spear closer to the meristem and extends to the whole spear. The spear could be easily pulled off. Cleaning the affected tissues and drenching the crown with carbendazim 0.1 per cent cures the disease. The leaves emerging immediately after the application of fungicides are shorter and successively emerging ones are normal.

Crown disease

This juvenile disease occurring frequently on palms during the first 3 years after planting has been reported from many oil palm growing countries. In India the disease has been observed in the nursery stage and

field planted palms in different states.

During the early phase of the disease brown lesions with water soaked margin are observed on the middle portions of the internal leaflets. No rotting is apparent in the spear externally. When the affected spear unfurls, it develops a characteristic bending in the middle of the rachis. The leaflets on either side of the curved portion of the rachis are either completely rotten or a few stumps remain. The recovery of the disease affected palms is spontaneous and hence control measures are not taken up usually. Non-pathogenic microorganism such as *Fusarium moniliforme*, *F. semitectum* and *Colletotrichum gloeosporioides* were isolated from the disease affected tissues.

Upper stem rot

Recently this disease was identified in

the oil palm plantations of Andamans Forest and Plantation Development Corporation, Little Andamans. Rotting on the upper portions of stem was observed in the 1975-76 plantations on 42 palms distributed in 12 foci in the 160 ha area raised with seed materials introduced from NIFOR, Nigeria.

The symptoms are gum exudation, bleeding and rotting of the stem. Gum exudation and stem bleeding occur at any point above 50 cm from the bole region. Decay of inner tissue is observed on chipping of the bark as the disease advances. In due course rotting extends internally in an irregular pattern (Fig. 4). The dark brown lesion also extends laterally causing dry rot of the stem. Externally the presence of fibrous strands is noticed. As the rotting advances internally the palm snaps at the site of rotting.



Fig. 4. Upper stem rot

The presence of healthy tissues above and below the lesion indicates that the infection is likely to be localised. Upper stem rot caused by *Phellinus noxius* has been reported from Malaysia (Sharples and Jorgensen, 1930) and Indonesia (Turner, 1971) and several other countries (Turner, 1981). However, fructifications of this fungus are not observed on the diseased palms in Little Andamans.

Identification of the disease in the early stage and removal of rotten tissues, swabbing with Calixin 0.1 per cent followed by application of hot coal tar is recommended to save the infected palms. This should be followed by plugging the holes with a paste containing sand, cement and BHC to provide mechanical support to the palm and to prevent further attack by rodents, insects etc.

Bunch failure

Bunch failure is most frequent in 3-10 year old palms, often to the extent of 20 per cent. The range of under development of fruits in a bunch may vary from 0 to 100 per cent. The tips of under developed fruits turn black and later become necrotic. Reddy *et al.* (1987) reported the occurrence of *Marasmius* bunch rot in oil palm plantations of Forest and Plantation Development Corporation, Little Andamans. They also recorded bunch rot in the plantations at Yeroor in Kerala and the association of *Ceratostomella* sp.

Marasmius palmivorus is saprophytic in nature usually colonising leaf axils and leaf bases. The bunches in the middle stages of development (8-12 weeks) are mostly invaded by the pathogen. Bunches produced during March-May are affected to the maximum extent. Neither the sex ratio nor the pollen load

in the atmosphere has any effect on bunch failure.

Retention of rotten immature bunches serves as a source of infection on fresh bunches. Periodical cleaning of the crown reduces the load of inoculum and fresh incidence. Bunch failure may also result from lack of adequate pollination, in which case assisted pollination is to be resorted to. Though bavistin 0.2% spray alone had no effect on bunch failure, complete control could be obtained through crown cleaning, assisted pollination and bavistin 0.2% spray when applied together. The bunch failure incidence is found to be low in Forest and Plantation Development Corporation of Little Andamans (Chander Rao *et al.*, 1990) and at Palode (Dhileepan and Nampoothiri, 1989) after the introduction of the pollinating weevil, *Elaeidobius kamerunicus*.

Leaf rot

Mathai *et al.* (1989) reported the occurrence of leaf rot in Chithara and Kumarakom of Kerala. Brown spots with yellow halos appear on the leaflets of inner whorl leaf lamina. Palms of all ages are found affected; but the severity is on palms up to ten years of age. Though *Colletotrichum gloeosporioides* has been reported as the causal agent, earlier inoculation trials could not establish the pathogenicity.

Leaf spots

Leaf spots caused by *Pestalotiopsis* spp. are noticed on the lower whorls of leaves. Magnesium deficiency favours disease incidence. The first symptom is the appearance of brown spots on leaflets, later spreading to the whole leaflets. The centre of the lesions

are light grey to brown with numerous black dots, the acervuli of the fungus. *Pestalotiopsis palmarum*, *P. glandicolax* and *P. monochetoides* were isolated from the infected leaves at Palode (Kochu Babu et al., 1990).

Petiole spots

Occurrence of these spots on petiole has been noticed on 52 per cent of the palms in Palode plantations (Kochu Babu et al., 1990). Irregular spots ranging from 2-12 mm are noticed on the outer surface of the petiole. This appears to have no harmful effect on the palms. *Cryptosporiopsis* sp. was isolated from the lesions.

Other diseases

Shanta et al. (1970) reported that oil palm is a natural host of coconut root (wilt) pathogen, when it was believed to be caused by a virus. Flaccidity, the diagnostic symptom of coconut root (wilt) disease has been taken as the criterion for symptoms on oil palm.

Reddy et al. reported infection by *Fusarium oxysporum* f. sp. *elaedis* on 950 out of 1,25,000 oil palm seeds imported from Nigeria.

Wither tip disease incidence in Oil Palm Research Station, Thodupuzha, Kerala state was recorded by Rajan et al. (1980). They implicated *Fusarium oxysporum* as the causal agent. Subsequent study however indicates that the disease found in Thodupuzha is actually spear rot.

Fruit tip rot and basal fruit rot have been recorded from the Oil Palm India Plantation, Chitharaby Mathai et al. (1991). *Diplodia*

tubericola and *Colletotrichum gloeosporioides* have been identified as the pathogens of fruit tip rot and basal fruit rot respectively.

Disorders

Besides these diseases, few disorders are also recorded in the Indian plantations. the nutritional disorders are covered under the chapter on 'Crop Management' and are not discussed here.

Leaf base wilt

Recently leaf base wilt has been observed in 14 year old plantations of Palode and Yeroor estates. The lower whorl fronds subtend downward from the point of insertion on the stem and hang around the stem giving a skirt of wilted fronds. These fronds do not dry up immediately. In general the bunches in the axils of the subtended leaves show rotting in the immature stage itself. The factors suspected as the cause of this disorder are frond length, bearing nature and nutritional status of major elements (Turner 1981).

Wind damage

Crown fracture or head bending

Two to three young leaves and group of spear cluster break at the petiole base and hang on to the crown. Occurrence of this would induce the affected palms to enter a prolonged male phase. The fractured portions on removal and treatment with protective fungicide allow the new leaves to emerge without hindrance. In the case of untreated ones crown twisting occurs.

Pinnae fragmentation and lodging of palms

The common symptom on palms exposed to severe wind is the shredding of pinnae

resulting in hanging of leaflets leaving the midrib projecting. Heavy winds cause reduction in assimilative area to about 25 per cent and induces the formation of male inflorescences and reduce yield (Turner, 1981).

In young plantation severe wind blow causes lodging. The leaflets get damaged due to constant rubbing with other leaves. Staking of seedlings is essential in such wind prone areas.

Important Diseases in other countries having quarantine significance

Freckle

This is the most widespread leaf disease on nursery seedlings and field palms in West Africa. The disease occurs throughout the year on all varieties and at all stages of growth from young seedlings to adult palms. Though not fatal, the disease can cause a reduction upto 10 per cent photosynthetic leaf area leading to reduction in vegetative growth and delay in onset of fruiting. Initial symptoms occur on the youngest fully opened leaves of prenursery or nursery seedlings as discrete, hyaline, pin point spots which later enlarge, becoming slightly sunken and dark brown in colour and may be surrounded by a distinct orange yellow halo. In the final stages, the lesions coalesce and cause desiccation and death of whole leaflets.

The disease is caused by *Cercospora elaeidis*, which is not present in the south east Asian countries. The conidia of this fungus is reported to be spread through pollen as contaminant. Hence the import of pollen from Africa needs a quarantine check. *Elaeis oleifera* and the hybrids with *E. guineensis* are highly susceptible to this pathogen.

Vascular wilt

This disease was first observed in Zaire and later in all West African countries. Although it is regarded as a disease of adult palm it is reported from grown up seedlings in nursery also. Young palms of 3-15 years age are reported to be mostly affected.

First visible symptom in nursery is growth retardation and flat topped appearance showing a desiccated outerwhorl of leaves. Pinnate leaves are not produced if infection is early. Severe necrosis of vascular tissues induces water stress leading to yellowing of older leaves. In field palms the young leaves become bright yellow and the leaves produced subsequently are shorter giving flat topped appearance. The outer leaves become desiccated. In the chronic type, the palm tapers and may linger on for several years. In acute type, the older leaves fracture near the base and hang downwards around the upper part of the stem and die within a few weeks or months. Internally the peripheral vascular bundles are discoloured.

The disease is caused by *Fusarium oxysporum* F. sp. *elaedis*. Though systemic infection of seeds is not yet proven the spread through seeds and pollen as contamination is reported (Flood, 1990). This aspect needs to be looked into during the import of planting materials.

Sudden wither

This has a widespread distribution on oil palm and coconut throughout South America and is considered to be a potential limiting threat to *E. guineensis* especially in Colombia. Initially the tips of the terminal leaflets of the older leaves become brown,

later spread to leaflets of younger leaves and within a month all the leaves become bronzed. Rotting and pre-mature fall of fruits and death ensues in a month after the onset of leaf symptoms.

Fatal yellowing (Marchitez progresiva/lethal spear rot)

Fatal yellowing primarily recorded in Colombia but also found in Panama, Ecuador and perhaps in Nicaragua and Costa Rica is more often associated with mature palms (Turner, 1981). Chlorosis of youngest whorl of leaves, spear rot, fungal lesions on the petiole of chlorotic leaves and snapping of the leaves at the lesion site are the symptoms. The affected palm dies in a period of 4-5 months.

The disease is of unknown etiology. However *E. oleifera* and its hybrids with *E. guineensis* are reported to be tolerant to the disease.

Leaf mottle

This fatal disease is reported to occur in nurseries and field palms in Ecuador and Peru. The earliest symptoms are found on the spear leaves. Paler linear spots appearing as continuous long mottled streaks appear on the spear leaves. Mottling symptoms are seen on the rachis also. Spear rot is frequently seen when chlorosis has set in.

The etiological agent is not identified so far. *E. oleifera* and its interspecific hybrids

show a range of tolerance to the disease.

Cadang-cadang

Cadang-cadang, a viroid disease on coconut in Philippines has been observed on oil palms also. As oil palms are more susceptible to this viroid, it affects the development of the oil palm industry in Philippines (Turner, 1981). As viroids are sap transmissible and can be seed borne, introduction of the planting materials should be avoided/restricted.

Red ring disease

Red ring - primarily a coconut disease - is reported on oil palm also in the Latin American countries. *Rhadinaphelenchus cocophilus*, a nematode is the causative agent, transmitted by the red palm weevil, *Rhynchophorus palmarum*. Since the disease is not reported from areas other than West Indies and Latin America, care should be taken while introducing planting material.

Conclusions

It should be borne in mind that copper fungicides are phytotoxic to oil palm. A constant vigil has to be kept on the planting materials so that curative treatments can be taken up early. It is necessary to give emphasis on pathological investigations of the recorded diseases in view of area expansion programme in the country. As a precaution, the oil palms planted in *Ganoderma* basal stem rot affected gardens in nearby areas need to be periodically checked as it has been proved to cross infect these palms in Malaysia.

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