

INTEGRATED DISEASE MANAGEMENT

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Several biotic and abiotic factors are reported to impair the quality and quantity of cocoa production. Among them, diseases are the major concerns, causing more than 30 per cent of the potential yield loss. In India, a detailed survey of cocoa gardens conducted in Kerala, Karnataka, Tamil Nadu and Andhra Pradesh states from 1980 onwards revealed that diseases like seedling blight, black pod, stem canker, cherelle wilt and vascular streak die-back (VSD) can be considered as the major problems in India based on the extent of damage and nature of disease (Chandramohan and Kaveriappa, 1981; Chowdappa *et al.*, 2014). Among them, cocoa is highly prone to black pod disease incited by *Phytophthora* which thrives on high humidity and surface wetness inflicting severe yield losses (Chowdappa, 1995). An outline of different cocoa diseases and/ or disorders along with the management strategies are summarized below.

A) Diseases

1. Seedling dieback/ seedling blight (*Phytophthora palmivora* Butler)

Symptoms: Defoliation and dieback are the characteristic symptoms of this disease. Infection starts from the tip of the stem and proceeds downwards as dark brown to black water-soaked linear lesions (Fig.1). Infection spreads to the entire stem causing wilting, defoliation and ultimate death of the seedlings. Infection also noticed in grafted or budded region and proceeds on both the sides.



Fig.1. Symptoms of seedling dieback

Management

- Field sanitation practices like removal and destruction of infected seedlings should be strictly followed.
- Sowing seeds before the onset of monsoon will reduce the disease. Also providing improved drainage and proper shade helps in disease management.
- Solarisation of potting mixture under hot sun or covering with transparent polythene sheets during summer months kills the pathogen inoculum.
- Bio-priming of cocoa seeds with 20 g *Pseudomonas* microbial culture is also effective in managing the disease.
- Soil drenching with Bordeaux mixture (1 %) or copper-oxy-chloride (0.2 %) just before the onset of monsoon and thereafter at frequent intervals provides good control over the pathogen.

2. Black pod disease or pod rot (*Phytophthora palmivora*, *P.capsici* and *P.citrophthora*):

Symptoms: Initially, small, circular water-soaked lesions were noticed on the pod. Later, it turns to dark brown colour and covers the entire pod. A white thread like mycelial growth consisting of numerous sporangia of the pathogen appears on the pod surface. In severe infection, discoloration of beans was also noticed.



Fig.2. Black pod disease



Management

- Strict field sanitation practices include phytosanitation, removal and destruction of infected pods and fallen leaves should be followed.
- Regular pruning of the branches should be carried out in order to facilitate the entry of sun light.
- Prophylactic spraying of Bordeaux mixture (1%) at 45 days interval starting from the onset of south- west monsoon helps in reduction of disease incidence.

3. Stem canker (*Phytophthora palmivora*)

Symptoms: Canker appears on surface of the the stem, as round to oval shaped dark brown discolored lesions. Later, reddish brown colour oozing can be seen from the infected area. In the advanced stage of infection results in girdling of stem. If infection noticed at the collar region, it spreads fast and infects the root system. Hence, water and nutrient uptake will be severely impaired. Yellowing and wilting of the foliage will be noticed under severe infection.



Fig.3 Stem canker

Management

- Strict field sanitation practices should be followed as described earlier.
- Pruning before the onset of monsoon and application of 10 % Bordeaux paste after pruning will avoid the infection.

- In case of mulching practices, trunk covering should be avoided or mulching 1 feet away from the trunk helps in disease reduction.
- Good drainage facilities should be provided to avoid further spread of the disease.
- Wound treatment and soil application with *Trichoderma coir pith cake* (TCPC), helps in long term management of the disease.

4. Cherelle wilt

Symptoms: Large number of cherelle or young pods of 2-3 months old will dry up and remain on the trees as mummified fruit. February-May considered as critical period for infection. Two kinds of cherelle wilts are observed *i.e.* physiological and pathological wilt.



Fig. 4. Cherelle wilt

Physiological wilt: It is due to the effect of the natural thinning mechanism of cocoa. The physiological wilt begins as general yellowing followed by browning and blackening of the entire pod.

Pathological wilting: It is caused by *Colletotrichum gloeosporioides*. Initially, small, circular water-soaked lesions will be noticed on anywhere of the stalk/ pod surface. Later, it spreads towards the tip of the pod (Fig.4). Sunken spots with diffused yellow halo will be observed in advanced stage of infection. Also pinkish slimy mass will be produced on the lesion and mummified pods.

Management

- Strict field sanitation practices should be followed.
- Fungicidal spraying with carbendazim @ 0.05 % or mancozeb @ 0.2 % was found effective in managing this disease.

5. Vascular streak dieback

(*Ceratobasidium theobromae*)

Symptoms: Yellowing of one or two leaves generally on the second or third flush behind the shoot apex with typical scattered green islands is the most distinguishable feature of this disease (Fig.5). Affected leaves dry and falls off by leaving the other leaves remain intact. Three blackened vascular traces are visible when the dry surface is scraped off scars resulting from the fall of diseased leaves. The disease can easily be diagnosed in the field by splitting the diseased stem to observe the longitudinal brownish streak due to infection of xylem vessels by the pathogen.

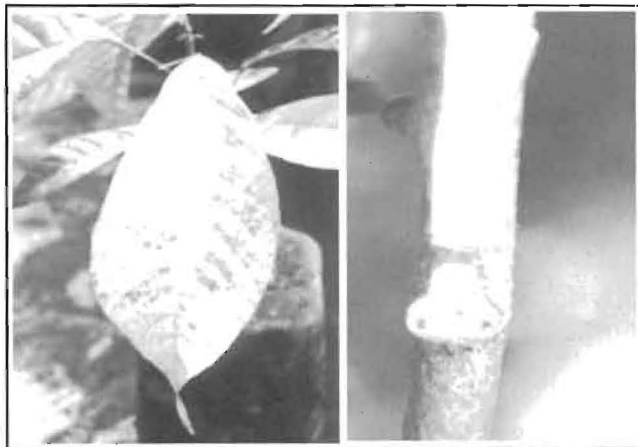


Fig.5. Vascular streak dieback

Management

- Strict field sanitation practices like removal and destruction of the diseased plants, burning of the fallen leaves etc. should be followed to avoid the inoculum build up.

- Pruning of infected branches from 30-40 cm below the infected region and applying 10 % Bordeaux paste will help in disease spread.
- Prophylactic spray of 1 % Bordeaux mixture or 0.25 % copper-oxy-chloride (COC) twice a year during May-June and October months helps in effective disease management. Soil drenching with 0.25 % COC will reduce the inoculum build up in the soil.

B. Disorders

1. Zinc deficiency

Symptoms: Mottling and crinkling with wavy margins are the characteristic symptoms noticed in leaves. Such leaves later malformed. Younger leaves become small, narrow and sickle-shaped (Fig.6).



Fig.6. Zinc deficiency symptoms

Management

- Foliar application of 0.3 % Zinc sulphate along with 0.15 % lime will reduce the effects of zinc deficiency.

2. Iron deficiency

Symptoms: Younger leaves showing darker green veins against paler green background, or showing green tinted veins against pale yellowish white



or almost completely white background, developing tip scorch. Older leaves frequently show narrow marginal and tip scorch.

Management

- Iron deficiency is occasionally seen and can be cured by repeated spraying of 1 per cent aqueous iron sulphate solution.

C. Integrated disease management

Integrated disease management (IDM) approaches should be strictly followed to get economic and potential yield in cocoa (Chowdappa and Rohini Iyer, 2000). In a nutshell, the IDM practices could be recommended for cocoa cultivation is given below:

- Use of disease resistant or tolerant cocoa accessions against *Phytophthora* diseases like black pod and stem canker.
- Use of disease free planting materials like seed pods, seedlings and bud wood/ scion stick collected from disease free regions and mother trees.
- Following strict quarantine measures to avoid or restrict the movement or spread of the infected germplasm from diseased to healthy areas.
- Following field sanitation practices includes regular removal and burning of the infected or dead plants and removal of diseased branches, pods to eliminate the initial source of inoculum especially in the high rainfall and humid zones.
- Providing improved drainage facilities and proper shading to the growing plants in the nursery as well as in the garden.

- Systematic annual pruning in the palm based cropping systems will considerably reduce the incidence, infection and spread of diseases.
- Use of biological control agents like *Trichoderma coir pith cake* (TCPC) against *Phytophthora* disease like stem canker.
- Use of chemical sprays like 1 per cent Bordeaux mixture or 0.2 per cent copper oxychloride against the *Phytophthora* diseases, black pod, stem canker and chupon blight and twig dieback; 0.05 per cent carbendazim or 0.2 per cent mancozeb against the *Colletotrichum* disease like cherelle wilt; Ergosterol biosynthesis inhibitors like Propiconazole, Tebuconazole and Triadimenol against VSD disease.

References

1. Chandramohan, R. and Kaveriappa, K.M. 1981. Occurrence and distribution of cocoa diseases in South India. In: *Proc. 8th International Cocoa Research Conference*. 18-23, Oct., 1981. Cartagena, Columbia. pp. 445-449.
2. Chowdappa, P. 1995. *Phytophthora* causing black pod disease of cocoa in South India, PhD. Thesis. Mangalore University, Mangalore. 211 p.
3. Chowdappa, P. and Rohini Iyer. 2000. Integrated management of cocoa diseases in India. In. *Proc. INCOPED 3rd International Seminar on cocoa pests and diseases*, 16-17 October, 2000, Kota Kinabalu, Sabah, Malaysia (eds. Bong C.L., Lee, C.H and Shari F.S.) pp.84-104.
4. Chowdappa, P., Sharma, P., Anandaraj, M., and Khetarpal, R.K. 2014. *Diseases of Plantation Crops*. Indian Phytopathological Society, IARI, New Delhi.