

## BREAKING OF THE LIFE CYCLE OF THE CACAO FROSTY POD ROT TO AVOID EPIDEMIC OUTBREAKS OF THE DISEASE

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**Abstract:** Cacao Frosty Pod Rot, caused by the fungus *Moniliophthora roreri* (Cif. & Par.) Evans et al, is an aggressive disease that causes significant losses in cacao production in Central and South America. It has already spread to the Antilles islands. Its control lies in the interruption of its life cycle by removing the diseased fruits, especially in the “brown spot” and in “sporulation” states, in weekly rounds during two and a half consecutive months and left freely on the ground. After this process, the diseased fruits are removed along with the ripe fruits that are regularly harvested without impairing the success achieved in the control of the disease.

**Keywords:** Cacao, disease, symptoms, cultural control.

### INTRODUCTION

Cacao Frosty Pod Rot (Figure 1), also called dust, ash, stain, ice, snow, and Monilia, Moniliasis, pasmo, malaria, paludismo in Spanish, among others, is a disease caused by the fungus *Moniliophthora roreri* (Cif. & Par.) Evans *et al* of great impact on the yields and quality of the raw material in South and Central America for more than two centuries. Worldwide, it is estimated that in 2016 the losses were of the order of 76,000 metric tons (Marelli et al, 2019). It has already spread to Jamaica (Johnson et al, 2017), the island of the Antilles, and constitutes an imminent threat to other Caribbean islands where the species is grown.



Figure 1. Different stages of cacao fruits affected by Frosty Pod Rot.

Cultural Control is the simplest, efficacy, lowest-cost, ecosystem-friendly and sustainable control mechanism over the long run. Its rigorous application allows lowering the incidence to minimum levels which would have no impact on crops (Cubillos, 2018; Cubillos et al, 2019).

The essence of Cultural Control lies in the breakdown of the disease life cycle through the timely removal of diseased fruits and their free disposal on the ground (Cubillos et al, 2019) (Figure 2).



Figure 2. State of cacao fruits with Frosty Pod Rot removed from a tree after four weeks of their free disposal on the ground (see yellow arrows).

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### As the life cycle of the Frosty Pod Rot breaks

The life cycle of the disease caused by pathogen elapses in two and a half months (Rodríguez et al, 2005; Merchán, 1981) and the critical states of the diseased fruits occur when they are with the brown spot symptom (Figure 3) and in sporulation stage (Figure 4).

Fruits in the brown spot stage sporulate in 8-9 days, becoming new sources of infection while sporulated fruits are found to be active sources of infection. That means that the round of the removal of diseased fruits, especially with symptoms of brown spot and in sporulation stage must be carried out once a week (every 7 days) and extended for at least two and a half months. At the end of this period, infection levels have been reduced to minimum densities that are not capable of triggering new epidemic outbreaks.



Figure 3. Fruit with Frosty Pod Rot in stage of brown spot.



Figure 4. Cacao fruit with Frosty Pod rot starting sporulation. Diseased fruits with the other symptoms (bellies or humps and with tiny sub-epidermal oily spots, Figure 5) should also be

picked up from trees but not with the same urgency of those that are in a brown spot and in sporulation states because they need more than 3-4 weeks to reach those critical states of infection.

The fruits removed from the branches and stems of the trees should be left freely on the ground, subject to the rapid natural decomposition caused by the biota that exists there without any risk of being sources of infection.



Figure 5. Other symptoms of Frosty Pod Rot. A, fruit with bellies or humps. B, fruit with tiny sub-epidermal oily spots.

After the life cycle is broken, the diseased fruits are removed in tandem with the ripe fruits that the grower is accustomed to in the harvest rounds, normally made each 2-3 weeks.

Figure 6 shows a tree of the clone CCN-51 after being exposed for nine weeks to the infection of 27 diseased fruits arranged on the ground, most of them in a sporulation state (Cubillos and Ardila, 2019). The advanced state of decomposition of the fruits above the ground (black bodies) and the way they go covering by the weeds can be observed. Also, some ripe fruits hanging from the tree in a good sanitary condition.

Figure 7 shows the good sanitary state of the green and ripe fruits of the trees near harvest from the San José farm, municipality of San Vicente de Chucurí, Colombia, whose yields were 1,138- 945 kilograms per hectare-annum in the period 2017-2020 submitted to the Cultural Control of Frosty Pod Rot with the level of incidence below 10%.





Figure 6. Clone tree CCN-51 after 9 weeks of remaining exposed to large sources of ground infection. Observe the advanced state of decomposition of the fruits left on the ground (black bodies pointed out with arrows).



Figure 7. Sanitary condition of cacao fruits proximate to harvest in November 2019 from the San José farm, municipality of San Vicente de Chucurí, Santander department, Colombia.

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