

Monilia Pod Rot of Cocoa

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Monilia pod rot is a very destructive fungus disease of cocoa in several South American countries. The disease, known as "watery pod rot", "Quevedo disease", and "ceniza", is caused by *Monilia roleri* Cif. and Par.

The disease was recorded for the first time in 1914 in Ecuador, but the pathogen was not properly identified until 1918 by Rorer (13). It is believed that the disease originated in Ecuador and spread south to Peru and north to Colombia, Venezuela and the southern part of the Panama Isthmus. *Monilia* has not been reported elsewhere in Latin America or in any other cocoa-producing country outside the Western hemisphere.

The pathogen attacks only the pods of cocoa and alternate hosts have not been found. In Ecuador and Colombia, where the disease is most serious, it causes the destruction of 15 to 80 per cent of the pods. The magnitude of the loss is directly correlated with climatic conditions.

Ecuador was once one of the major cocoa-producing countries of the world, exporting 47,000 tons in 1914. The incidence of *Monilia* pod rot and witches' broom caused a dramatic crop reduction in 1922, and exports reached their lowest level of 10,580 tons in 1933 (11). It is difficult to separate the losses attributed to *Monilia* pod rot and witches' broom because both diseases occur during the rainy season; however, when the attack of *Monilia* is very severe, it is the major limiting factor in cocoa production.

Symptoms

The pods are infected when they are young and the infection develops internally as the pod grows. The first indication of the disease is the appearance of spots of mature coloration on the surface of immature pods without any other external symptoms. The coloured spots, which are surrounded by yellowish halos, turn brown and later increase rapidly in size, sometimes covering the entire surface of the pods. Under favourable weather conditions the spots are covered with a layer of white mycelium in which abundant cream or tan-coloured spores are produced. This stage of the disease is the most characteristic symptom in the field. The spores are easily detached from the pods. Some pods may be infected without any external symptoms. When the pods are opened abundant liquid is present as a result of tissue maceration. The beans may be partially or completely destroyed, depending on the stage of ripening when infection occurs. Hardening of the exterior surface resembles that of pods from trees infected with witches' broom disease. They can be differentiated because *Monilia*-infected pods are heavier than healthy pods of equal size (14) and there is also some watery rot. Pods become less susceptible to infection as they mature.

Disease cycle

The fungus remains in the conidial stage in infected pods between the wet and dry seasons. Spores are disseminated by wind, insects and rain (12). The role of each of these disseminating agents has not been satisfactorily resolved. It is believed that wind is the most important means of dissemination in Ecuador,



Diseased pod showing white mycelium.



Cocoa pod attacked by monilia.

although several investigators in Colombia (9, 12, 16) have reported that *Monilia* infection increased when pods were injured by insects.

The conditions favourable for spore germination and penetration have not been fully studied. However, Lopez (10) indicated that spores germinated better at 22°C. than at 35°C. at 80.5 per cent relative humidity.

Desrosiers *et al.* (5) found a close relationship between the amount of rainfall occurring during the early stages of pod formation and the incidence of *Monilia* subsequently found on the pods as they approached maturity. Based on this information, he suggested that *Monilia* infection takes place either during the flowering period or very early in the development of the pod. Bejarano (2) agreed with this theory because he found fruit-set to be reduced when flowers were inoculated six hours after pollination.

The sexual stage of the pathogen has not been found in the field or produced *in vitro*. Thus, the conidial stage is the only known infectious stage in the life-cycle of the organism. Desrosiers (15) and Naundorf (12) have suggested that the fungus might survive on the soil surface, but there is insufficient evidence to be conclusive.

Control

Favourable conditions for *Monilia* infection occur throughout the rainy season. During this period there is considerable flowering and fruit-set. Therefore, it is important to protect young fruits with fungicides during this critical period. It is not necessary to spray mature pods because they are much less susceptible or they may be infected internally already.

Several attempts to control *Monilia* pod rot with fungicides have been conducted in Ecuador. Zineb, maneb, Brestan 60, cuprous oxide and sulphur have given control when sprayed on a 10-14-day cycle during the rainy season, using high or low volume applications (1, 2, 4, 6, 7). The number of cycles can be reduced by applying fungicides only during the peaks of flowering and fruit-set in the rainy season, when conditions are more favourable for infection. Spraying is not necessary during the dry season.

Because of the great variability within the species *Theobroma cacao*, the possibility of finding plants with resistance to *M. royeri* has been considered. With this purpose in view, studies are being conducted at Pichilingue Experiment Station to assess the germ plasm available. Several clones have shown low incidence of *Monilia* pod rot under natural conditions (3) or field inoculation using a technique developed by Bejarano (2). There is no evidence that pod colour exerts any influence on the incidence of the disease (8). Until resistant varieties can be developed, harvesting at frequent intervals and destruction of infected pods should help to reduce the amount of primary inoculum and the subsequent loss from this disease.

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