Diseases Caused by Fungi and Fungus-Like Organisms

First Report of Powdery Mildew Caused by *Podosphaera fusca* on *Helianthus tuberosus* in China

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Helianthus tuberosus L. (Jerusalem artichoke) is an herbaceous perennial plant in the Asteraceae that is native to North America but introduced to China in the 17th century. The tubers of *H. tuberosus* are used as a vegetable, for the pharmaceutical production of inulin, and as a source of ethanol biofuel, several B vitamins, and minerals. From June to September 2009, severe powdery mildew infection was observed on *H. tuberosus* in a vegetable garden at Shangqiu Normal University, Shangqiu, China. Approximately 60% of leaves on individual plants were symptomatic, and almost 70% of the plants were infected. Initially, discrete powdery mildew colonies appeared on the upper surface of the leaves and on stems of the plants. Later, mycelial growth was amphigenous, thick, forming irregular white patches, covering the whole leaf surface. Eventually, leaves turned yellow, withered, and abscised. Microscopic observations showed that conidia on infected leaves were ellipsoid-ovoid to barrel-shaped, with distinct fibrosin bodies visible in their cytoplasm, measuring 28 to 38 × 15 to 22 μm ($n = 40$). Conidiophores were unbranched, straight, 80 to 210 × 8 to 14 μm ($n = 40$) in size, and produced two to six immature conidia in chains with intercellular diaphragms. Foot cells of conidiophores were cylindrical and 45 to 65 × 8 to 14 μm ($n = 40$), with slight constrictions at basal septa, and followed by one to three short cells. Fungal hyphae were septate, branched, and flexuous to straight, and 5 to 8 μm wide with indistinct to slightly nipple-shaped appressoria. These structures are typical of the genus *Podosphaera*, although chasmothecia were not observed. The sequence of ITS1-5.8s-ITS2 region of rDNA was amplified from conidia collected from infected leaves with universal primers ITS1F and ITS4 (White et al. 1990), sequenced, and analyzed using

the BLASTn search of GenBank. Amplicons were 603 bp (GQ927254) and exhibited 99.83% sequence identity with the sequence of *P. fusca* from *Cucurbita pepo* (KJ698669) in Italy (Pirondi et al. 2015). The fungal species was identified as *P. fusca* (synonym *P. xanthii*) by morphological characteristics and molecular analysis (Braun and Cook 2012; Braun and Takamatsu 2000). Pathogenicity tests were conducted by gently pressing the infected leaves onto leaves of six healthy *H. tuberosus* plants, and six noninoculated plants served as controls. Plants were maintained in a greenhouse at 25 ± 2°C. Eight days after inoculation, symptoms similar to those observed under natural conditions developed on the inoculated leaves of *H. tuberosus* plants, whereas the control plants remained symptomless. The fungus on inoculated leaves was morphologically identical to that first observed in the field. *P. fusca* parasitizes a large number of asteraceous species including *Euryops pectinatus* (Saenz et al. 2000), *Coreopsis lanceolata* (Garibaldi et al. 2007), *Cosmos caudatus* (Siddiqui et al. 2011), *Herba eupatorii* (Ding et al. 2013), and so on. Powdery mildew caused by *P. fusca* has been reported on *H. tuberosus* in Russia (Farr and Rossman 2019). *Golovinomyces ambrosiae* was previously recorded on *H. tuberosus* in China (Huang et al. 2017; Radisek et al. 2018). This is the first report to our knowledge of powdery mildew *P. fusca* on *H. tuberosus* in China. It could cause significant yield losses and become a threat to production of *H. tuberosus*.

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