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Gray Mold of Grafted Cactus Caused by *Botrytis cinerea* in Korea

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Grafted cactus, produced by grafting two different cactus species including photosynthetic stocks (mostly *Hylocereus trigonus*) and non-photosynthetic scions (usually *Gymnocalycium mihanovichii* or *Chamaecereus silvestrii*), is one of the most popular exporting ornamental plants, comprising about 70% of the world trading market (Song et al., 2009a, 2009b). Since the grafted cactus is cultivated in greenhouses with warm temperature and high humidity during the whole growing season, several diseases especially caused by fungi such as *Bipolaris cactivora*, *Colletotrichum gloeosporioides* (anamorph of *Glomerella cingulata*), *Fusarium oxysporum*, and *Alternaria alternata* are frequently found in the cactus farms in Korea (Chang et al., 1998; Choi et al., 2010; Hyun et al., 1998; Kim et al., 2000).

A stem disease of *G. mihanovichii* caused by a fungus was observed in 2010 in several greenhouses especially with high humidity at Goyang, Gyeonggi province, the major cactus-growing area in Korea. Its occurrence was not prevalent and found mostly in mature (old) cactus plants. Characteristic symptoms were initial black or brown spots that were enlarged with time to become shrunken or water-soaked black lesions at advanced infection stages (Fig. 1A & B). Isolation of fungi and bacteria from the rotten stems of *G. mihanovichii* was tried to, but it was fail the isolation of the previously known fungal and bacterial pathogens such as *B. cactivora*, *C. gloeosporioides*, *F. oxysporum*, *A. alternata*, and *Pectobacterium carotovorum* (Kim et al., 2007) except seven fungal isolates with identical morphological characteristics. The mycological characteristics of the fungal isolates were as follows. The fungus formed grayish brown colonies with the production of abundant flat or irregular black sclerotia on potato-dextrose agar (PDA) (Fig. 1C). Conidiophores were upright, tall and slender, 8.0–31.0 µm in width, determinate, hyaline or grayish, branched irregularly in upper portions, bearing clusters of conidia simultaneously on short denticles (Fig. 1D). Conidia were one celled, colorless or pale brown, mostly ellipsoid or ovoid, and 8.5–12.3 × 6.3–11.2 µm in size (Fig. 1E). These morphological characteristics of the present isolates coincide with those of *Botrytis cinerea* described by Ellis and Waller (1974).

To confirm the identification of the fungus, the partial internal transcribed space (ITS) region of rDNA from the present isolate was amplified using the primers ITS1 and ITS4 as described by White et al. (1990) and sequenced. The resulting sequences were compared

to the GenBank database using the NCBI BLAST search program. A total of 798 base sequences determined from the ITS DNA were 100% identical to those of several *Botryotinia fuckeliana* (teleomorph of *Botrytis cineria*) strains of NCBI accession nos. HM849615.1, HM849047.1, HQ166517.1, and FN812726.1, indicating the causal fungus was confirmed to be *B. cinerea*.

For pathogenicity test, one-year-old stems of *G. mihanovichii* were inoculated with spore suspension (1×10^6 spores/ml) of the fungal isolate by spray on a wound of ca. 0.5 mm (diameter) x 5 mm (depth) made with a syringe needle, and were incubated under saturated humid condition at room temperature for one day, and placed at 25 °C and RH 40% in a growth chamber. Initial symptoms of dark brown lesions (identical to those found in the cactus greenhouses) were developed around wounding sites and enlarged with time (Fig. 1B). The same fungus was re-isolated from the diseased area to fulfill the Koch's postulates. Therefore, the cactus disease was caused by *B. cinerea* whose identity was confirmed on the basis of its morphological and molecular characteristics. This is the first report of gray mold by *B. cineria* in the grafted cactus. As found no other fungal and bacterial pathogens previous known to occur in *G. mihanovichii*, especially *B. cactivora* causing the similar cactus stem rot, *B. cinerea* should be the primary causal agent for the disease development.

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Fig. 1. Gray mold on a mature grafted cactus (*Gymnocalycium mihanovichii*) caused by *Botrytis cineria*, showing the symptoms on the stems with natural infection (A) and induced by artificial inoculation (B), the fungal colony with black sclerotia (arrows) grown for 30 days on PDA (C), and light microscopy of the fungal conidiophores (D, bar 10 µm) and conidia (E, bar 20 µm) (D, E).

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