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Differential symptoms of the three most important diseases of the cocoa fruit

Abstract

The cocoa fruits are affected by different fungal diseases that damage the crops, but three of them are considered the main ones in Central and South America and Caribbean islands: Cocoa Frosty Pod Rot (*Moniliophthora roreri*), Witches'Broom (*Moniliophthora perniciosa*) and Black Pod (*Phytophthora palmivora*). It is important to distinguish each one of them with the purpose to specifically adjust control measures to the causal agent.

Keywords: cocoa diseases, cocoa frosty pod rot, witches' broom, black pod

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Introduction

The economic impact of cocoa diseases is often underestimated in some Latin American countries, despite the persistence of diseases which cause recurring production losses.[1] The cocoa fruit (*Theobroma cacao* L.) is attacked by various diseases that significantly impact production and the profitability of the crop. Among them, the most important in Latin America are Cocoa Frosty Pod Rot (*Moniliophthora roreri* (Cif. & Par.) Evans et al.), Witches' Broom (*Moniliophthora perniciosa* Stahel), and Black Pod (*Phytophthora palmivora* Butler). It is important to distinguish the symptoms of these three diseases, as each has its own specific control approach, thus avoiding the application of practices that are not appropriate for the crop's phytosanitary problem.

Symptoms and signs of Cocoa Frosty Pod Rot (CFPR) in the fruit

Symptoms of this fungal infection could not be clear initially, as colonization begins in the endocarp and then spreads outward.[2] In fruits less than three months old (cherelles), the first symptoms are swellings, deformities, or bulges (Figure 1). In fruits older than three months, the first symptoms are tiny oily spots under the epidermis (Figure 2). One month after the first symptoms appear, a brown spot forms (Figure 3), which can be confused with that caused by Witches' Broom or Black Pod. The typical brown spot of CFPR is characterized by having irregular borders. Seven to nine days after the brown spot forms, the white mycelium appears, indicating the beginning of the disease sporulation process (Figure 4).[3,4]

Figure 1 Symptoms of bulges or swellings in fruits less than three months old caused by CFPR.

Figure 2 Oily spots under the epidermis caused by CFPR in fruits older than four months.

Figure 3 Brown spot, symptom of CFPR on the fruit, that appears one month after the first symptoms are formed: The borders of the spot are irregular.

Figure 4 Fruit during mycelium formation and CFPR sporulation phase.

Symptoms of Witches' Broom on Fruits and other plant organs

Witches' Broom, caused by the fungus *Moniliophthora perniciosa*, is a disease that affects vegetative shoots (Figure 5), flower cushions (Figure 6), and fruits. Symptoms on the fruit consist of dark spots with deformations and irregular edges (Figure 7). It differs from the brown spot symptom of CFPR in its darker color.

Figure 5 Symptoms of Witches' Broom in vegetative shoots.

Figure 6 Symptoms of Witches' Broom on floral cushions.

Figure 7 Dark spot as Witches' Broom symptom on the fruit.

Symptoms of Black Pod on the fruit and stem

Black pod, caused by *Phytophthora palmivora*, is a disease that affects fruits of all ages, but especially those that have reached maturity (Figure 8). It also attacks the stems and branches, causing what is known as stem canker (Figure 9).

Figure 8 Symptoms of Black Pod on the fruit.

Figure 9 Symptoms of canker (*Phytophthora palmivora)* in the stem.

The typical color of Black Pod is its brown appearance with well-defined borders.

It is important to identify the disease causing crop damage in order to adjust control measures according to the causal agent. Figure 10 shows comparative symptoms of the three most common cocoa fruit diseases.

Figure 10 Main diseases of the cocoa fruit. A, cocoa frosty pod rot; B, witches' broom; C, black pod.Figure 5: Symptoms of Witches' Broom in vegetative shoots.

CFPR and Witches' Broom are controlled through cultural practices, especially the timely removal of diseased plant organs, which are left on the soil to decompose naturally.[3,4] In the case of Black Pod, in Brazil it is customary to apply two sprays of copper-based products to the fruit at an interval of 45 days when it is in the adult phase.[5]

Conflict of interest statement

Author declare that no conflicts of interest.

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