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Diseases and Disorders of Oil Palm

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1. INTRODUCTION

Oil palm is reported to be affected by a few diseases and disorders in India (Kochu Babu et *al.*, 1990). According to Turner (1981), oil palm when grown in a new environment is affected by new diseases like Cadang-Cadang in the Philippines, sudden wither, red ring and fatal yellowing diseases in Central America, etc. However, the extent of the maladies is low in India for the present, since the crop is being cultivated in a limited area so far. The diseases and disorders recorded so far in India are grouped under seed, nursery and field palms and discussed in this chapter.

2. SEED DISEASES

Two types of seed diseases, viz., brown germ disease and Schizophyllum seed infection have been noticed during storage and germination.

2.1 Brown Germ Disease

Brown germ affecting seeds during storage and different stages of germination is on record from several countries (Turner, 1971). Losses up to 5 per cent have been recorded on preheated seeds. Symptoms are not apparent before emergence of sprouts. In the case of pre-emergence rot, the embryo and kernel are seen affected. Sprouts just at emergence show light brown spots on radicle causing discolouration. In most of the cases, rotting extends up to the micropyle and subsequently the embryo ceases to develop. Sporulations of fungi are seen on the rotten area. The fungi isolated from affected seeds are *Aspergillus* niger, ***A. terreus, Penicillium*** sp.. Trichoderma *viride, Botryodiplodia* fheobromae and *Rhizopus nigricans*.

The mesocarp remnants on seeds harbour these fungi and favour their multiplication. It is presumed that high seed moisture levels and higher temperature (40°C) during prehealing favour the multiplication of these thermophilic fungi. Perfect removal of mesocarp remnants and maintenance of seed moisture levels at 17 per cent during storage and preheating help to check brown germ. Wet seed treatment with emisan (methoxy ethyl mercury chloride) (0.1 per cent) solution for 20 min before preheating of seeds is recommended.

2.2 Schizophyllum Seed Infection

This has been noticed in stored seeds during preheating and at various stagks of germination in seed lots which had more mesocarp remnants. Occurrence of this disease has been reported from Colombia, Malaysia and Papua New Guinea (Turner, 1971; Williams and Liu, 1976). Infection of seeds by Schizophyllum commune was noted to the extent of 0.25-0.4 per cent of seeds imported from Papua New Guinea and captan treatment controlled the infection (Reddy et *al.*, 1984).

White patches of fungal mycelium are noticed over the shell. Fructifications are formed at high moisture levels. Prophylactic seed treatment in emisan (0.1%) solution prevented the infection.

2.3 Phytosanitary Seed Treatments

Methyl bromide fumigation of seeds at normal moisture content of 18 per cent has been reported to affect seed germination and seedling vigour and hence cannot be used indiscriminately for seed treatments (Kochu Babu etal., 1991). Mok (1970) found that oil palm seeds at a moisture content of 10 per cent can be fumigated at 75-85°F with 2 lb methyl bromide11000 cft for as long as 18 h without impairingviability, germination and seedling growth. Soaking in emisan (0.1%) solution for 20 minutes is found to eliminate the external microflora and improve seed germination (Kochu Babu etal.. 1991). The international phytosanitary requirement for disinfection of seeds during exportlimport is washing for 2 minutes in 0.1 per cent thiram (75% a.i.) plus 0.1 per cent teepol prior to preheating, during soaking to induce germination, prior to despatch and on arrival at destination (Turner, 1981).

3. NURSERY DISEASES

3.1 Early Leaf Diseases

Early leaf disease (otherwise known as seedling anthracnose) is the infection of young seedlings by species of Glomerella, Botryodiplodia and *Mélanconium* (Turner, 1981). In the nurseries raised in Karnataka and Kerala, seedling anthracnose has been observed to the extent of 5 per cent. Botryodiplodia theobromaeand Glomerella cingulata werethefungiencounlered. During1981, anthracnosecaused by Botryodiplodiapalmarum was recorded on seedlings from Ivory Coast and Republic of Zaire (Reddy etal., 1984). The symptoms caused by individual fungus are described hereunder.

3.1.1 Botryodiplodia (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 yellow halo. The entire leaf tips get affected. Black dots, the pycnidia of the fungus, are visible on the lesions. Healthy leaves in contact with the diseased ones get infected.

3.1.2 Glomerella (Glomerella *cingulata)*

The symptoms caused by Glomerella infection are different from those 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 yellow halo. The tissues at the centre dry and become brittle. Small dark dots, the acervuli of the fungus, are seen in the lesions.

In the nursery raised with the sprouts imported from Costa Rica at Shimoga, Karnataka, severe incidence of early leaf disease was observed in 1989. This could probably be due to the shading with coconut leaflets which had leaf spots. Clipping off the affected portions and spraying dithiocarbamates control the disease.

3.2 Leaf Rot

Stray incidence of this disease has been recorded during the rainy period in the nursery at Central Plantation Crops Research Institute. Research Centre, Palode (Anon..1988). The infection begins at the base of the spear as irregular pale olive green patches bounded by brown zone. These later become dark brown and dry out. The pale desiccated tissues in the middle of the lesions shred easily and become tattered in appearance. The causal fungus *Corticium* solani (asexual state : Rhizoctonia *solani*) reported from other countries was also isolated. Avoiding overcrowding of seedlings and excessive shade, roguing and application of carbendazim (0.1%) have been recommended.

3.3 Leaf Spots

Incidence of leaf spot caused by *Curvularia lunata* and C. *geniculata* was recorded on primary and secondary nurseries. Small circular translucent yellow spots appear on unfurling spear and young leaves. These later enlarge and become brown with sunken centre and yellow orange halo. The lesions range from 3 to 7 mm in diameter. A narrow rim of raised tissues, oily in appearance develops at the merging point of yellow halo with the brown lesion. In severe cases, the lesions coalesce causing a complete dieback of leaf tissues. The persistence of primary lesions within the necrotic area is characteristic.

In the case of Pestalotiopsis leaf spots, large irregularly shaped orange red lesions occur on the older leaves of secondary nursery seedlings. Later these lesions become necrotic with dark grey margin and light brown centre. Association of Pestalotiopsis *palmarum* and P. monochaetioides is recorded (Kochu Babu et *al.*, 1990).

Nursery leaf spots caused by *Helminthosporium halodes* var. elaeicola and Freckle caused by Cercospora elaeidis were reported by Reddy et *al.* (1984). These identifications appear to be based on symptoms and in none of the cases pathogenicity was proved. Fortunately 'Freckle' caused by Cercospora elaeidis reported from African countries has not been observed in South-East Asia so far.

3.4 Nursery Spear Rot

Rotting of unopened spear has been recorded to be caused by Phytophthora arecae in Republic of Zaire and *Fusarium* spp. in Malaysia. But the symptoms of nursery spear rot recorded in Kerala are different from others because of the prominent yellowing on the young unfolded leaves (Fig. 1).

Water soaked lesions develop on the middle portion of spear leaflets which 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 of field palms. Association of Mycoplasma-like organisms (MLOs) has been observed (Kochu Babu, 1993).

3.5 Collante

Collante is a symptom associated with inadequate soil moisture condition. Though it occurs in all stages of nursery, collante is particularly severe in the primary nursery stage. Symptoms are also noticed on field palms when planted during dry weather.

Fig. 1 : Nursery spear rot in oil palm

In the affected seedlings of primary nursery, the leaves fail to unfurl properly with a constriction developing in the central portion of the leaf. The veins become prominent and the leaves are rigid. In extreme cases, the leaf remains as woody spike without the separation of leaflets. Adequate watering prevents the occurrence of collante.

4. DISEASES OF OIL PALM PLANTATIONS

4.1 Spear Rot

Rotting of spear originating away from the meristem is common in Indian plantations as reported from other countries. Reddy el al. (1984) reported spear rot on five years old palms of Nigerian origin in Yeroor Estate, Kerala. Spear rot associated with foliar yellowing has been noticed in plantations of Kerala (Kochu Babu, 1989). The oil palm plantations of Andhra Pradesh, Andamans, Karnataka and Maharashtra are free from this disease so far.

Yellowing of the youngest whorl of unfolded leaves is the initial symptom (Fig. 2). The yellowing starts from the tips of leaves and spreads mostly along the margins of leaflets. In some cases, one or two yellowing affected leaves collapse at the leaf base. The chlorotic area later turns brown and dries up in a short period. Large fungal lesions on leaf base as in fatal yellowing in tropical America are not observed.

At the beginning of innerwhorl yellowing, watersoaked lesions are seen at the central portion of the youngest spear which later result in rotting and extend downwards as well as towards the tips. Rotting is confined to portions about 50 cm above meristem.

Yellowing or rotting does not progress to the lower whorls of leaves and the bunches produced prior to disease incidence in their leaf axils mature normally. The leaves emerging later on show rotting and are reduced in size. With diseaseadvancement rudimentary leaves are produced indicating the possibility of reduced meristem activity. In older palms the trunk tapers. Though there is inflorescenceinitiation in axils of affected leaves, they abort before emergence resulting in total loss in productivity. The symptoms are different from those of spear rot diseases reported from other oil palm growing countries, viz., crown disease, wither tip, patch yellow, spear rot-bud rot-little leaf disease complex and fatal yellowing.

Initial occurrence is sporadic. The spread of the disease is erratic and patchy. Higher disease incidence is seen during the rainy period and on 3-5 years old palms. Jhe *tenera* x *tenera* population at Palode planted at a spacing of 5 metres on a steep sloppy land had the highest incidence of 40 per cent from 1985 to 1991. The oil palm plantations adjoining root (wilt) disease affectedcoconut and yellow leaf diseaseaffected arecanut palms had higher spear rot incidence indicating the possible relationship (Kochu Babu and Ramachandran Nair, 1993).

The micro-organismsisolated from spear rot affectedpalms are given in Table 1. The most consistent fungal isolates are *Fusarium moniliforme* and Colletotrichum

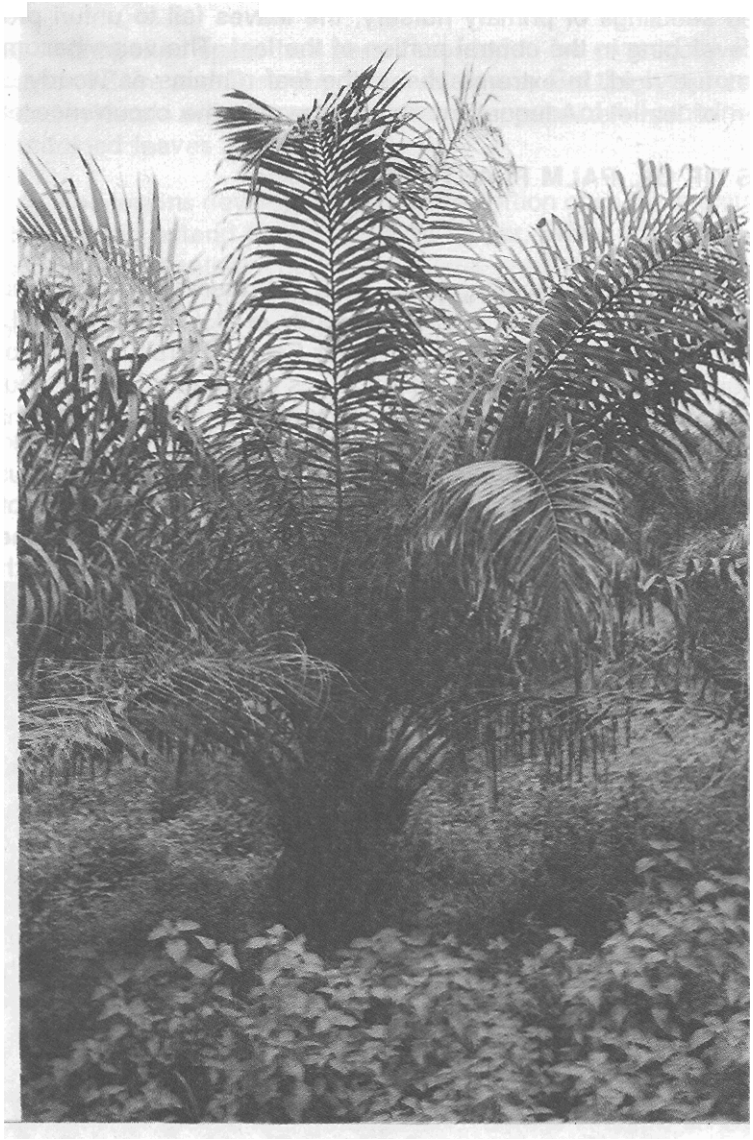

Fig. 2 : Spear rot in oil palm

gloeosporioides. But these are not pathogenic. The bacterial isolates so far identified are saprophytic only. Macro and micro nutrient levels in diseased and healthy palms show no significant variation. Recently Mycoplasma-like organisms have been observed in the sieve tubes of submeristematic tissues and unopened inflorescence rachilla of spear rot palms collected from three locations in Kerala. Besides the presence of MLOs, structural changes like phloem necrosis, compression of sieve cells and presence of

Table 1 : *Micro-organisms associated with oil palm*

Alternaria alternata (Fr.) Keissler.
Aspergillus fisheri Wehmer
Aspergillus fumigatus Fres.
A. infectoria E. sirnrnons
A, intermedia Boedijn
A. tenuissima (Kunze) Wiltshire
Aspergillus terreus Thom
Bacillus subtilis (Ehrenberg) *Cohn.*
Beltraniella portoricensis (F. stev.) Piozynski & *Patil.*
Botryodiplodia palmarum
Botryodiplodia theobrvmae Pat.
Chaetomium aureum Chiver's
Cochliobiolus eragrostidis (Tsuda & Ueyama) Sivan.
(anamorph of *Curvularia eragrostidis* (Henn.) J.A. *Meyer*
Cochliobolus geniculatus Nelson.
(anarnoph of Curvularia geniculata (Tracy 8 Earle) *Boedijn*
Colletotrichum gloeosporioides (Penz.) *Sacc.*
Colleotrichum sp.
Corynespora cassicola (Berk & *MA Curtis) Wee.*
Curvularia intermedia Boedijn.
(anamorph of Cochliobolus intemedius Nelson)
Cuwularia lunata (Wakker) Boedijn.
(anamorph of Cochliobolus lunatus Nelson & Haris)
Curvularia maculans
Cryptosporiosis sp.
Diplodia sp.
Helminthosporium halodes var. elaeicola
Enterobacter sp.
Fusarium compactum (Wollen W.)
Fusarium moniliforme Sheldon
F. moniliforme var. *intermedium Neish 8 Leggett.*
F. moniliforme var. *subglutinans* Wollenw. & *Reinking.*
Fusarium oxysporum Schlecht.
Fusarium pallidoroseum (Cooke) *Sacc.* (*F. semitectum* Berk & *Rav.)*
Fusarium solani (Mart.) *Sacc.*
Glomerella cingulata (Stonem.) Spauld. & *Schrenk.*
Macrophomina phaseolina (Tassi) Goid.
Nigrospora sphaerica (Sacc) Mason
Paecilomyces variotii Bainier
Penicillium pinophylum Hedgcock
Pestalosphaeria elaeidis (C. Booth & Roberston) Van der As.
Pestalotiopsis sp.

Table 1 : Continued

P. *glandicola* (Cast) Steyaert.
P. *monochaetioides* (Doyer) Steyaert.
P. palmarum (Cooke) Steyaert.
P. versicolor (Speg.) Steyaert.
Pseudomonas sp.
Phoma *sorghina* (Sacc.) Boerema et *al.*
Phomopsis elaeidis Punith.
Phyllosticta sp.
Schizophyllum commune Fr.
Serratia marcescens Bizio.
Setosphaeria *rostrata* Leonard (anamorph of *Exserohilum rostratum* (Drechsler)
Thielavia terricola (Gilman & Abbott) Emmons

large number of cell organelles in cells adjoining the vascular tissues were also evident (Anon., 1992). Positive disease transmission using dodder laurel, Cassytha *filiformis* L. and response to tetracycline antibiotics confirmed the mycoplasmal etiology (Kochu Babu, 1993). Roguing of affected palms is recommended to prevent spread of this malady.

4.2 Bud Rot

Bud rot is reported to occur in all oil palm growing countries. It has been noticed in the plantation of Kerala, Andamans, Karnataka and Andhra Pradesh (Kochu Babu et *al.*, 1990). The young palms below five years had higher disease incidence. In one plot in Karnataka having 165 palms, up to 12.7 per cent incidence has been noticed in 1989.

In bud rot, the rotting starts at the basal portion of the spear closer to the rneristem and extends to the whole spear and is different from the spear rots. The affected spear falls off leaving a crater at the centre (Fig. 3). The spear could be easily pulled off. If the rotting is left unchecked, extension to the meristem occurs. In the case of recovery, the palm enters into a little leaf phase temporarily with twisted petiole/rachis. The leaves emerging immediately after recovery are shorter. Normal leaves are produced after a few months. Cleaning of crown and drenching with carbendazim (0.1%) cure the disease (Anon., 1990).

4.3 Crown Disease

This disease otherwise called juvenile disease occurring frequently during the immature phase has been reported from many other oil palm growing countries. Occurrence of this disease has also been noticed in the plantations of Kerala, Andhra Pradesh and Karnataka (Kochu Babu etal., 1990).

During the early phase of the disease, the rotting is not apparent on the spear externally. Brown lesions with watersoaked margin are observed on the middle portions

Fig. 3 : Bud rot in oil palm

of the internal leaflets. When the affected spear opens, it develops characteristic bending at the middle of the rachis (Fig. 4). The leaflets on both sides of the curved portion of the rachis are either completely rotten or a few stumps remain. The leaves emerging subsequently also had the symptoms. As spontaneous recovery is featureof this disease, control measures are not taken up. This disease is reported to be mainly influenced by genetic and physiological factors. The microorganisms isolated from affected portions

are *Fusarium moniliforme*, F. *semitectum* and Colletotrichum gloeosporioides which are not pathogenic.

4.4 Bunch Failure

Failure in the development of bunches at any stage during anthesis to harvest has been termed as bunch failure. This is most frequent in 3-10 years old palms to the extent of 20 per cent (Nair, 1986). Failure in the development of fruits is the first visible symptom of this malady. The tips of under-developed fruits turn black and later become necrotic. The bunches remain as such for 8-12 weeks unless they are invaded by fungi like Marasmius palmivorus and Fusarium which cause complete rotting of the bunches. Marasmius palmivorus is saprophytic in nature usually colonising leaf axils and leaf bases. Reddy *et al.* (1987) reported the occurrence of Marasmius bunch rot in oil palm plantations of Forest and Plantation Development Corporation in Little Andamans. They also recorded bunch rot in oil palm plantations at Yeroor and the association of *Ceratostomella* sp. (Reddy *et al.*, 1984). Delicate sporophores of Marasmius palmivorus appear during wet weather. Sporophores produced during wet weather are white and large whereas those produced in dry months are small and pink. Bunches produced during March-May reach half maturity during monsoon (July-August) and are affected to the maximum extent.

Neither sex ratio nor pollen load in the atmosphere has any effect on bunch failure. Retention of rotten immature bunches favour infection on fresh bunches. Periodical palm cleaning reduces the load of inoculum and fresh incidence.

By assisted pollination, perfect bunches could be obtained. Though bavistin (0.2%) spray alone has no effect on bunch failure, complete control could be obtained through crown cleaning, assisted pollination and bavistin (0.2%) spray when taken up simultaneously. The bunch failure incidence is found to be low in Forest and Plantation Development Corporation plantations of Little Andamans (Chander Rao et *al.*, 1990) and at Central Plantation Crops Research Institute. Palode (Dhileepan and Nampoothiri, 1989) after the introduction of pollinating weevil *Elaeidobius kamerunicus*.

4.5 Upper Stem Rot

This disease is recorded from the fifteen years old oil palm plantation of Forest and Plantation Development Corporation (Kochu Babu and Pillai, 1992).

The symptoms are gum exudation, stem bleeding and rotting of the stem. Gum exudation and stem bleeding occur at any point above 50 cm from the bole region. In the early stage of disease, the bleeding lesion is found to converge inwards and gradually reduced in size. In due course, rotting extends internally in an irregular pattern. In few cases, the lesion extends laterally girdling the stem. Once the rotting advances inside, the palm snaps at the site of rotting due to lack of mechanical support (Fig. 5). No symptoms are visible on the foliage even when about 75 per cent of the stem tissues showed rotting.

Fig. 4 : Crown disease in oil palm

Fig. 5 : **Upper stem** rot, snapping of **the upper** portion of the ***stem*** in oil palm

The presence of healthy tissues above and below the lesion indicates that the infection is not likely to be systemic and may be localised. Though the symptoms are similar to *Phellinus* upper stem rot reported from several other countries (Turner, 1981),

the absence of fructifications of *Phellinus noxius* on frond butts and stem suggests that this fungus may not be the etiological agent. The gum exudates revealed the presence of spores of Thielaviopsis sp. The etiological role of Thielaviopsis sp. isolated from early stage lesions needs confirmation by pathogenicity studies.

Identification of disease in the early stages and removal of rotten tissues, swabbing with calixin (0.1%) followed by application of hot coal tar is recommended. In advanced cases, removal of the rotten tissues to the extent possible followed by spraying with calixin (0.1%) in the interior portions and application of hot coal tar could save the 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 rodent, insect and wind damage.

4.6 Leaf Rot

Mathai et al. (1989) reported the occurrence of leaf rot symptoms on oil palm in Chithara and Kumarakom of Kerala. Brown spots with yellow haloes appear on the leaflets of inner whorl leaf lamina which later become necrotic and are flown off in the wind. The disease is reported to progress slowly. Palms of all ages have been found affected: but is more severe on palms below 10 years.

Colletotrichum gloeosporioides has been reported as the causal agent. Occurrence of similar symptoms could not be observed later on. Also, C. gloeosporioides isolates were not pathogenic in later pathogenicity trials.

4.7 Leaf Spots

Leaf spots caused by Pestalotiopsis spp. are noticed on the lower whorl leaves. Magnesium deficiency increases the incidence. The first symptom of Pestalotiopsis leaf spot is appearance of brown spots on leaflets of lower whorl of leaves later spreading to the whole leaflets. The centre of the lesions are light grey to brown with numerous black dots, which are the acervuli of the fungus. The isolates from Palode plantations are Pestalotiopsispalmarum, P. glandicola and P. monochaetioides (Kochu Babu etal.. 1990).

4.8 Petiole Spots

Occurrence of these spots has been noticed on **52-64** per cent of the palms in Palode plantations (Kochu Babu etal., 1990). Irregular spots ranging from 2 to 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.

4.9 Stray Reports

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

Reddy et *al*. (1984) reported infection of Fusarium oxysporum f. sp. *elaeidis* on 950/1,25,000 seeds imported in India from Nigeria.

Wither tip disease incidence at Oil Palm Research Station. Thodupuzha, Kerala state was recorded by Rajan *et al.* (1980). They implicated Fusarium oxysporum as the causal agent. However, this disease has not been noticed later on.

5. DISORDERS

Apart from the diseases, few disorders listed below are also noticed in the plantations of India.

5.1 Leaf Base Wilt

Recently, leaf base wilt has been observed on the 14 years old plantations of Palode and Yeroor. The lower most whorl fronds subtend downward from the point of insertion on the stem and hang around the stem giving a skirt of wilted fronds (Fig. 6). These fronds do not dry up immediately. In general, the bunches 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).

5.2 Wind Damage

5.2.1 Crown Fracture or Head Bending

Two to three young leaves and group of spear break at the base and fall. Occurrence of crown fracture 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.

5.2.2 Pinnae Fragmentation

The common symptom on palms exposed to severe wind is the shredding of pinnae resulting in hanging of leaflets leaving the mid rib projecting. Heavy winds cause reduction in assimilative area to about 25 per cent and induce the formation of male inflorescences and reduce yield two years later (Turner, 1981).

Severe wind damage results in even lodging of young palms. The leaflets of the palms get damaged due to constant rubbing with the other leaves. In young seedlings. staking can prevent wind damage.

5.3 Chimaeras

Occurrence of asymmetrical pattern of yellowing of leaflets of some fronds in a palm is grouped as chimaeras. Symptoms are noticed on the leaflets, rachis and mid

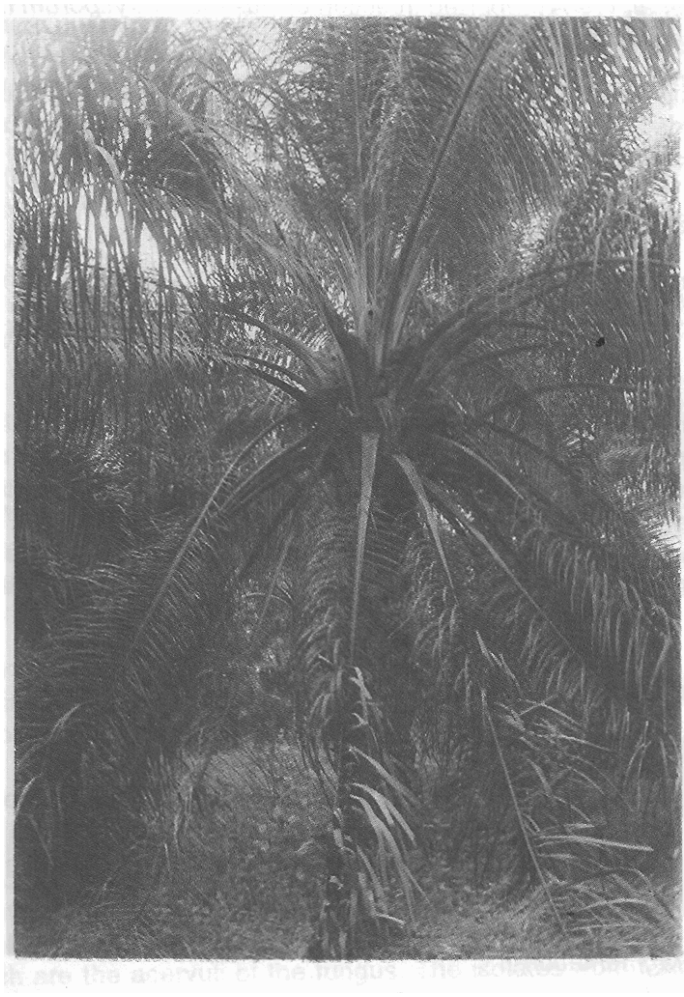

Fig. 6 : Leaf base wilt in oil palm

rib with variation in the pattern of distribution (Fig. 7). As most chimaeras could be spotted out in the nursery stage, elimination at this stage itself could reduce the chimaera population in the field. Chimaeras are due to genetic reasons and need not be treated or removed because there is no adverse effect on the yield.

5.4 Genetic Orange Spotting

Palms with severe orange spotting for long time in isolated localities without other associated symptoms of potash deficiency are grouped under this. These orange spots do not have necrosis in the central portions as present in the confluent orange spotting due to potash deficiency.

Fig. 7 : A Chimaera in oil palm

6. GENERAL PLANT PROTECTION AND QUARANTINE MEASURES

It should be borne in mind that copper fungicides should not be applied to oil palm because of phytotoxicity. A constant monitoring has to be done on new plantations in different states which contain imported materials also for the disease occurrence, if any, so that appropriate curative measures can be taken even at the early stages of disease occurrence. From the quarantine angle, it is very essential to screen the imported pollen, seeds and sprouts for the presenceof Cercospora *elaeidis* and *Fusarium oxysporum* f. sp. *elaeidis*. Introduction of planting material from countries where diseases of unknown etiology exist needs to be done very carefully.

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