

Symptomatology of *Colletotrichum* disease of cocoa in India

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Colletotrichum disease of cocoa is widespread in India. The symptomatology of the disease was studied during a survey of cocoa gardens in Kerala, Karnataka, and Tamil Nadu states. The disease causes three types of foliar symptoms viz., leaf blight, shot hole and irregular leaf spot, and rotting of cherelles and young pods.

Repeated isolations of the pathogen from the affected parts of the plants collected from various gardens have shown that the pathogen was *Colletotrichum gloeosporioides* (Penz.) Sacc. Pathogenicity of the isolates was established on cocoa seedlings through artificial inoculation experiments. In all the cases the symptoms of the disease could be reproduced on the leaves of seedlings. The isolates from pods produced only leaf blight and shot hole symptoms on artificial inoculations.

Large areas along the west coast of India are recognised as ideally suited for the cultivation of cocoa. In these coastal regions, arecanut and coconut are the principle plantation crops grown and the cultivation of cocoa in these plantations has been found to be ideal. Mixed cropping of arecanut and coconut with cocoa is being accepted as a beneficial farming practice by the farmers in Kerala and Karnataka. During the past 12 years, the expansion of area under cocoa has been significant in several districts of Kerala state, Dakshina Kannada district of Karnataka and Kanyakumari district in Tamil Nadu.

Cocoa is affected by several diseases of which only a few have been reported to be of any serious proportion in India.

Colletotrichum disease of cocoa (*Theobroma cacao* L.) has been recorded in several cocoa-growing countries. In most of the cocoa gardens, it has not been observed to cause very serious problems. But the disease was reported to have attained epiphytotic proportions

in Ghana during 1975 (Dakwa & Danquah, 1978). Foliar infection of cocoa caused by *C. theobromicolum* was reported as one of the serious problems of cocoa in Colombia (Sanchez, 1957). In India, *C. gloeosporioides* has been reported to have caused shot hole symptoms on cocoa leaves (Sarma & Nambiar, 1976), and rotting of immature pods (Reddy & Chandra Mohanan, 1976). Though *Colletotrichum* disease of cocoa is widespread in India, detailed investigations on the symptomatology have not been carried out. This paper considers the symptomatology of the disease.

MATERIALS AND METHODS

During 1980-81, a survey was undertaken to study the disease in the major cocoa-growing areas of the states of Kerala, Karnataka and Tamil Nadu. Various symptoms of foliar infections and pod rots of cocoa were recorded in detail from the fields of 101 gardens including nurseries. Infected leaves and

Pods collected from each garden were examined under a microscope and whenever *Colletotrichum* spp. was found associated with the infection, single spore cultures of the fungus were prepared on potato dextrose agar medium. The isolates collected were identified on the basis of cultural and morphological characters. Representative isolates of each group based on symptoms and cultural characters were sent to the Commonwealth Mycological Institute, England, for confirmation of the identification.

Pathogenicity of all the isolates was tested on cocoa seedlings of the 'Forestero' variety by artificial inoculations. For this, a suspension of conidia and mycelia of each isolate was prepared in sterile tap water and sprayed on the seedlings. The seedlings were covered with polythene bags containing wet cotton pads for 72 hours. The symptoms of the disease caused by each isolate on the seedlings were examined and compared with their natural symptoms.

RESULTS AND DISCUSSION

The detailed studies have revealed the occurrence of three types of foliar symptoms and a pod rot.

Foliar symptoms

Leaf blight. The infection was found to initiate anywhere on the leaf lamina, but more usually from the tips or margins. The symptoms appeared as round to slightly irregular chlorotic spots of 2–5 mm diameter which later turned brown with a clear yellow halo around each spot. Such spots increased in size considerably or coalesced to form large blighted areas with an even margin (*Figure 1*). Defoliation occurred when

such lesions covered a major portion of the leaf. Occasionally acervuli with setae appeared as black erumpent, globular structures on dead blighted areas of the leaves. Microscopic examination of the lesions revealed the presence of abundant conidia. This was widespread, and affected plants of all ages including seedlings: it was observed to be more common on older leaves. Dakwa & Danquah (1978) also found the leaf blight initiating on lower leaves and gradually spreading to upper leaves.

Shot hole. The infection occurred anywhere on the leaf lamina and many spots were found on each leaf. They appeared as minute, pin-point sized, round, sunken, light brown spots with distinct yellow haloes. When such spots attained 4–6 mm diameter, the centre of the necrotic spots shrivelled and dropped off forming shot holes (*Figure 2*). The spots, when enlarged; coalesced with adjacent spots to form bigger spots occupying a considerable area of the leaf lamina. In advanced stages shrivelling of the leaves was also observed. In very severe cases defoliation occurred. Acervuli with setae were observed on some of the spots. Conidia were moderate in number. The symptoms were observed on plants of all age groups including seedlings in the nurseries. The infection was usually confined to tender leaves and rarely occurred on older leaves. This kind of symptom was earlier described by Sarma & Nambiar (1976).

Irregular leaf spot. The infection appeared anywhere on the leaf lamina as small, circular to irregular, black spots with a broad and bright yellow halo. Later these spots increased in size longitudinally and irregularly along the veins or veinlets and were observed to attain a diameter of 10–25 mm: the centre of

The physiological wilt begins as a general yellowing of the cherelles followed by browning and blackening. The characteristic dark brown lesion which is seen on the stalk region of the infected pods is not seen on these pods and are thus distinguishable from pod rot. In rare cases infection was initiated from other parts of the pod other than the stalk region as dark brown, sunken lesions. Coalescence of lesions was also noticed.

Under conditions of high humidity, abundant conidia were produced as a pinkish slimy mass on the lesions. Microscopic examination of the affected pods always revealed the presence of acervuli with setae and abundant conidia. In this study, pod rot was observed only on cherelles and young pods with the maximum incidence on cherelles. Nearly mature or mature pods were not found to be affected. Even though pod rot is widespread, its incidence is less common compared to foliar infection. However, the symptoms were more characteristic on the leaves.

Wilting of cherelles and young pods was generally considered to be due to physiological factors. But the current observations show that a considerable percentage of pod rot of cherelles and young pods occurs due to *Colletotrichum* infection.

Isolation of pathogen

Isolation of the pathogens from affected parts of the plants from various gardens invariably yielded *Colletotrichum gloeosporioides* (Penz.) Sacc. Representative isolates from each of the above groups were sent to the Commonwealth Mycological Institute and the identification was confirmed.

But the occurrence of three different types of symptoms on the foliage of

cocoa plants caused by *C. gloeosporioides* could be attributed to the existence of different varieties of the same species or pathological strains. Such distinct types of anthracnose lesions caused by the same species of the fungus have been observed in other crops like sorghum, where *C. graminicola* (Ces.) Wilson caused two distinct types of leaf spots on the same leaf (Rajasab & Ramalingam, 1981).

Various species of *Colletotrichum* infecting cocoa pods have been reported from other countries. They are: *C. theobromae*, *C. luxificum* and *C. cradwickii* from West Indies and *C. incarnatum* from Cameroons and Sri Lanka (Briton-Jones, 1934); *C. fructitheobromae* from Brazil and *C. theobromicolum* from Congo (Thorold, 1975). Leaf anthracnose caused by *C. theobromicolum* was reported as one of the serious diseases of cocoa in Colombia (Sanchez, 1957). *C. gloeosporioides* was found associated with cocoa dieback in Bahia, Brazil (Ram, Ram & Rocha, 1972) and leaf spot in nurseries in Costa Rica (Diaz & Newhall, 1966). The infection of the root system of cocoa trees by *C. crassipes* was reported to cause wilting and ultimately the death of the trees in Brazil and was found to be more pathogenic on leaves and pods than *C. gloeosporioides* (Ram *et al.*, 1973). In this study, no incidence of root system infection or wilting of trees due to *Colletotrichum* infection was observed.

Though different species of *Colletotrichum* has been reported from other countries, no effort has been made so far on a comparative study of isolations of *Colletotrichum* spp. from different localities. Genetically *Glomerella cingulata* is known to be a variable

fungus species (Wheeler, 1954). Studies on the variations in morphological, cultural, biochemical and other characters between isolates causing three types of symptoms observed during the present investigations are in progress.

Pathogenicity of all the *C. gloeosporioides* isolates was established on cocoa seedlings by artificial inoculation experiments. The isolates from each of the three foliar symptoms reproduced the natural symptoms of infection on the seedlings. The isolates from irregular leaf spot symptom were less pathogenic and produced very small spots. The pod isolates produced only blight and shot hole symptoms on leaves of seedlings.

Thus three clearly distinguishable symptoms on the foliage were apparent in cocoa plants affected with *C. gloeosporioides*. Among the foliar symptoms leaf blight and shot hole were found to be widespread and observed in a severe form causing defoliation leading to dieback of twigs in certain localities of Dakshina Kannada and Kodagu districts of Karnataka State, Quilon, Kottayam, Trichur, Calicut and Cannanore districts of Kerala and Kanyakumari district of Tamil Nadu. In Ghana also leaf blight was found to be widespread and caused heavy defoliation in some of the plantations (Dakwa & Danquah, 1978).

Though pod rot was widespread the severe incidence was observed only in certain localities of Quilon, Kottayam, Trichur, Dakshina Kannada and Kodagu districts. Previous reports on the incidence of pod rot in Dakshina Kannada district indicates that *Colletotrichum* disease may assume severe proportions and cause economic losses on cocoa (Reddy & Chandra Mohanan, 1976).

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REFERENCES

- BRITON-JONES, H.R. (1934) *The diseases and curing of cocoa*, pp. 161. London: Macmillan.
- DAKWA, J.T. & DANQUAH, O.A. (1978) A colletotrichum leaf blight of cocoa in Ghana. *Plant Dis. Repr.*, 62, 369-373.
- DIAZ, F. & NEWHALL, A.G. (1966) Fungicides for the control of *Colletotrichum gloeosporioides* leaf spot or 'shot hole' or anthracnose in seed beds of cocoa in Costa Rica. *Turrialba*, 16, 88-89.
- RAJASAB, A.H. & RAMALINGAM, A. (1981) Zonate anthracnose, a new disease of sorghum caused by *Colletotrichum graminicola* var. *zonatum* var. *Nov. Curr. Sci.*, 50, 34-35.
- RAM, C., RAM, A. & ROCHA, H.M. (1972) Some fungi associated with cocoa dieback in Bahia. *Rev. Theobroma (Brazil)*, 2, 3-6.
- RAM, A., RAM, C. & ROCHA, H.M. (1973). *Colletotrichum crassipes* associated with cocoa wilting in Bahia, Brazil. *Rev. Theobroma (Brazil)*, 3, 33-40.
- REDDY, M.K. & CHANDRA MOHANAN, R. (1976) Occurrence of pod rot of cocoa caused by *Colletotrichum gloeosporioides* in India. *J. Plant Crops*, 4, 14-15.
- SANCHEZ, R.P. (1957) Diseases of cocoa, (*Theobroma cacao*) in Colombia. *Acta Agron. Colombia*, 7, 1/70.
- SARMA, Y.R. & NAMBIAR, K.K.N. (1976) Leaf spot of cocoa. *Curr. Sci.*, 45, 466.
- THOROLD, C.A. (1975) *Diseases of cocoa*, pp. 423. London: Clarendon Press, Oxford.
- WHEELER, H.E. (1954) Genetics and evolution of heterothallism in *Glomerella*. *Phytopathology*, 44, 342-345.