

# DISEASE MANAGEMENT STRATEGIES IN ARECANUT AND COCOA



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## Introduction

Arecanut (*Areca catechu* L) is an important plantation crop grown in humid tropics of India. Traditionally, the crop is grown in the states of Karnataka, Kerala, Assam, West Bengal, Tamil Nadu and Maharashtra. It is also grown in Andamans, Tripura, Manipura to a certain extent. At present, arecanut is grown in 2,64,000ha with an annual production of 3,13,000 tonnes. Cocoa has been found to be profitable mixed crop in the existing arecanut and coconut (*Cocos nucifera* L) gardens in India. At present, cocoa is cultivated in 12,400 ha As the diseases are causing heavy yield losses, disease management is of utmost importance to maintain sustainable productivity.



## DISEASES OF ARECANUT

### Fruit rot ('Kole roga/mahali')

The disease is caused by *Phytophthora meadii*. The disease is wide spread in occurrence in all arecanut growing tracts. The crop losses due to this disease varies from 10-90 per cent depending on the weather conditions. The first visual symptoms appear as water soaked lesions on the nut surface near the perianth end. Later, these lesions spread over to other parts giving the nut a dark green colour. Infected nuts are shed usually with out calyx. A whitish mycelial growth develops on the lesion of the shed nut and it eventually envelops the entire nut surface. In severe cases, fruit stalks and axis of the inflorescence are also affected. Infection also causes discoloration of the kernel. The diseased nuts will be lighter in weight and posses large vacuoles.



Disease can be controlled satisfactorily by prophylatic pre-monsoon spraying with one per cent Bordeaux mixture and second spray after 40-45 days. A third spray would be necessary if the monsoon is prolonged.

The cultural practice of covering of arecanut bunches with polythene covers (125 gauge, 75×60 cm) has been found to

be very effective in checking the disease by acting as mechanical barrier.

### Bud rot and crown rot

Bud rot is a fatal disease caused by same organism (*Phytophthora meadii*) causing fruit rot. The disease is prevalent during South-west monsoon (June-September) as well as in the subsequent winter months (October. - February) First visual symptom of the disease is the yellowing of spindle leaf. As a result of infection, spindle loses its green colour and turns into yellow which later changes to brown. Finally, whole spindle rots. In advanced stages of disease, the spindle can be drawn out of the crown with slight pull.

In recent years, crown rot caused by *P. meadii* has been increasingly noticed in many parts of Kerala and Karnataka. Unlike bud rot, infection initiates from the base of leaf sheath of the outer whorl of leaves during the monsoon season and gradually spreads towards the growing bud. As a result, infection causes yellowing and drying of the leaves and, if neglected, infection spreads



The inner whorl of leaves and then in the growing bud and causes toppling of the crown within a short period.

Early detection of the disease and prompt removal of the infected tissues will help in the recovery of the palms and also prevents further spread of the disease. Infected tissues may be scooped off by making longitudinal side slit and treated with 10 per cent Bordeaux paste. The treated portion has to be covered with areca leaf sheath or polythene sheet to ward off insects visiting the infected tissues and also to avoid washing off of chemical.

#### **Anabe roga or foot rot:**

It is a major problem of wide occurrence in the Malnad and Maidan areas of Karnataka, parts of Tamil Nadu, Kerala and Assam. The initial visible symptom is yellowing of outer whorl of leaves which gradually extends to the inner whorls. In advanced stage of the disease the leaves droop and drop off one by one leaving a tuft of one or two leaves along with the spindle at the centre. The affected palm initially exhibits a dull brownish patch at the base of the trunk which later enlarges in size and a brownish exudate oozes out from the ground level. Roots as well as basal portion of stem of the infected trees show varying degrees of discolouration and rotting. Most of the cases, the roots become brittle. The infection leads to interruption of water and nutrient uptake by the palm resulting in the bracket shaped sporophores. The fruiting bodies of the fungus are formed at the base of the trunk immediately after the death of the palm or occasionally in advanced stages of the disease or at times on the stumps, after felling the affected palm.

The disease is caused by a bracket forming fungus *Ganoderma lucidum*. The diseased palms are to be isolated by digging deep trenches of 30 cm wide and 60 cm deep all around the affected palm. The palm in the early stages of disease may be root fed with 125 ml of 1.5 per cent calixin solution at quarterly interval i.e., during March, July October and January. The basins of affected palms are to be treated with 1.5 per cent calixin by drenching. Besides, all palms in the infected garden may be given neem cake @ 1.5 - 2.0 kg along with recommended dose of organic and inorganic fertilizers.

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#### **Yellow Leaf disease**

The diagnostic symptom of the disease is yellowing of the leaves. Yellowing starts from the tips of the leaflets of the outer leaves, gradually extending along



the margin interspersed with green stripes. Affected leaves often develop necrosis from their tips. In advanced stages, the leaves become smaller, stiff and pointed. The crown gets reduced and the palm is stunted giving very few or no nuts at all. The developing feeder roots show varying degrees of blackening and they gradually rot. In some palms, nut size gets reduced and they shed before reaching maturity. The kernel from diseased palms becomes soft and exhibit blackish discoloration and assumes spongy structure. The symptoms are clearly discernible during months of September to November. With advent of summer, the symptoms will disappear.

The disease is caused by phytoplasma. The plant hopper, *Proutista moesta* has been found to act as a vector in the spread of the disease.



As the disease is not amenable to control by conventional plant protection measures, proper management of the garden is the only suggested method to prevent the loss due to this malady. Regular application of fertilizers at the rate of 100g N, 40g P and 140g K per palm per year in two splits, application of additional dose of Mussorie phos (800g/palm), application of organic manures and green leaf (12kg each/palm/year), avoiding water stagnation by providing good drainage facilities, growing cover crops in the interspaces will minimise the disease incidence. Besides, spread of the disease can be minimised by removing diseased palms.

### **Inflouescence die-back and button shedding**

The disease is noticed throughout the year but becomes severe during summer months (Feb.- May). Yellowing and drying of the rachis from the tip towards the base followed by shedding of female flowers or buttons are the characteristic symptoms of the disease. The disease may be caused by several factors such as lack of pollination, insufficient nutrients, water stress, high temperature or due to other physiological reasons. A pathogenic fungus *Colletotrichum gloeosporioides* is also associated with this disease.



The disease due to the fungus can be controlled by spraying with Indofil M-45 @ 3 g/L. of water or a mixture of aureo-fungin-sol and copper sulphate both at 0.05g/L. The first spraying has to be given at the time of opening of the female flowers and the second 20-25 days thereafter.

### **Bacterial leaf stripe**

The disease occurs in an endemic form in the maidan parts of Karnataka. Symptoms appear as dark green water soaked lesions, translucent linear lesions or strips on the leaf lamina. On the corresponding lower surface, the lesions show a creamy white exudate. The wet exudate is slimy but on drying it becomes waxy and leads to necrosis of the leaves. The infection may cause partial or complete blighting of the leaf and in extreme cases the plants succumb to infection. It is caused by a bacterium *Xanthomonas arecae*. The disease can be controlled by spraying with streptomycin or tetracycline (0.5g/L).

### **Leaf spot**

This disease is severe during South-West monsoon season. Young palms of less than 10 years old are more susceptible. Infection is usually restricted to 3-4 leaves of lower whorl. The symptoms develop as small brown to dark brown or black round spots. They vary in size and are characterised by an yellow halo around and in advanced stages form blighted patches. In severe cases the infection cause drying, drooping and shedding of leaves. *Phyllosticta arecae*. and *Colletotrichum gloeosporioides* are the pathogens involved in this disease. Disease can be controlled by spraying with one per cent Bordeaux mixture or Dithane M 45 @ 3 g/L.

### **Band or Hidimundige**

It is a physiological disorder. It is prevalent in all arecanut growing tracts of India. The disease is characterized by production of small, crinkled dark green leaves with brittle leaflets, tapering of stem, reduction in internodal length. In advanced stages, the crown forms a rosette shape. The affected palms remain mostly unproductive and if at all inflorescences are produced they will be small



malformed. Roots are poorly developed, short, brittle and crinkled. No biotic agents are associated with the disease.

Better soil management and improvement of drainage are important operations to reduce the disease incidence. Hard soil strata, when present, may be removed to increase the soil aeration, which will improve the formation of better root system. Basal application of borax (25g/palm/year) is effective in improving the health of the affected palm.

### **Sun scorch and stem breaking**

Sun scorch and stem breaking is due to the adverse effect of high temperature rather than a disease. Initial symptoms appear on the exposed portion of the stem as golden yellow patches. These patches later turns to brown and loses turgidity. Further colonization by saprophytic organisms and insects cause decay of the stem which finally breaks during heavy wind.

The deleterious effect of sun scorch and subsequent breaking of the stem can be reduced by (a) trailing pepper vines along the stem or (b) raising rapidly growing trees on the southern and western sides of the garden or (c) Tying the trunk with areca leaf. Adapting the suitable alignment of planting also is suggested to minimise the disease.

### **Stem bleeding**

This disease is of rare occurrence and resembles stem bleeding disease of coconut. This is reported from parts of Kerala, Kamataka and Tamil Nadu.

Palms in the age group of 10-15 years are more prone to this disease. Symptoms appear on the basal portion of the stem as small discoloured depressions. Later, these spots coalesce and cracks develop on the stem leading to disintegration of the fibrous tissues inside. With the progress of the disease, a brown exudate oozes out from these cracks. High water table predisposes the palm to this disease. The fungus *Thielaviopsis paradoxa* is associated with this disease.

Improvement of drainage and root feeding of 125 ml calixin (1.5%) is suggested as control measures against this disease.

### **Nut splitting**

This can be called a physiological disorder than a disease. Palms in the age group of 10-25 years are more susceptible. Symptoms are premature yellowing of the nuts when they are half to three-fourth mature. Later splits develop at the tips which extend longitudinally exposing the kernal. Sometimes kernal also show splitting and malformation. Rarely the kernal inside may exhibit splitting without visual symptoms on the husk, resulting in nut fall. Hyper nutrition or sudden flush of water after a period of drought or insufficient moisture in the soil etc. are the suggested cause(s) of the disease.

The disease incidence can be minimised by making longitudinal side slit at the base of the inflorescence. Improvement of drainage in ill drained gardens and spraying of Borax @ 2 g/lit. water are also found effective in reducing the disease incidence

## **DISEASES OF COCOA**

### **Seedling dieback**

Defoliation and dieback of seedling are the characteristic symptoms of this disease. Generally the infection starts from the tip of the stem and proceeds downwards as dark brown to black water soaked linear lesions. The lesions also extend to the leaves through the petioles resulting in wilting and subsequent defoliation of the seedlings. The infection also initiates from the collar region, cotylendony stalk or leaves as dark brown to black discolouration. In all the cases, the infection spreads to the entire stem causing wilting, defoliation and ultimately death of the seedlings. The disease is caused by *Phytophthora palmivora*.

The disease may be controlled by drenching the seedling with Bordeaux mixture(1%) or any other copper oxychloride (0.2%) just before the onset of monsoon and thereafter at frequent intervals.

### **Black pod disease**

It occurs in the rainy season (June - September). Pods of all ages are susceptible to the disease. The infection appears as one or more small, brown, circular lesions anywhere on the pod surface. They increase rapidly and cover the whole surface of the pod. Ultimately, the whole pod and the beans are invaded by the fungus and the pod turns black in colour. Three species of *Phytophthora* such as *P. palmivora*, *P. capsici* and *P. citophthora* have been found to be associated with disease.

Since the infected pods will form the main source of further infection of healthy pods, the infected pods should be cut and removed from the gardens at weekly intervals. The beans in ripe pod which are only partly black may escape from infection because the beans are separated from the husk on ripening. But all unripe pods which are infected should be discarded. If the diseased pods are not removed it is difficult to get better control from fungicide application alone. Since high humidity and low temperature are favourable for disease development, cocoa should not be planted very closely. Proper pruning of cocoa trees is also very essential to minimise the shade.

Weekly removal of infected pods and spraying Bordeaux mixture (1%) at frequent intervals depending on the severity of the disease will give good control of the disease. The spray should be mainly directed at the pods and bearing branches.

### **Charcoal pod rot**

It is found throughout the year with severity during summer months. Pods of all ages are susceptible. The infection takes place through wounds generally caused by rodents, other pests and insects. The infection appears as dark brown to black spot anywhere on the pod surface and spreads rapidly. As a result of which the pods turn black and remain on the tree as mummified fruit. On the surface of the affected pods, spores appear as black powdery mass resembling soot. The infection spreads to the internal tissues and the affected beans turn black in colour. This disease is caused by *Botryodiplodia theobromae*. Spraying with one per cent Bordeaux mixture is recommended for the control of this disease.

### **Collectotrichum Pod rot**

It is noticed during months of December to May when susceptible pods are plenty. The infection mostly starts from the stalk end particularly at the point of attachment of stalk to the pod. Then it proceeds towards the tip as dark brown discolouration with a diffuse yellow halo. The infection also extends to stalk and reaches the cushion, but does not spread further on the cushion. The infected stalk is highly shrunken and is easily distinguishable from a healthy stalk. With the progress of infection, the internal tissue of the pod also turns to black. Ultimately the whole pod turns black and persists on the tree as mummified fruit. Sometimes the infection initiates from parts other than the stalk region as dark brown, sunken lesion. It is caused by *Colletotrichum gloeosporioides*. Under conditions of high humidity profuse sporulation is observed as pinkish mass on the lesions. This fungus also causes leaf spots. However, nearly mature pods are reported to be free of *C. gloeosporioides* infection. It can be controlled effectively by spraying with Bavistin (1g/L) or Indofil M-45(3 g/L) at monthly intervals starting from December to May depending on severity of disease.

### **Stem canker**

The appearance of greyish-brown, water soaked lesions with broad, dark brown to black margin anywhere on the main trunk, jorquetts or fan branches is the earliest symptom of this disease. A reddish-brown liquid oozes out from these lesions, which later dries up to form a rusty deposit. The internal tissues beneath the outer greyish-brown lesions appear as reddish-brown which can be easily distinguished from the healthy tissue. As a result of infection the wood shows greyish-brown discolouration with black streaks. When the cankers girdle



trunk or branches, discolouration, wilting and ultimately defoliation of the leaves take place. Such plants/branches show symptoms of dieback and eventually the portion above the point of attack dies.

Stem canker is caused by *P. palmivora*. The canker often develops from the pods infected by *P. palmivora*. The infection from the pods spreads to the peduncle and then to the cushion and bark causing canker. Hence, such infected pods should be removed and destroyed. This disease can be controlled in the early stages by the excision of diseased bark followed by painting with 0.25 percent metalaxyl solution.



### Vascular streak dieback

Vascular streak die back (VSD) has been recognised as the most destructive disease of cocoa in Papua New Guinea, Malaysia, Indonesia and Philippines. In India, at present, VSD has been observed in Thiruvananthapuram, Kottayam, Idukki, Kozhikode and Wynad districts of Kerala State.

The first visible symptoms of VSD is the yellowing of usually a single leaf in the second or third flush from the tip of twigs with characteristic green islets. Such infected leaves fall prematurely and the leaves above and below also develop similar symptoms subsequently. These lead to distinctive situation where the younger and older leaves present whereas middle leaves have fallen away. Although roughening of bark in the leaf fall region due to swelling of the lenticel is the earliest symptoms to appear, this is not usually seen until the leaves fall. If the thin layer of tissue is removed from the leaf scar left by the abscission of the infected leaf, three vascular traces which served the diseased leaf can be seen clearly as three dark brown to black patches. The axillary buds of the fallen leaves often begin to sprout and then rapidly die. At later stages, die back symptoms appear on these branches. When the diseased stem split longitudinally, brown streaking of the wood is clearly evident. This streaking is associated with the presence of the fungus in the xylem vessels of the wood and provides the basis for the name 'Vascular streak die back'. The cambium in the diseased region turns rusty-brown abnormally fast when exposed to air. In wet weather, the fruiting bodies of the fungus appear as white crust around the leaf scars. Leaves in the diseased seedling or branch often show interveinal necrosis similar to symptoms of calcium deficiency. The infected branch dies while the other branches of the tree remain healthy. The disease is caused by *Oncobasidium theobromae*.



As the disease has an incubation period of 3-6 months or even longer period in infected seedlings to express first visible symptoms, movement of vegetative planting material from diseased areas to disease free zones should be prevented. The branches should be split open from the tip towards the base to reveal the extent of brown streak in the wood and then they are cut off 30

cm. below the last point of visible streak as the fungus may be present beyond the brown streaked portions. Regular pruning may also help to remove infection from the plant by reducing internal colonisation by the fungus and also thus prevent the spread of disease by reducing number of propagules. Removal of prunings from gardens is not necessary because the fungus can not live in dead and decaying plant parts.

**Pink disease:**

The disease is characterised by the presence of pinkish powdery coating on the stem. It causes wilting of shoots, shedding of leaves and ultimately drying up of the branches. It is caused by *Pellicularia salmonicolor*



The disease can be checked effectively by pruning the affected branches and swabbing the cut ends with Bordeaux paste. Its incidence can be prevented to a greater extent by spraying one per cent Bordeaux mixture at regular intervals during the rainy season.

**White thread blight**

The white mycelial threads of the fungus spread longitudinally and irregularly along the surface of the stem of young branches and enter the leaf along the petioles. On the leaf lamina it spreads extensively and forms a much branched system of fine threads. The affected leaves turn dark brown and such dead leaves eventually get detached from the stem, but are found suspended by the mycelial thread. Extensive death of the young branches and suspended leaves in rows are the common field symptoms. *Marasmius scandens* has been found to be causal agent of the disease.

The disease generally spreads from plant to plant through dead leaves with mycelial mat which are easily carried by wind. Removal and burning of the affected plant parts and removal of heavy shade when cocoa is grown as a mixed crop will help in the control of the disease.

**Zinc deficiency:**

Incidence of severe zinc deficiency leading to foliar abnormality and twig dieback has been observed in many cocoa gardens in Kerala, Karnataka and Tamil Nadu states. Chlorosis of the leaves is the initial symptom of zinc deficiency. It appears in patches and in advanced conditions, the green portion is found along the sides of the veins, giving a vein banding appearance. These leaves later show mottling and crinkling with wavy margin. The younger leaves produced subsequently are much reduced in size and are sickle shaped. In severe cases, premature defoliation followed by dieback.

Foliar spray of a mixture of 0.3 per cent zinc sulphate and 0.15 per cent (w/v) lime has been reported to be an effective and quick method of correcting zinc deficiency in cocoa.

Diseases such as swollen shoot (virus disease), Witch's broom, Monilia pod rot, *Certocystis* wilt and green point gall which are all of fungal etiology are known to occur in severe forms in other countries. But these diseases were so far, not recorded from India. With the expansion of cocoa cultivation in India, strict quarantine measures may be necessary to prevent the introduction of these diseases.