Diseases Caused by Fungi and Fungus-Like Organisms

Occurrence of Postharvest Snow Rot Caused by *Sclerotinia nivalis* on Asian Ginseng in China

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Asian ginseng (*Panax ginseng*) is a valuable medicinal plant that is commercially cultivated in China. A long postharvest storage period is required before ginseng is processed. From October 2019 to May 2020, snow rot was observed on the roots of 4- and 5-year-old fresh ginseng stored in three cold storage facilities located in Tonghua and Changbai cities in northeastern China, which are the most important regions for Asian ginseng production. We sampled 1,000 ginseng roots from the three cold storage facilities, and the average disease incidence was 21%. Initially, sparse hyphae and micro-sclerotia appeared on the root epidermis. Lesions gradually softened, and the epidermis detached easily. Multiple infected sites slowly converged, resulting in the formation of a dense complex of multiple sclerotia and thick hyphae on the surface of the ginseng root as well as internal decay. The infection eventually spread to the adjacent ginseng roots. Sixteen diseased ginseng roots were collected, and then sclerotia were removed from the root surface, immersed in 1% NaClO for 2 min, rinsed three times with sterile water, and placed on potato dextrose agar (PDA) containing streptomycin (40 µg/ml) in Petri dishes. After a 3-day incubation at 20°C in darkness, 22 suspected *Sclerotinia* isolates were obtained. Isolates SN1 and SN2 were randomly selected for identification. On PDA, fast-growing colonies produced white,

sparse, powdery, and cotton-like aerial mycelia, and the reverse side showed the same color. Small and white sclerotial primordia formed 3 days later, and a ring of sclerotia was detected at the plate periphery. At 7 to 10 days after incubation, the mature sclerotia were black, spherical to subspherical, and elongated or fused to form irregular shapes. Each Petri dish produced 55 to 65 sclerotia, measuring 1.1 × 1.2 to 3.2 × 3.9 mm ($n = 100$). The sclerotia were firmly attached to the agar surface. The isolates were initially identified as *Sclerotinia* sp. (Saito 1997). After sequencing the nuclear ribosomal internal transcribed spacer region (MW927134 and MW927135) and the β -tubulin gene (MW929179 and MW929180) (Glass and Donaldson 1995; White et al. 1990), BLAST searches revealed 100% homology with JX262268 and JX296007 of the published *Sclerotinia nivalis* strain KGC-S0601, respectively. The pathogenicity of the two isolates was tested using detached ginseng roots. Briefly, healthy roots were washed, surface disinfested with 75% alcohol, and rinsed with sterile water. Mycelial plugs (5-mm diameter) removed from the margin of actively growing colonies on PDA were placed on the ginseng roots. For each isolate, four roots were inoculated, with two plugs per root. Additionally, PDA plugs without mycelia were used as the negative control. The roots were placed in a fresh-keeping box at 20°C in darkness and evaluated after 7 days. The pathogenicity test was repeated twice. The symptoms on the inoculated roots were the same as those observed on the roots during cold storage, whereas the control roots remained symptomless. The same fungus was reisolated consistently from all infected roots, and its identity was confirmed by resequencing, thereby fulfilling Koch's postulates. To the best of our knowledge, this is the first report of *S. nivalis* causing postharvest snow rot on Asian ginseng in China. The occurrence of this disease threatens the postharvest storage of Asian ginseng. Hence, effective management strategies must be developed.

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