Diseases Caused by Fungi and Fungus-Like Organisms

First Report of *Fusarium oxysporum* Causing Basal Stem Rot on *Panax ginseng* in China

Y. Y. Ma, Y. M. Guan, Y. Zhang, M. J. Li, X. X. Pan, and Q. X. Wang[†]

Institute of Special Wild Economic Animal and Plant Science, Chinese Academy of Agricultural Sciences, Changchun, 130112, Jilin, China

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Ginseng (*Panax ginseng* C. A. Meyer) is a valuable plant widely used in medicine, cosmetics, and food. Basal stem rot was found in 3-year-old ginseng plants in Fusong and Dunhua counties in northeast China in August 2019. Symptoms appeared as a water-soaked fusiform lesion located 1 cm from the base of the stem that gradually extended around the base. The stem base and roots became easily detached. The rhizome was also occasionally infected. In the early stage, the aboveground plant parts were intact. As the disease progressed, these parts gradually wilted and dried. Although the roots were not infected, they stopped growing. More than 35% of the ginseng plants in a 50-ha field were infected in 2019. Fifteen infected plants were collected from two fields, and the lesions at the base of the stem were removed, cut into 0.5-cm sections, surface disinfested by immersion in 1% NaOCl for 2 min, washed three times with sterile water, and evenly placed on potato dextrose agar containing 50 µg/ml of streptomycin (Fang 1998). After 3 days, a total of 19 isolates were obtained. All isolates were purified by single-spore isolation and transferred to carnation leaf agar (Fisher et al. 1982). Stains JJF1 and JJF2 were randomly selected for morphological identification. The colonies were initially white and then gradually became purple. The colonies were velvety, and a small number of microsclerotia were produced after 2 weeks. Macroconidia were slender, straight or slightly curved, with pointed ends, 24.9 to 50.3 × 2.8 to 5.7 µm, with a hook-shaped apical cell and a foot-shaped basal cell, and generally three to five septa. Microconidia

predominated and were elliptical or kidney shaped, aseptate, and borne on monophialides on sparsely branched conidiophores. Microconidia measured 5.4 to 11.7 × 2.5 to 4.2 µm. Chlamydospores, most of which formed after 20 days, were spherical, intercalary or terminal, and single or in short chains. According to these morphological characteristics, the pathogen was initially identified as *Fusarium oxysporum* (Leslie and Summerell 2006). Further confirmation of the identification was obtained by sequencing the nuclear ribosomal internal transcribed spacer region (ITS, GenBank accession no. MN626451 and MN626452), translation elongation factor (*TEF*-1α, MN629914 and MN629915), and the second largest subunit of RNA polymerase II (*RPB2*, MN629914 and MN629915) (O'Donnell et al. 2000, 2015). These sequences showed 100% identity to GenBank accessions MH290453 (ITS), JF740827 (*TEF*-1α), and JF740827 (*RPB2*) of *F. oxysporum* in the NCBI and the *FUSARIUM*-ID databases. The same two strains were used for pathogenicity testing. Fifteen healthy 3-year-old ginseng plants cultivated in a greenhouse (12-h photoperiod, 25°C) were selected, and the base of the stem of five plants was wrapped in sterile cotton treated with a spore suspension (1 × 10⁵/ml) of JJF1 or JJF2. Then the plants were covered with plastic to maintain a moist environment for 72 h. Control plants were inoculated with sterile water. After 7 days, the inoculated plants showed lesions at the stem base consistent with those observed in the field, and the pathogen was successfully reisolated and identified by sequencing. No disease symptoms were observed on the controls. To our knowledge, this is the first report of ginseng basal stem rot caused by *F. oxysporum*. The disease poses a threat to the production of ginseng, and management strategies need to be developed.

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[†]Indicates the corresponding author.

E-mail: wangqiuxia1018@126.com (Q.X.W.)