

## Ginseng Anthracnose Caused by *Colletotrichum dematium*

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**Ginseng anthracnose was observed in Koyang area, Korea. A fungus was repeatedly isolated from leaves and stems of the infected ginseng plants and identified as *Colletotrichum dematium* according to the morphological and cultural characteristics. The fungus showed pathogenicity on inoculated ginseng leaves. This is the first report of ginseng anthracnose caused by *Colletotrichum dematium* in Korea.**

**Keywords :** Anthracnose, *Colletotrichum dematium*, Ginseng

Ginseng (*Panax ginseng* Meyer) is one of the important economic crops in Korea. Ginseng roots are used as important ingredient in processing oriental medicine. Ginseng yield was easily influenced by attacks of many kinds of root and aerial diseases. Among these diseases, anthracnose of *Colletotrichum gloeosporioides* Penz. (*C. panacicola* Nakada & Takimoto) is one of the most important diseases since it causes leaf blight, which defoliates the plants and retards the growth of roots (Ohh, 1981).

Ginseng anthracnose was first reported by Nakata and Takimoto (1922). They described the symptom, physiology and ecology of the pathogen, *C. panacicola* in Korea. The disease was named leaf blight at that time to avoid confusion with leaf anthracnose which had been reported by Whetzel et al. (1912). Few reports on ginseng anthracnose are available, except those found in ginseng seeds or on plants obtained from North Korea by Russian scientists (Bunkin, 1960; Edel'Shtein, 1960) after the World War II.

American ginseng, *Panax quinquefolius* L., is cultivated in the United States and Canada. Reviews of literature reveal two *Colletotrichum* species: the *C. dematium* and the *C. coccodes* which repeatedly have caused anthracnose in American ginseng (McPartlant and Hosoya, 1998). The present observation reveals that *C. dematium* (Pers.: Fr.) Grove may also be a potential anthracnose agent in Korean

ginseng under environmental conditions favorable to the disease.

### Materials and Methods

**Identifying anthracnose.** In this study, the new agent of anthracnose in Korean ginseng (*Panax ginseng*), except for the *C. gloeosporioides* was identified, and its pathogenicity to the ginseng was examined.

**Symptoms.** In August 2002, a severe anthracnose occurred on the leaves of three-year-old ginseng plants in Koyang area, Korea. Symptoms of anthracnose developed on leaves and petioles of ginseng plants (Fig. 1). Small spot lesions initially appeared on the infected leaves. These lesions gradually enlarged and fused with some lesions having black color, and some having holes in the center, resulting in blight or defoliation. Setae and spores of pathogen could be easily seen from lesions of leaves under the microscope. Setae tapered at the base then sharpened towards the end. Conidia were falcate and curved, and tapered to two ends. **Morphology and cultural features.** To investigate the morphological and cultural characteristics, isolates were obtained by picking conidia from sporulating acervuli and placing them in water. A 0.1 ml conidial suspension was placed on acidified 2% water agar and spread through out the medium in the plate. Single germinated conidia were selected with the aid of a dissection microscope. Isolates were cultured in acidified PDA (pH 5) at  $25 \pm 2^\circ\text{C}$  for 7 days or 14 days under light condition.

Colony color on PDA was dark in center to gray at margin. Many black sclerotia were formed in the black region on the colony, but rarely formed or not on PDA adjusted to above pH 5.0. Setae on the sclerotia appeared brown and measured  $100\text{--}280 \times 2.5\text{--}5 \mu\text{m}$  (Fig. 2B). Conidia formed on PDA were falcate with acute apex and narrow truncate base, aseptate  $25.0\text{--}30.0 \times 2.5\text{--}5.0 \mu\text{m}$  (Table 1, Fig. 2).

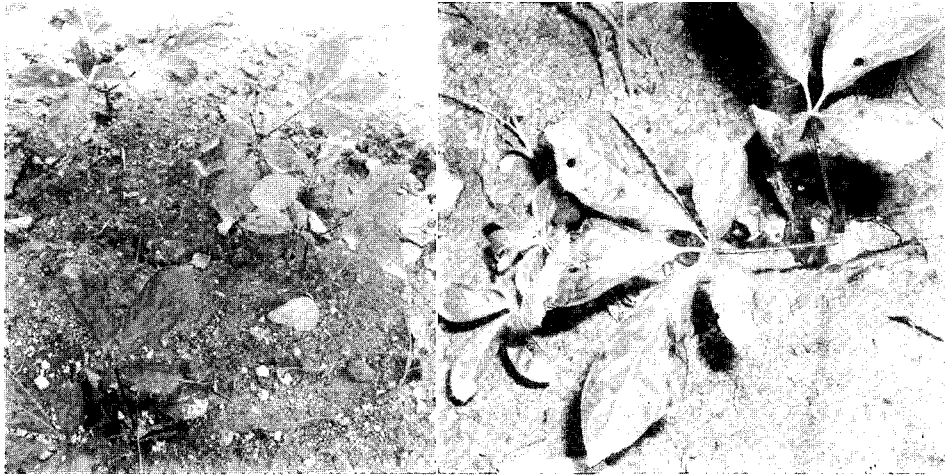
The above-mentioned morphological characteristics of the isolates are very similar to those of *C. dematium* reported in the previous studies (Arx, 1970; Sutton, 1980; Kim et al., 2001; Park and Kim, 1992; Yoshida et al., 1995).

**Pathogenicity.** A test was performed to investigate the pathogenicity of this fungus with *Colletotrichum gloeosporioides*, which was isolated from anthracnose-infected ginseng and pepper plants. Ginseng leaves and pepper fruits were obtained from field and green house grown plants. Pepper fruits were separated from their pedicels by using scissors. The detached leaves of ginseng

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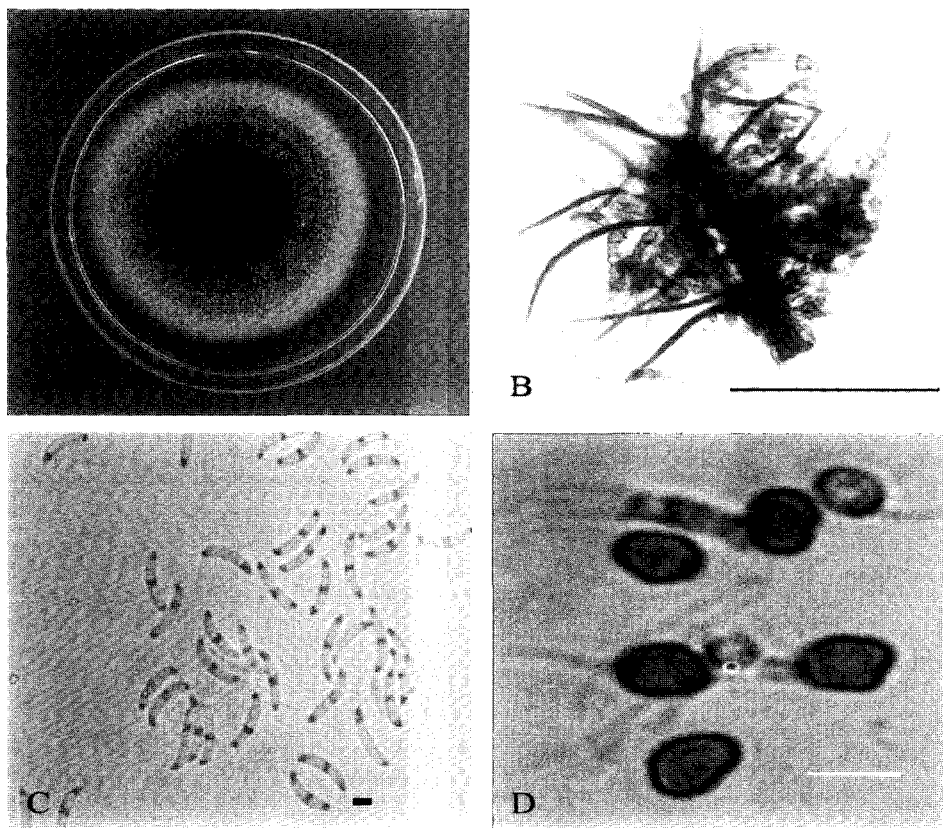


**Fig. 1.** Symptoms of anthracnose on plants in the field. Small spots at early stage (left), and blight at late stage of disease development (right).

and pepper and fruits pepper were rinsed in tap water, disinfested in 70% ethyl alcohol and 1% NaOCl (Sodium hypochlorite) for three minutes.

These were continuously rinsed in sterile distilled water, and dried up in laminar flow hood. The plant materials were placed

securely in plastic boxes (30 × 22 × 9 cm) containing plastic mesh screen and paper towels with sterile distilled water on the bottom. The plant materials were then dot-marked near the equatorial region with a marking pen. Conidia were harvested from a 7-day-old culture grown on acidified PDA (pH 5.0) at 28 ± 2°C under



**Fig. 2.** Cultural and morphological features of *Colletotrichum dematium* isolated from ginseng leaf. **A**, Colony after 10 days of incubation on PDA (pH 4.5) at 27°C under fluorescent light; **B**, Setae produced in PDA (pH 4.5) culture (scale bar = 100 µm); **C**, Conidia (scale bar = 10 µm); **D**, Appressoria (scale bar = 10 µm).

**Table 1.** Morphological characteristics of *Colletotrichum* sp G20, from ginseng anthracnose

Characteristic	Shape	Size ( $\mu\text{m}$ )	
		G20	<i>C. dematium</i>
Conidia	Falcate, fusiform, tapered to each end	25.0-30.0 $\times$ 2.5-5.0	22.5-27.5 $\times$ 4.2-5.5(1) 24.0-30.0 $\times$ 3.0-4.0(2) 20.0-28.0 $\times$ 3.0-4.0(3)
Appressoria	Ovate to clavate	6.3-9.8	6-10 $\times$ 5-8(3)
Setae	1-3 septate on Sclerotia, the base tapering to sharpened apices	100-280 $\times$ 2.5-5	40-244 $\times$ 3-8(3)
Perithecia	—	—	—
Sclerotia	Abundant on acidified PDA	—	—
Colony color	Dark to gray	—	—

**Table 2.** The degree of pathogenicity of *Colletotrichum* spp. associated with ginseng anthracnose on ginseng leaves and pepper fruits inoculated with or without wounds *in vitro*

Isolates	Pepper fruits		Ginseng leaves	
	wounded	unwounded	wounded	unwounded
KGSP	+++	—	++	+
GP4	++	—	++	+
G14	—	—	+++	—
G20	—	—	+++	+++

*Colletotrichum* sp. GP4 was isolated from pepper fruits

*Colletotrichum* spp. KGSP, G14 and G20 were isolated from ginseng leaves

+++ = abundant lesions developed on leaves or fruits; ++ = moderate lesions developed on leaves or fruits; + = few lesions developed on leaves; — = no lesion.

continuous fluorescent light. About 5-10 ml of sterilized distilled water, stirred with rubber sticks, was poured in the culture plate.

The number of conidia in suspension was adjusted to  $1 \times 10^6$  conidia/ml. Leaves and fruits wounded or non-wounded were inoculated adjacent to dot-marks with a 10- $\mu\text{l}$  drop of conidial suspension. The inoculated leaves and fruits were kept in the plastic box for researcher to observe disease development. The boxes were covered with glass lids and kept at  $28 \pm 2^\circ\text{C}$ , near 100% relative humidity, and a 12/12 hours light dark cycle.

## Results and Discussion

Development of typical symptoms was observed 10 days after inoculation. The isolate G20 (*C. dematium*) was strongly virulent on the wounded or healthy leaves of ginseng, but rarely virulent on pepper fruits (Table 2). *C. gloeosporioides* from ginseng (Kgsp) or pepper (GP4) appeared virulent on both plants. Black symptoms, which were induced on the leaves after inoculation with the isolate G20, were similar to those observed in the field. The fungus was reisolated from the inoculated leaves and given similar cultural management. This is the first report of *C. dematium* causing anthracnose on ginseng (*Panax ginseng*) in Korea.

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