

Phytophthora* associated with cocoa (*Theobroma cacao* L.) in south Kanara District, Karnataka, India

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Studies to identify the *Phytophthora* associated with cocoa in the south Kanara District, Karnataka, India, showed the presence of only one species of *Phytophthora*. From the sporangial morphology of the various isolates it is concluded that *P. palmivora* (Butl.) Butler is the pathogen associated with cocoa in south Kanara.

Keywords: *Phytophthora*; Cocoa; Fungal diseases

Black pod and other diseases of cocoa, i.e. chupon blight, seedling blight and canker attributed to infection by *Phytophthora* have recently been the subject of renewed interest. Prior to 1975 *P. palmivora* (Butl.) Butler was believed to be the causal organism of black pod disease of cocoa wherever it is present. Work done in Nigeria showed the existence of a totally different species of *Phytophthora* (*P. megakarya* Brasier & Griffin) which was shown to be the predominant pathogen of cocoa in Nigeria (Griffin *et al.*, 1977). At the International workshop held at Rothamsted in 1976, a third species of *Phytophthora*, temporarily designated as Morphological Form 4 (MF 4), was reported as the black pod pathogen from several countries (Griffin, 1977). Later *P. citrophthora* (Smith & Smith) Leonian was reported to be causing black pod disease of cocoa in the cooler areas of southern Brazil (Kellam & Zentmyer, 1981). Even though the occurrence of *P. palmivora* was confirmed earlier on several hosts, black pod disease of cocoa was reported for the first time from India in 1965 (Ramakrishnan & Thankappan). Other diseases of cocoa caused by *Phytophthora* were also reported (Chandra Mohanan, 1978; Chandra Mohanan *et al.*, 1979; Chandra Mohanan & Kaveriappa, 1981). However, there were no *Phytophthora* isolates from cocoa in India studied at the Rothamsted workshop. In the light of the occurrence of different diseases of cocoa and the existence of distinct species of *Phytophthora* on cocoa in other cocoa-growing countries it was felt worthwhile to investigate and determine the *Phytophthora* associated with cocoa in the south Kanara District of Karnataka state of India.

Materials and methods

Collections of diseased cocoa material and soil

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samples were made from the majority of cocoa plantations in the District. Isolations were made from naturally infected chupons showing blight and die-back symptoms. For the purpose of this study a bait method using cocoa pod was used for the isolation of *Phytophthora*. A tissue plug was removed from surface-sterilized (0.1% HgCl₂) mature cocoa pod with an 8mm diameter cork borer. A small quantity of infected tissue which was surface-sterilized and rinsed was placed in the well and plugged with the pod tissue removed earlier. The baited pods were enclosed separately in polythene bags containing moist cotton. Sporangia were removed from the infected pods six days after inoculation. Microscopic observations were made on sporangia mounted in water.

Field-infected pods, showing initial symptoms of black pod disease, were washed thoroughly under running water and kept in moist conditions to initiate sporulation of the fungus.

Soil samples were collected from the base of cocoa trees 15cm away from the trunk after removing the leaf litter from the soil surface. The collected samples were placed in polythene bags and sealed to prevent loss of moisture. Isolations were made from soil using the technique described by Newhook and Jackson (1977). The cocoa pod tissue baits were removed from the soil surface at 24h intervals. The exposed baits were washed, surface-sterilized, rinsed and sealed in polythene bags containing moist cotton. Fungal growths from the baited tissues were removed after 4 days for microscopic study.

Results and discussion

Inoculation with infected leaf and stem material produced disease symptoms on baited cocoa pods. A sporulating mycelial mat was formed around the inoculation site and spread readily preceding the discoloured area. Sporangia and chlamydo-spores

Table 1 Summary of data on chlamyospore and sporangial morphology of *Phytophthora* isolated from different sources

Source of isolate	Number of samples	Chlamyospores	Sporangia ^a				
			Shape	Pedicle	Length: breadth ratio	Papilla	Caducity
Leaf	60	Spherical	Ovoid, ellipsoid	Short 2.1–5µm occluded	1.2–1.7	Present	Caducous
Shoot	40	Spherical	Ovoid, ellipsoid	Short 2.1–5µm	1.2–1.7	Present	Caducous
Pods	80	Spherical	Ovoid, ellipsoid	Short 2–5µm occluded	1.2–2.1	Present	Caducous
Soil	80	Spherical	Ovoid, ellipsoid	Short 2–5µm	1.2–1.9	Present	Caducous

^a Average from measurements of 100 sporangia from each source

were produced abundantly on the surface of the pods.

All the soil samples collected from the cocoa farms contained infective propagules of the black pod pathogen. The pod tissue cores exposed to soil samples showed profuse growth of *Phytophthora*. Both sporangia and chlamyospores were observed on the tissues. Naturally infected cocoa pods showed intense sporulation under moist conditions.

From the data obtained (Table 1) it is evident that the same species of *Phytophthora* is associated with the black pod and chupon blight diseases of cocoa. The *Phytophthora* species inhabiting cocoa estate soils was also identical to that present on chupons and pods. From the comparison of collected data with sporangial morphological characteristics reported by Newhook *et al.*, (1978) it is concluded that the *Phytophthora* inciting black pod disease and chupon blight of cocoa and the *Phytophthora* present in cocoa soils in the south Kanara District of Karnataka state, India is *P. palmivora* (Butl.) Butler.

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