

## First report of frosty pod rot (moniliasis disease) caused by *Moniliophthora roreri* on cacao in Belize

W. Phillips-Mora<sup>a\*</sup>, J. Cawich<sup>a</sup>, W. Garnett<sup>b</sup> and M. C. Aime<sup>c</sup>

<sup>a</sup>Tropical Agricultural Research and Higher Education Centre, PO Box 7170 CATIE, Turrialba, Costa Rica; <sup>b</sup>Inter-American Institute for Cooperation on Agriculture (IICA), PO Box 448, 31–33 Toucan Avenue, Belmopan, Belize; and <sup>c</sup>USDA-Agricultural Research Service, Systematic Botany and Mycology Laboratory, 10300 Baltimore Avenue, Beltsville, MD 20705, USA

*Moniliophthora roreri* causes frosty pod rot (FPR), a highly destructive cacao disease, currently found in 11 countries in South and Central America (Aime & Phillips-Mora, 2005). In Belize, the disease was first detected during a field visit to a small farm in the village of Maya Mopán, Stann Creek District in September 2004. Symptoms characteristic of typical FPR included pod deformation, premature ripening and chocolate-coloured pod lesions with creamy-coloured mycelium becoming darker as the spores mature. Internal pod tissues showed a typical necrotic compact mass, surrounded by a decayed watery substance. The presence of mummies (dehydrated, sporulated pods); the high disease incidence estimated at 60% of the pods affected; and the extent of FPR within the plantation all suggested that the disease had been present for at least 6 months. The fungus was grown on modified V8 juice agar and the morphology of isolates examined.

Colonies showed an initial whitish growth, later salmon-cream and finally dark brown due to massive formation of spores. Spores were produced in chains and were thick-walled, pale yellow, brown *en masse*, heteromorphic, but most frequently globose/subglobose (59%) to ellipsoid (34%), with maximum dimensions 5–11 × 8–20 µm. These observations agree with the description of *M. roreri* given by Cifferi & Parodi (1933) and Evans (1981).

Further confirmation was obtained by amplifying and sequencing two

regions of the nuclear ribosomal DNA repeat-internal transcribed spacer region (ITS) and 28S large subunit (LSU) with fungal specific primers ITS1-F/ITS4 (ITS) and LSU4-B/LR6 (Aime & Phillips-Mora, 2005). The sequences obtained (GenBank accession nos. DQ222927 and DQ222928) were identical (100% homologous) to those of isolates from Panama, Costa Rica, Nicaragua and Honduras, which form a proposed Mesoamerican subgroup of the pathogen. The causal agent was deposited with the US National Fungus Collection (BPI) as MCA2954. Following the initial discovery, FPR was detected in one additional farm in Maya Mopán in October 2004, and in three farms in the village of San Felipe (Toledo District) in April 2005. This is the first report of FPR disease in Belize.

### References

- Aime MC, Phillips-Mora W, 2005. The causal agents of witches' broom and frosty pod rot of cocoa (chocolate, *Theobroma cacao*) form a new lineage of Marasmiaceae. *Mycologia* 97, 1012–22.
- Cifferi R, Parodi E, 1933. Descripción del fungo que causa la 'moniliasis' del cacao. *Phytopathologische Zeitschrift* 6, 539–42.
- Evans HC, 1981. *Pod Rot of Cacao caused by Moniliophthora (Monilia) roreri*. Phytopathological Papers no. 24. Kew, UK: Commonwealth Mycological Institute.

\*E-mail: wphillip@catie.ac.cr. Accepted 21 October 2005 at [www.bspp.org.uk/ndr](http://www.bspp.org.uk/ndr) where figures relating to this paper can be viewed.

## First report of *Moniliophthora roreri* causing frosty pod rot (moniliasis disease) of cocoa in Mexico

W. Phillips-Mora<sup>a\*</sup>, A. Coutiño<sup>b</sup>, C. F. Ortiz<sup>c</sup>, A. P. López<sup>d</sup>, J. Hernández<sup>b</sup> and M. C. Aime<sup>e</sup>

<sup>a</sup>Tropical Agricultural Research and Higher Education Center, PO Box 7170 CATIE, Turrialba, Costa Rica; <sup>b</sup>Subsecretaría de Desarrollo Rural del Estado de Chiapas, Carr. Juan Crispín – Chicoasén Km 2.5, Tuxtla Gutiérrez, Chiapas; <sup>c</sup>Colegio de Posgraduados, Campus Tabasco, PO Box 24, H. Cárdenas, Tabasco; <sup>d</sup>INIFAP, Campo experimental Huimanguillo, PO Box 17, Huimanguillo, Tabasco, México; and <sup>e</sup>USDA-Agricultural Research Service, Systematic Botany and Mycology Laboratory, 10300 Baltimore Avenue, Beltsville, MD 20705, USA

*Theobroma cacao*, the source of cocoa or cacao, has been cultivated in Mexico for hundreds of years, with around 37 000 farms covering 62 000 ha in Tabasco and Chiapas dedicated to its production. In March 2005, deformed and prematurely ripening cocoa pods were noted in the vicinity of Ignacio Zaragoza, Pichucalco in northern Chiapas. Chocolate-coloured lesions with creamy mycelium, darkening with age, mummies (shrivelled pods) and internal necrosis were also commonly observed. By April, local sources stated that c. 1000 ha were affected by the disease in the municipalities of Pichucalco, Juárez, and Ostucacán in Chiapas, and nearby Huimanguillo in Tabasco.

The distinctive symptoms suggested frosty pod rot (FPR), caused by the fungus *Moniliophthora roreri*. This was confirmed via colony morphology and DNA sequencing. Isolates obtained from diseased pods showed an initial whitish growth on modified V8 medium, later salmon-cream and finally dark brown due to massive spore formation (Evans, 1981). Spores were produced in chains and were thick-walled, pale yellow and heteromorphic, but commonly (74%) globose to subglobose (5–10 µm diameter), with a further 20% ellipsoid (6–11 × 8–19 µm).

The internal transcribed spacer (ITS) and 28S large subunit (LSU) regions of the nuclear ribosomal DNA were amplified and sequenced with fungal specific primers ITS1-F/ITS4 (ITS) and LSU4-B/LR6 (LSU) (Aime &

Phillips-Mora, 2005). The sequences obtained (GenBank accession numbers DQ222923–26) were 100% homologous to those from other *M. roreri* isolates from Panama, Costa Rica, Nicaragua, Honduras and Belize. Two isolates obtained from diseased pods are deposited in the US National Fungus Collection (herbarium BPI) as MCA 2952 and MCA 2953.

*Moniliophthora roreri* began spreading north from Panama in 1956 (Orellana, 1956) and has now reached the northern limit of cocoa cultivation in continental America. This is the first report of FPR in Mexico, where production is now threatened by one of the most devastating cocoa diseases.

### References

- Aime MC, Phillips-Mora W, 2006. The causal agents of witches' broom and frosty pod rot of cocoa (chocolate, *Theobroma cacao*) form a new lineage of Marasmiaceae. *Mycologia* 97, 1012–22.
- Evans HC, 1981. *Pod Rot of Cacao caused by Moniliophthora (Monilia) roreri*. Phytopathological Papers no. 24. Kew, UK: Commonwealth Mycological Institute.
- Orellana RG, 1956. La moniliosis y otras enfermedades del cacao en el este de Panamá. *Boletín Fitosanitario de la FAO* 4, 168–9.

\*E-mail: wphillip@catie.ac.cr. Accepted 31 January 2006 at [www.bspp.org.uk/ndr](http://www.bspp.org.uk/ndr) where figures relating to this paper can be viewed.