

CACAO CANKER CAUSED BY PHYTOPHTHORA PALMIVORA

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## ABSTRACT

A severe canker on the trunk and branches of Criollo and Forestero cacao varieties, and subsequent dieback of affected plants or branches, were observed in India. Phytophthora palmivora was consistently isolated from the cankered portion. Pathogenicity experiments proved that this fungus is the causal organism of the disease. Symptoms of the disease are described. This is the first report of canker of cacao in India.

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Diseases of cacao caused by Phytophthora are common in most cacao-growing countries (4). Among the Phytophthora diseases of cacao, only black pod disease has been reported from India (6). Gregory (4) mentioned that Porter had described the symptoms of canker as early as 1833. Cacao canker was reported in 1897 from Sri Lanka (9), and has since been reported from various cacao-growing areas (2, 3, 10).

From October 1977 to February 1978, many cacao plants of Criollo and Forestero varieties of different age groups, grown either as a mixed crop in arecanut and coconut gardens or as a pure crop in Karnataka (India), were found to be affected by canker.

## MATERIALS AND METHODS

Isolation of the pathogen: The causal organism was isolated from infected tissue by the method used by Manço (5). Pieces of infected bark were inserted into holes made on surface-sterilized healthy cacao pods by using a 3-mm cork borer. The organism was then reisolated from lesions formed on the pod and subsequently was maintained on potato-dextrose agar (PDA) or oatmeal agar medium.

The pathogen was also isolated directly from active cankers by plating pieces of surface-sterilized bark on PDA medium incorporated with rose bengal.

Pathogenicity tests: Pathogenicity of the organism was tested on the main stem and branches of Forestero cacao plants. Tissue to be inoculated was surface sterilized with 0.1% mercuric chloride solution and rinsed with sterile water. Five-millimeter inoculum discs, cut with a cork borer from a 7-day-old culture of the fungus, were placed in a cavity made on the sterilized surface. The host tissue was replaced and then covered with moistened cotton to provide humidity. Similar uninoculated wounds served as controls.

The relative humidity and maximum and minimum temperatures in the cacao-acreanut mixed garden were recorded daily in the month of February 1978 by hygrothermographs and by maximum and minimum thermometers located 1.5 meters above the ground level.

Surface-disinfected cacao pods were inoculated with a pure culture of the same fungus and incubated in a moist chamber at room temperature ( $30 \pm 1^\circ\text{C}$ ). Inoculations with the same isolate were also made on the stems of 2-month-old cacao seedlings in the field as well as in the laboratory.

## RESULTS AND DISCUSSION

Symptoms: In nature, the canker appeared either on the main trunk, jorquetts, or fan branches. The earliest symptom was the appearance of a grayish-brown water-soaked lesion with a broad dark brown to black margin. A reddish-brown liquid oozed from these lesions (Fig. 1). Later the liquid dried up to form a rusty deposit. Sometimes there was no liquid oozing and only discoloration of the bark was apparent. Cankers also developed at varying

distances from the point of infection without any external symptoms on the outer bark. Such cankers could be detected only in the later stages. Infection spread from the cortical tissues into the vascular tissues, reaching the wood. The present studies corroborate the observation of Briton-Jones (1) that internal spread of infection is always more rapid than spread in the outer bark. Tissues beneath the outer grayish-brown lesions always had a reddish-brown discoloration, caused by rotting, which could be clearly distinguished from healthy tissues beneath apparently healthy bark. Infection in the wood appeared as a grayish-brown discoloration with black streaks. Cankers on the stem coalesced to form larger cankers (Fig. 2). When the cankers girdled the main stem or branch, the pods that remained on the tree wilted, the leaves discolored and defoliated, branches died back, and eventually the tree died. In some trees the emergence of abundant flowers and new leaves was initially found to be associated with canker. Zaiger and Zentmyer (10) and Briton-Jones (1) also reported such a phenomenon.

The cankers could be detected only by close examination of affected plants. Usually the disease was noticed only in advanced stages when defoliation and dieback of twigs was occurring. Early stages of canker development were difficult to recognize, because there were no external symptoms on the outer bark. Such cankers could be detected only when they were in an advanced stage of the disease.

Isolation of the pathogen: Isolations made from the infected tissues consistently yielded Phytophthora palmivora.

The fungus grew well and produced sporangia and chlamydospores abundantly on potato-dextrose agar and oatmeal agar media at room temperature ranging from 25.5 to 29.0°C. The sporangia of the fungus, which were ellipsoidal or ovoid, caducous and papillate with a length/breadth ratio 1.3-2.0 (usually 1.6) were typical of P. palmivora. The stalks of the sporangia were short and thick, closely resembling group I of the morphological groups described by Zentmyer, et al. (11).

Pathogenicity tests: Symptoms obtained on artificial inoculation closely resembled those observed in diseased plants under field conditions. The fungus was reisolated from lesions formed by artificial inoculation. Uninoculated wounds did not produce any symptom of canker. The temperature range and relative humidity range in cacao-arecanut mixed garden for the month of February 1978 were 16.5-36.0°C and 58-97%, respectively.

Cacao pods inoculated with Phytophthora palmivora isolated from cankered tissue became infected within 24 hours, and produced symptoms identical to black pod. Cacao seedlings inoculated with the same isolate showed infection within 48 hours. Lesions on the stems of seedlings initially were dark brown, and then became black. The infection spread in all directions and the seedlings wilted after 10 days; however, black pod disease of cacao and Phytophthora infection of cacao seedlings were not observed during this season in any of the gardens when cankers were noticed. Several workers have connected canker with black pod disease (1, 7, 8). They found that the infection spread from the pod to the peduncle, and then to the cushion and bark.



FIGURE 1. Cacao trunk with canker lesion, caused by Phytophthora palmivora, on the surface of the bark. The black spot at the center is the reddish-brown liquid oozing out.

FIGURE 2. Cacao trunk with coalescing canker lesions.

Based on symptomatology and pathogenicity tests, Phytophthora palmivora has been found to be the causal organism of cacao stem canker. This is the first report of this disease from India.

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