Diseases Caused by Fungi and Fungus-Like Organisms

First Report of Root Rot Caused by the *Fusarium oxysporum* Species Complex on *Codonopsis pilosula* in China

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Codonopsis pilosula Franch., also known as Dangshen, is an important medicinal plant in China. It is widely cultivated for a major income of local farmers in Dingxi, Gansu Province. Its dried roots have the effects of supplementing vital energy, nourishing spleen and lung, enhancing organic immunity, helping depressurization, and improving microcirculation. In June to October of 2018–2020, root rot disease was observed on *C. pilosula* with incidences up to 20% in the Dingxi region. We collected 10 diseased and healthy plants from Dingxi (35°06′N, 104°29′E, 2,206 m a.s.l.) in October 2019. The rotting root tissues were sterilized with 70% ethanol for 30 s and 3% NaOCl for 5 min and placed on potato dextrose agar (PDA) plates incubated at 25°C to isolate the pathogen (Shang et al. 2014). From the similar fungal cultures isolated after 7 days on PDA, isolate B17 was purified for morphological and molecular characterization. Its colony appeared light purple and produced long aerial hyphae. Slightly curved macroconidia (12.3 to 31.7 × 3.1 to 5.1 µm, *n* = 40) and oval-ellipsoid and cylindrical microconidia (6.1 to 9.9 × 2.8 to 4.5 µm, *n* = 30) were observed. The internal transcribed spacer region (ITS) and the translation elongation

factor-1 alpha (*TEF-1α*) gene were amplified using primers ITS1/ITS4 and EF-1/EF-2 (Uwaremwe et al. 2020), respectively. The 489 bp (ITS) and 631 bp (*TEF-1α*) sequences were deposited in GenBank (accession nos. MN744360 and MN786974, respectively). The ITS sequence had 100% homology to isolate JJF2 (MN626452, ITS) (Ma et al. 2020), and the *TEF-1α* sequence had 100% homology to isolate Fo353 (KM065860) (Koyyappurath et al. 2016) of *Fusarium oxysporum*, which caused root rot of *Panax ginseng* and *Vanilla planifolia*, respectively. A phylogenetic tree was generated using the unweighted pair-group method with arithmetic average in the MycoBank database (O'Donnell et al. 2015), which clustered isolate B17 in the *F. oxysporum* species complex. Twenty 1-year-old plants of *C. pilosula* were inoculated with were inoculated by dipping the washed roots in a conidial suspension (2 × 10⁶ conidia/ml added with 0.2% Tween 20) for 20 min before transplanted into pots (16 × 16 × 23 cm) with four plants per pot filled with sterilized peat and soil mixture (2:1 v/v) and grown in a greenhouse at 26°C with >70% humidity and 16 h light. Sterilized water added with 0.2% Tween 20 was used as a control. One week after inoculation, the leaves of pathogen-inoculated plants became yellow, and wilting occurred at the leaf tips 18 days later. Some of the inoculated plants died 45 days after inoculation, and the low part of roots had dark brown to black lesions and became rotted. The control plants did not show symptoms. The pathogenicity test was repeated three times with the same fungus isolated from the infected root tissue. To the best of our knowledge, this is the first report that *F. oxysporum* causes root rot on *C. pilosula* in China. *F. oxysporum* is a serious threat to *C. pilosula* cultivation, and the finding of this pathogen provides a clear target for root rot control.

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