

## Diseases Caused by Fungi and Fungus-Like Organisms

### First Report of *Fusarium oxysporum* f. sp. *cubense* Tropical Race 4 Causing Fusarium Wilt in Cavendish Bananas in Peru

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*Fusarium oxysporum* f. sp. *cubense* Tropical Race 4 (Foc TR4), the causal agent of Fusarium wilt of banana (FWB), is currently the major threat to the banana industry worldwide (Dita et al. 2018). Restricted to South Asia for more than 20 years, Foc TR4 has spread in the last years to the Middle East, Mozambique, and Colombia (García-Bastidas et al. 2020; <https://pestdisplace.org/embed/news/map/disease/11>). The incursion of Foc TR4 in Colombia increased awareness and prevention efforts across Latin America and the Caribbean (LAC). However, new Foc TR4 outbreaks in LAC countries were considered inevitable. In April 2021, banana (*Musa* spp., Cavendish, AAA) plants (30% of incidence) showing typical symptoms of FWB, such as leaf yellowing, wilting, and vascular discoloration, were observed in one farm (about 1 ha) located in Querecotillo, Peru (4°43'54.84" S, 80°33'45.00" W). Mycological analyses of samples (pseudostem strands) collected from 10 symptomatic plants were performed as described by Dita et al. (2010). These analyses revealed a continuous presence of fungal colonies identified as *F. oxysporum* species complex. Molecular diagnostics targeting two different genome regions (Dita et al. 2010; Li et al. 2013) identified nine of these isolates as Foc TR4. These results were further confirmed by qPCR analyses using the commercial Clear Detections TR4 kit. The genomes of four single-spore isolates (PerS1, PerS2, PerS3, and PerS4) were sequenced using the

Illumina platform (MiSeq Kit, 2x151 bp Paired-End). The strain PerS4 was also sequenced using Oxford Nanopore (FLOW-MIN111; R10.3 chemistry) as described by López-Alvarez et al. (2020). The generated draft assembly yielded 533 contigs for a size of 47 Mbp (BioProject: PRJNA755905), which is comparable with sizes of previously reported Foc TR4 strains (Asai et al. 2019; García-Bastidas et al. 2020; Maymon et al. 2020; Warmington et al. 2019; Zheng et al. 2018). The sequence assembly showed high contiguity (94.9%) and high similarity (95.48%) with the high-quality genome sequence of the Foc TR4 isolate 'UK0001' (Warmington et al. 2019). Further analyses to identify the presence/absence of full sequences for the putative effector genes (*Secreted in Xylem - SIX*) and their allelic copies also revealed that the *SIX* gene profiles of the strains isolated from Querecotillo matched with previously reported Foc TR4 isolates (Czislowski et al. 2017). Pathogenicity tests with three isolates and water controls were performed as described by Dita et al. (2010), using five Cavendish plantlets per treatment. Four weeks after the inoculation, typical external and internal symptoms of FWB were observed only in the inoculated plants. Fungal isolates recovered from inoculated plants tested positive for Foc TR4 when analyzed with PCR diagnostics as mentioned above. No fungal isolates were recovered from water-control plants, which did not show any symptoms. Altogether, our results confirm the first incursion of Foc TR4 in Peru. Currently, Foc TR4 has the phytosanitary status of a present pest with restricted distribution in Peru, and it is under official control of the National Plant Protection Organization – SENASA. Reinforced prevention and quarantine measures, disease monitoring, and capacity building to detect, contain and manage eventual new outbreaks of Foc TR4 are strongly encouraged across LAC banana-producing countries, especially those bordering Peru with larger banana plantations, such as Ecuador and Brazil.

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The author(s) declare no conflict of interest.

#### e-Xtra

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