Moniliophthora roreri (frosty pod rot)

Datasheet

Frosty pod rot of cacao caused by *M. roreri* with whitish to creamy-colored spores on the pod surface

PEST IDENTITY

NAME	*Moniliophtora roreri* (Evans et al 1978)
SYNONYMS	*Monilia roreri*
TAXONOMIC POSITION	Fungi: basidiomycetes: agaricales: marasmiaceae
COMMON NAMES	Frosty pod rot, pod rot of cocoa, monilia pod rot, quevedo disease, water pod rot of cocoa

MORPHOLOGY

The mycelium for the fungus is branched and shows basidiomycete-like dolipore septa. The mycelium of the fungus forms a 2-3mm thick felt-like pseudostroma on the surface of external as well as exposed internal necrotic lesions of pods. This is subsequently covered by a dense mat of spores which are powdery when mature.

BIOLOGY AND ECOLOGY

Behaviour

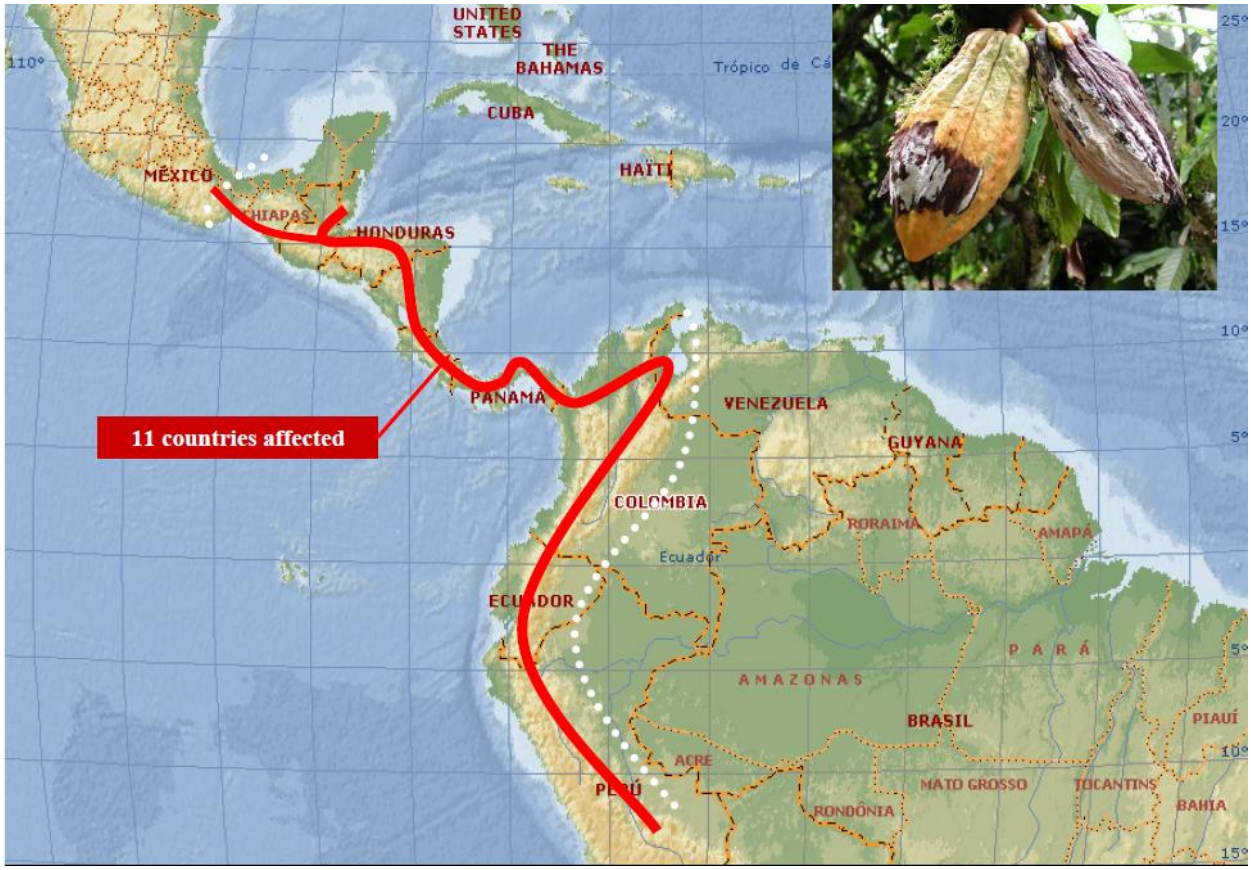
The high level of adaptation to different environments and the huge numbers of long-lived spores that are generated by each infection have made *M. roreri* a very effective pathogen and a formidable invader of new geographic regions.

Conditions for survival

M. roreri is able to strive under a wide range of environmental conditions, from sea level to over 1,000m above sea level and from very dry to very humid zones.

GEOGRAPHICAL DISTRIBUTION

M. roreri was confined to north-western South America until the 1950s. Its appearance in Panama in 1956 signalled a change in its geographical distribution. Currently the fungus is found in eleven (11) countries in tropical America to include Ecuador, Colombia, Panama, Venezuela, Costa Rica, Nicaragua, Peru, Honduras, Guatemala, Belize and Mexico. Up to 2004, there has been no official report of the fungus invading neighbouring countries such as Brazil and Trinidad & Tobago in the Caribbean; however it is believed it may have invaded wild populations of *Theobroma* and *Herrania* spp in some of these countries.



Geographical range of *Moniliophthora roreri (courtesy of Phillips-Mora)*

HOST RANGE

Major hosts	*Theobroma cacao* (cocoa)
Wild Hosts	*Theobroma* spp, *Herrania* spp

DAMAGE TO HOSTS

Stage of plant affected	fruiting stage
Plant part affected	fruits/pods & seeds

Only the fruits of *Theobroma* and *Herrania* species are susceptible. *T. cacao* fruits are infected when they are young (0 to 3 months old) and become less susceptible as they mature. Fruit maturity occurs 5 to 6 months after pollination.

DETECTION

Symptoms

Symptoms appear only on pods and their nature is dependent on the age of the pods when it was infected.

Infected at one (1) month and less

Pods that are infected very young show slightly chlorotic swellings and sometimes distortion followed by general necrosis before the pod reaches half of it size. The seed mass may become soft and watery.

Infected at one to three months

Pods that are infected at this age may show some swelling and/or distortion. The pod surface is generally covered with large, necrotic, dark brown spots with irregular borders, which grows rapidly. Larger pod show partial or total premature ripening. Ultimately necrosis is seen internally particularly affecting the endocarp and placenta.

Infected at three months and older

> Pods infected after 3 months old may show no external symptoms or only limited necrosis, often slightly sunken and surrounded by premature ripening. Infected pods are usually slightly heavier that healthy ones. Internally partial or total reddish-brown necrotic areas can be seen at the endocarp, seed and placenta.

The pod surface at all stages of initial infection remains firm. The necrotic external surface soon becomes covered by a thick, felty fungal growth (pseudostroma), which is initially white, and changes to cream, tan and finally light brown. The infected pods will remain on the tree, gradually becoming dry and shrunken until they become necrotic, hard and mummified still partly covered with hardened remains of pseudostroma.

A cocoa pod thoroughly colonized by *Moniliophthora roreri,* cause of frosty pod. The external surface is covered with felty fungal growth.

Visual Inspection

Cocoa should be inspected during the fruiting peaks and pods covered with cream to tan pseudostroma are an indication of frosty pod rot. Early detection is required for effective assessment of the disease. During early detection, the young pods (5-10cm) should be inspected weekly and sign such as small (1-3cm), raised, clear shiny swellings should be noted. Older pods may first show signs of brown necrotic areas or swelling.

Diagnostic Test

Mature spores may be collected for microscopic examination by blowing, tapping or gently scratching the pseudostroma on pods.

The fungus can also be grown on various agar media (such as yeast extract, malt extract-maltose agar or PDA). An abundance of single-celled spores which are globose/subglobose in shape, 8-15µm in diameter and hyaline to light brown with distinct wall is sufficient to for diagnosis.

MEANS OF MOVEMENT AND DISPERSAL

The fruits become the major source of inoculum for waves of infection that occurs over a long period of time. Spores are produced in great abundance on diseased fruits (over 7 billion per fruit) and become widely distributed after they are released. Wind is the major means by which spores are dispersed; however wind dispersal has not been able to explain the spread of frosty pod rot over large distances and geographical barriers. The spread across these barriers was more likely to occur as a result of human activities. The fungus has a long latency period prior to the manifestation of visible symptoms, this will allow for apparently healthy systematically infected fruits to be selected and transported for use as a source of planting material (Phillips-Mora et. al 2007).

Potential of spread to other region

The apparent susceptibility of most commercial cacao genotypes to the fungus, the aggressiveness of this airborne fungus, its adaptability to different environmental conditions and it rapid natural and man-mediated dispersal, collectively presents a substantial threat to cacao cultivation world-wide.

MANAGEMENT

CONTROL

- BIOLOGICAL

Other fungi, as well as bacteria and nematodes may parasitize old pseudostroma on the pod, particularly those on the ground. Numerous microbial antagonists of *M. roreri* have been isolated from diseased pods and proven experimentally to reduce the disease incidence. Bacteria within the genera *Bacillus* and *Pseudomonas* were identified; however none has been tested on a commercial scale. Fungal complexes of *Trichoderma* and *Clonostachys* species were also found to show high parasitic activities.

- CULTURAL

These include the periodical removal of diseased pods, pruning of the cacao and shade trees, maintaining draining systems. Cultural management is however difficult and labour intensive.

- CHEMICAL

Numerous fungicides such as copper fungicides and organic protectants have been proven effective and may be economical. Fungicides are applied on young pods to reduce disease incidence. Spraying should be concentrated on the early stages of the pod development, from the start of the main pod-set peaks until most pods are 3 months old.

PEST SIGNIFICANCE

ECONOMIC IMPACT

Frosty pod rot has had devastating effects on cacao in many countries, including Colombia, Ecuador, Costa Rica, and Mexico. Current losses are highly variable, ranging from 10 to 100% and is dependent on factors such as length of time disease is present in a site; age of plantation; crop and disease management; presence of neighbouring affected plantations; and weather conditions. An average of 30% losses have been reported by most countries however losses can exceed 90% under favourable conditions for the pathogen. These conditions include continuous rainfall, high temperatures (20-30^{o}C or higher) and pod-set coinciding with rainy periods.

Severe disease outbreaks have led to the total abandonment of cacao cultivation in extensive areas as has occurred in most affected countries. In a global context, the current annual loss from frosty pod rot is small, but the potential danger presented by the disease is enormous. *M. roreri*

ranks with most of the other major cacao pod pathogens in terms of its economic impact during an epidemic. Frosty pod rot has been reported to be twice as destructive as black pod (*Phytophthora* spp.), and more dangerous and difficult to control than witches' broom (*M. perniciosa*) (Phillips-Mora et. al 2007).

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PHYTOSANITARY RISK

Avoidance is the best strategy to be followed in countries or areas that are still free of the disease. Because human-mediated dispersal of this fungus into new areas and affected countries represents the most serious threat, major efforts should be made to strengthen quarantine measures and educate producers about the risks of moving pods from affected areas.

PHYTOSANITARY MEASURES

- Stop importation of pods and infected beans.
- Spores are the only means of infection; therefore all materials (seed and budwood) used in propagation must be treated with fungicide.

REFERENCES

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