

Producing disease-free coconuts

Integration of various disease management practices depends on crop, disease/pathogen, cropping system, location and climatic factors. Disease management might be viewed as a holistic approach. The emphasis should be given to integrated management practices to achieve the desired goal. However, this is not always easy to accomplish, and 'disease management' may be reduced to single 'disease control' measures using chemicals. Effective disease management can be achieved only if the integrated plant-protection measures are adopted at the right time.

COCONUT palm is susceptible to a number of diseases. Some of them are fatal while others reduce its vigour and finally result in economic loss. Among diseases, root (wilt), leaf rot, bud rot, stem bleeding and basal stem rot are major problems. The Integrated Disease Management (IDM) programme integrates all the suitable techniques and methods in a compatible way to prevent and manage diseases in crops. The IDM includes selection of disease-free planting material, field and plant sanitation, weed management, integrated nutrient management through application of compost or other organic manures along with the recommended dose of chemical fertilizers, biocontrol of pathogens etc.

INTEGRATED DISEASE MANAGEMENT

Root (Wilt)

The most obvious and diagnostic symptom of disease is the abnormal inward bending of leaflets termed ribbing or flaccidity. Yellowing and marginal necrosis of leaflets are other associated foliar symptoms. Rotting of roots increases with the progress of the disease. Shedding of immature nuts, drying up of spathes and necrosis of spikelets in unopened inflorescence is noticed in certain cases. The husk, kernel and oil of the nuts of disease affected palms are of poor quality. The disease also causes several internal changes in the palm.

A phloem bound mollicute (phytoplasma) is the cause of the disease. Constant association of phytoplasma with root (wilt) disease has been established beyond doubt. The insect vectors transmitting the disease in nature have been identified as lace bug (*Stephanitis typica*) and plant hopper (*Proutista moesta*). The disease also could be experimentally transmitted to phytoplasma indicator host, periwinkle.

Leaf Rot with Root (Wilt) Disease

Leaf rot, caused by fungi (*Exerohilum rostratum* and

Colletotrichum gloeosporioides), occurs superimposed on root (wilt) affected palms. About 65 % of root (wilt) diseased palms are affected by leaf rot disease caused by fungi. Normally farmers identify a palm as root (wilt) affected only when the leaf rot sets in.

Leaf Rot

Palms of all ages are susceptible to this disease. The disease causes drastic reduction in photosynthetic area,

Healthy leaves after leaf rot management



which in turn causes reduction in yield. Severity of leaf rot symptom is more during monsoon.

Tiny water-soaked lesions appear on spindle leaves which gradually enlarge, coalesce freely, leading to extensive rotting. The rotting may advance into the interior of the spindle. When the spindle grows, the rotten portions dry up, turn dark brown to black, break and are blown off in the wind. In many cases, the rotten distal portions of leaflet adhere to each other from top to bottom on both sides thereby giving a fish bone appearance. On drying these portions drop off. Hardening of the tissues and development of chlorophyll in the maturing leaflets generally slow down the progress of rotting towards the base of the leaflets so that the basal portions of the affected leaflets remain green and normal giving a fan like appearance.

The *Exserohilum rostratum* and *Colletotrichum gloeosporioides* are major pathogens causing leaf rot. Fungi infect the newly emerging spindle leaves and thus leaf rot disease has direct bearing on the decline in yield of palms.

Management

Since root (wilt) disease is caused by phytoplasma, it is not amenable to conventional plant protection measures. One of the significant features of the disease is that it is not lethal but a debilitating malady which responds to ideal management practices. Two strategies, one for the heavily diseased contiguous area, and another for the mildly affected area have been formulated.

In heavily diseased area, the yield of palms can be sustained or even improved through adoption of integrated management practices:

- Removal of disease advanced and juvenile palms
- Management of leaf rot disease
- Balanced fertilizer application
- Addition of organic manures
- Raising of green manure crops in the basins and incorporation
- Irrigation during summer
- Management of other diseases and pests
- Adopting inter and mixed cropping
- Mixed farming in the diseased gardens involving raising of fodder crops in the inter spaces, maintaining milch cows and recycling of organic waste.

Cut and remove rotten portions of the spindle and the adjacent two innermost fully opened leaves, if affected

by leaf rot. White soft leaflets of the spindle alone are susceptible to fungal attack. Therefore, older leaves that had leaf rot disease earlier need not be removed.

- Mix Contaf 5 EC (Hexaconazole) 2 ml or Dithane M-45 (Mancozeb) 3 g in 300 ml water and pour into the well around the base of the spindle leaf.
- Apply 20g Phorate 10G or 30g Furadan 3G mixed with 200g sand around the base of the spindle leaf.
- Treat all palms in the garden (healthy and diseased) twice a year, i.e. in April-May and October-November. To make this operation more economical the treatment should be given along with harvest of nuts before and after south - west monsoon.

Residue analysis done for the chemicals, Contaf 5EC, Indofil M45 and Phorate 10 G in mature and tender nuts showed that the nut water, kernel, coconut oil and coconut cake are free from residues after 45 days of application at the rates suggested above



Bud rot in coconut

Bud Rot

Palms of all age groups are susceptible. The incidence is found to be high in palms below the age of 20 years. Mortality rate is also high in palms belonging to the age group of 15-20 years. The first visible symptom is withering of

spindle leaf marked by pale colour. The spindle leaf turns brown and bends down. Farmers often experience difficulties in the detection of the disease at this stage, though it is essential to diagnose the disease at the initial stage to take up curative control measures. The affected spindle leaf can easily be pulled out as the basal portion of the spindle is completely rotten emitting a foul smell. Symptoms are later observed in younger leaves next to the spindle. Later the inner leaves also fall away one by one leaving only outer whorl of matured leaves in the crown. Ultimately the palm succumbs to the disease with the death of the growing bud.

Bud rot disease is caused by the fungus *Phytophthora palmivora*. In endemic areas where bud rot incidence is increasing year after year, the survival of *Phytophthora* propagules as well as the inoculum build-up are very high. The *P. palmivora* is reported to over tide the unfavourable weather conditions during the post-monsoon period in the disease affected crown tissues and begin to multiply during the subsequent monsoon period. The implication of *Phytophthora* inoculum present in the crown as a

potential source of primary inoculum for bud rot is obvious. Further, secondary spread of disease from freshly bud rot affected palms is very fast under favourable weather conditions. Rain water acts as a carrier for the infectious propagules and plays an important role in the spread of the disease

Management

Bud rot disease can be effectively managed by cutting and removing of palms which are in advanced stage of bud rot. This will help to reduce the inoculum load in the garden and thereby checking the fast spread of the disease within the garden and to the neighbouring gardens. Rotten portion of the crown should be destroyed by burning.

- Curative measures have to be adopted when the disease is in early stages.
- The appropriate period would be the stage when the spindle has just started showing symptoms of withering.
- In early stage of disease, remove spindle leaf by pulling it out and cut and remove the infected tissues completely.
- Two or three healthy leaves adjacent to the spindle may have to be removed if necessary for easy removal of all rotten portions and thorough cleaning.
- The wound should be treated with Bordeaux paste(10%)/Mancozeb
- The treated wound should be covered with polythene cover to prevent entry of rain water and this protective covering should be retained till normal shoot emerges.
- In case of advanced stages of infection, palm should be cut and removed.
- The diseased tissues should be burnt after their removal.
- All the healthy palms in the surroundings should be treated with 1% Bordeaux mixture/ Mancozeb sachets.

It is important to give prophylactic treatment to all palms before the onset of monsoon, in gardens with a previous history of bud rot incidence. In certain dwarf palms, phytotoxic symptoms like brown sunken spots followed by nut shedding have been observed when Bordeaux mixture is sprayed. Therefore, in copper sensitive palms like Chowghat Orange Dwarf (COD) and Malayan Yellow Dwarf (MYD), keeping perforated sachets containing mancozeb in the innermost leaf axils during rainy season is found to be useful. Pouring Mancozeb solution (5g in 300 ml water /palm) well around the base of the spindle followed by placing perforated sachets containing Mancozeb (2 sachets/palm; 5 g Mancozeb/sachet) in the inner most leaf axils before the onset of south West monsoon is a very effective prophylactic treatment.



Immature nut falling in coconut

Immature Nut Fall

Immature nut fall in coconut has been attributed to several factors. The characteristic feature of mother palm is one of the prime reasons for button shedding in coconut. Hence the selection of high-yielding mother palm is very important for collection of seed nuts for raising coconut seedlings. Very high soil acidity or alkalinity also leads to more button shedding and immature nut fall. Drought condition or water shortage for a longer period, waterlogging and sudden changes in soil moisture also cause heavy button shedding. Imbalance or deficiency of nutrients leads to nut fall. Poor pollination is also one of the major factors responsible for button shedding in coconut.

Shedding of buttons is also caused by insect attack. Eriophyid mite attack also leads to immature nut fall to some extent. It has been observed that mite injury provides entry points for pathogenic fungi causing rotting and nut fall. In certain cases, even though the mite infestation or injury is negligible, the infection caused by fungal pathogen

causes severe rotting and immature nut fall. Such severe incidence of immature nut fall due to rotting of mite infested nuts has been observed in several locations in Kerala state leading to heavy economic loss.

Rotting of Mite Infested Nuts

Rotting starts from the point of mite infestation on the nut surface near the perianth as dark brown to black discoloration and gradually extends to the entire surface area. The lesion also spreads deep into the internal tissues. As the lesions spread to about 30% surface area near the perianth region or when the lesion encircles the perianth region, the nut gets detached from the bunch and shed or remains on the bunch in between other nuts.

Mite attack followed by rotting of nuts is noticed in different varieties. Though mite infestation in COD nuts is comparatively low, incidence of rotting and immature nut fall due to fungal infestation is frequently observed in COD. Even slight injury caused by mite paves way for the pathogen to enter and cause severe rotting. Intensity of rotting and immature nut fall varied from locality to locality as well as from garden to garden. In certain cases when the fungal infection starts in nearly mature nuts, it continues even after harvest and storage. The infection goes deep into the husk and spreads to the kernel through the soft eye. The kernel rots assuming a grayish black discoloration and becomes soft.

Nut fall or mahali or koleroga caused by *Phytophthora palmivora* is common in high rainfall areas during monsoon season. Though, *P. palmivora* and *Thielaviopsis paradoxa* are also found associated with mite infested nuts, *Lansiodiplodia theobromae* is the main causal organism of rotting and immature nut fall of mite infested nuts.

Management

Rotting or immature nut fall of mite infested nuts caused by *L. theobromae* can be controlled by spraying of Carbendazim (Bavistin 0.1%) to bunch of the affected palms. If coconut is cultivated under the organic farming system, spraying of garlic bulb extract (10%) can be recommended for the management of the disease.

Stem Bleeding

The disease is characterized by development of dark brown patches appearing at the basal portion of the trunk. In course of time, this progresses upwards. A dark reddish brown liquid exudes from the longitudinal growth cracks present on the stem bark and form irregular streaks of exudation. These streaks may coalesce and form larger lesions. No oozing is seen from old lesions. The exudates eventually dry up to form black encrustations with brownish orange margin. The tissues beneath the discoloured patch show decay. The internal decay can be observed even in areas beyond the margins of external lesions indicating that the internal decay is not confined to the area of external symptoms. As the decay progresses, the tissues become black and fibrous.

Management

The disease can be effectively managed if control

measures are adopted in early stages of infection

- The affected tissues should be completely removed using a chisel. Destroy the chiselled tissues by burning.

- Treat the wound with Calixin 5% followed by application of hot coal tar after 2 days.

- Apply 100 ml Calixin 5% through root feeding thrice a year during June, September- October and January

- Soil application of 5 kg neem cake fortified with *Trichoderma* per palm per year during September-

October is also found beneficial

- Summer irrigation improves the health of the palm as well as yield.

- Since wounds on the trunks predispose the palms to infection, any type of wounding of palms is to be avoided. Care should be taken not to injure the stem base while ploughing the garden with tractor.



Stem bleeding in coconut

Bansal Stem Rot

Five distinct stages can be recognized in the development of Ganoderma wilt. Wilting of leaflets (which sometimes may not be very prominent), yellowing of the leaves of lowest leaf whorl and decay and death of fine roots are the symptoms in the initial stage of disease development. In the second stage bleeding patches appear at the base of the stem near the ground level; the lesions

gradually extend upwards; roots decay extensively and there is no new bunch production. Bleeding patches extend in the stem, leaves droop in the outer whorl followed by heavy button shedding and barren nuts. As stem decay traverses upwards; outer leaf whorl dries and drops off; other leaves also droop except the spindle leaf and surrounding two or three young leaves which remain erect and healthy. Ultimately all the leaves droop and fall off leaving the decapitated stem. Stem shrivels and dries up.

The time taken from the initial appearance of bleeding patches in the stem to the death of the palms is from 6 to 54 months, the average being 24 months. In the middle or late stages of disease sometimes the scolytid beetle, *Xyleborus perforans* and the weevil, *Diocalandra stigmaticollis* are found infesting the stem in large numbers at the bleeding patches from which powdery mass is thrown out. The insects accelerate the death of the palm

Management

The disease can be effectively contained by following an integrated approach with cultural, chemical and biological methods involving the following operations.

- Removal of dead palms and palms in advanced stages of the disease and destruction of the bole and root bits of these palms.
- Isolation of diseased palms from healthy palms by

digging isolation trenches of 1 m deep and 30 cm wide.

- Regular basin irrigation during summer months or moisture conservation by coconut husk burial (250 husks/palm).
- Avoiding flood irrigation or ploughing in infected gardens to prevent spread of the inoculum.
- Addition of 50 kg of farmyard manure or green leaves or 200 kg tank silt per palm per year.
- Application of 5 kg neem cake per palm per year.
- Raising banana as intercrop wherever irrigation is possible.
- Soil drenching with 40 L of 1 per cent Bordeaux mixture thrice a year for one year.
- Root feeding of 2 g of Aureofunginsol + 1 g of Copper sulphate in 100 ml of water thrice a year at quarterly interval. Alternatively, Calixin (Tridemorph) (2 ml/100 ml) can also be used for root feeding instead of Aureofunginsol. Fungicide treatments will be effective only for palms in early stages of the disease
- If *Xyleborus* attack is found in the stem, smearing with heptachlor may be done.

For further interaction, please write to:

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