Diseases Caused by Fungi and Fungus-Like Organisms

First Report of *Fusarium avenaceum* Causing Leaf Spot on *Angelica sinensis* in China

Zi-Kun Zhang,¹ Jian-Qiang Zhang,¹ Wan-Xia Zhang,¹ Zhi-An Kou,¹ Xin-Fang Wang,¹ Lu Liu,¹ Zhao-yu Li,² Ya-Li Wang,¹ Tong Shen,² and Yong-Qiang Tian^{1,†}

¹ School of Biological and Pharmaceutical Engineering, Lanzhou Jiaotong University, Lanzhou 730070, Gansu, China

² Biological Pesticide Engineering Center of Gansu Province, Lanzhou Jiaotong University, Lanzhou 730070, Gansu, China

Funding: Funding was provided by Gansu province science and technology key research and development project (20YF3FA038), Gansu Jiayuguan city science and technology major project (20-04), and Natural Science Foundation of Gansu Province (21JR7RA299). Plant Dis. 106:1524, 2022; published online as <https://doi.org/10.1094/PDIS-08-21-1753-PDN>. Accepted for publication 11 October 2021.

Angelica sinensis (Oliv.) Diels (Umbelliferae) is a popular Chinese herb that is mainly distributed in Gansu Province, China, accounting for more than 90% of the national output and sales. A survey for diseases of *A. sinensis* in Gansu Province in August 2019 found foliar disease with an incidence of 60 to 100%, and severities ranging from 5 to 15%. The disease mainly occurred in late July and August. The initial symptoms included many light brown, small lesions, round or irregular in shape, which gradually increased in size. White mycelia were visible in the lesions. Severely affected leaves became chlorotic, withered, and died. In the *Angelica* planting area in Weiyuan County (33°26'N, 104°02'E), diseased leaves from 20 plants were collected by the five-point sampling method (Zheng et al. 2018), and small samples (4 × 4 mm) were cut from the border between diseased and healthy tissue, successively sterilized with 75% ethanol for 30 s, washed three times with sterilized water, dried on sterilized filter paper, and placed on potato dextrose agar plates. After 5 days at 25°C, five morphologically similar colonies were obtained. Colonies were somewhat round, pink overall, and formed an abundant fluffy white mycelium in the center. Conidia were solitary, macrospores slender, straight to slightly falcate with two to six septa, and 20.0 to 77.6 × 2.5 to 3.6 μm (*n* = 50). The microspores were elliptical and 3.0 to 8.0 × 2.5 to 3.0 μm (*n* = 5). A strong pink pigment was observed on the reverse side of the PDA culture. The

morphological characteristics were consistent with the description of *Fusarium avenaceum* (Jahedi et al. 2019; Parikh et al. 2018). To further identify the strains, the internal transcribed spacer (ITS), β-tubulin, translation elongation factor 1α (EF1-α), and RNA polymerase second largest subunit (RPB2) gene regions were amplified with ITS1/ITS4, Bt2a/Bt2b, EF1/EF2, and 5f2/7cr (Glass and Donaldson 1995; O'Donnell et al. 2010; White et al. 1990), respectively. The sequences of the five strains were identical, and those of representative strain K0721 were deposited in GenBank (ITS, MZ389899; TUB2, MZ398139; EF1-α, MZ388462; RPB2, MZ394004). BLAST analysis revealed that the ITS, β-tubulin, EF1-α, and RPB2 sequences were 100% (563/563), 100% (423/423), 99% (643/649), and 99% (930/935) homologous with those of *F. avenaceum* (KP295511.1, KY475586.1, KU999088.1, and MH582082.1), respectively. A multigenic phylogenetic tree was inferred by maximum likelihood phylogenetic analyses based on the combined data set with ITS, EF1-α, and RPB2. The strain K0721 was clustered with *F. avenaceum*. Pathogenicity tests were performed on five 1-month-old healthy plants in plastic pots (20-cm diameter) with sterilized soil. Each was sprayed with 50 μl of a conidial suspension (1 × 10⁴ conidia/ml), and five healthy plants were sprayed with sterile water as controls. Small lesions were observed after 5 days at 25°C in a greenhouse. Symptoms were similar to those observed under field conditions. Control plants remained symptomless. Six isolates were reisolated from infected leaves and all confirmed to be *F. avenaceum* based on morphological observations and molecular identification. To our knowledge, only *Septoria anthrisci* has been previously reported as a pathogen of *A. sinensis* leaf spot (Wang et al. 2018), and this is the first report of *F. avenaceum* causing this disease. This discovery needs to be considered in developing and implementing disease management programs in *A. sinensis* production.

References:

- Glass, N. L., and Donaldson, G. C. 1995. Appl. Environ. Microbiol. 61:1323.
- Jahedi, A., et al. 2019. Arch. Phytopathol. Plant Prot. 52:953.
- O'Donnell, K., et al. 2010. J. Clin. Microbiol. 48:3708.
- Parikh, L., et al. 2018. Crop Prot. 108:120.
- Wang, Y., et al. 2018. Plant Dis. 102:442.
- White, T. J., et al. 1990. Page 315 in: PCR Protocols: A Guide to Methods and Applications. Academic Press, San Diego, CA.
- Zheng, L., et al. 2018. Plant Dis. 102:628.

The author(s) declare no conflict of interest.

e-Xtra

Keywords: *Angelica sinensis*, *Fusarium avenaceum*, leaf spot

[†]Indicates the corresponding author.
Y. Tian; tian2918@163.com