

Occurrence of Anthracnose on Chinese Mallow Caused by *Colletotrichum malvarum*

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Anthracnose symptoms were frequently observed on leaves, petioles, and stems of Chinese mallow grown in Namyangju, Korea, during a disease survey performed in November, 2007. The disease incidence was as high as 30% in the 12 greenhouses investigated. A total of 38 isolates of the *Colletotrichum* species were obtained from the anthracnose symptoms, and all the isolates were identified as *Colletotrichum malvarum* based on their morphological and culture characteristics. Three isolates of the fungus caused anthracnose symptoms on leaves and stems following artificial inoculation, which were similar to those observed during the greenhouse survey. In this study, mycological and pathological characteristics of *C. malvarum* identified as causing anthracnose of Chinese mallow were clarified.

KEYWORDS: Anthracnose, Chinese mallow, *Colletotrichum malvarum*, Pathogenicity

Chinese mallow (*Malva verticillata* L.) is widely grown in the temperate and subtropical regions of the world. The plant is commonly cultivated in Korea as one of the vegetables used for cooking soybean paste soup. Anthracnose symptoms were frequently observed on leaves, petioles, and stems of Chinese mallow grown in Namyangju, Korea, during a disease survey performed in November, 2007. The symptoms appeared as circular to irregular grayish brown spots on the leaves (Fig. 1A) and sunken, ellipsoidal to elongated, brown to dark brown lesions on the petioles and stems (Fig. 1B). Sometimes, the lesions on the stems originated from the soil surface line and developed upward (Fig. 1C and 1D). Severely infected plant parts began to develop dark brown discoloration and were blighted at the later stages of disease development. Pale yellow conidial masses were produced on the lesions. The incidence of the disease reached as high as 30% of the infected plants in nine out of the twelve greenhouses investigated.

A total of 38 isolates of *Colletotrichum* species were obtained from anthracnose symptomatic leaves, petioles, and stems of the Chinese mallow. Morphological and cultural characteristics of the isolates were examined for identification purposes. All the isolates were identified as *Colletotrichum malvarum* (Braun and Casp.) Southw. The morphological characteristics of *C. malvarum* examined by the authors were similar to those described by Sutton (1992) (Table 1).

Colonies of *C. malvarum* grown on potato dextrose agar (PDA) showed dark pigment with irregular margins,

and pale yellow conidial masses were scattered on the surface of cultures (Fig. 2A). Setae were produced on lesions and in PDA cultures. They were dark brown to black, 1~3 septate, and measured $52.5\sim 115.0 \times 3.0\sim 7.0 \mu\text{m}$ (Fig. 2B). Conidia were straight or slightly irregular, cylindrical to ellipsoid, apex obtuse, base truncate, and measured $12.0\sim 24.0 \times 4.5\sim 7.0 \mu\text{m}$ (Fig. 2C). Appressoria were brown to dark brown, globose, ovate to clavate, sometimes lobed, and measured $5.0\sim 12.5 \times 5.0\sim 7.5 \mu\text{m}$ (Fig. 2D). The temperature range and optimum temperature for mycelia growth of the fungus on PDA were $10\sim 32^\circ\text{C}$ and $24\sim 26^\circ\text{C}$, respectively.

Three isolates of *C. malvarum* were tested for pathogenicity to leaves and stems of Chinese mallow (cultivar Chimaook) by artificial inoculation with conidial suspensions ($1\sim 2 \times 10^6$ conidia/ml) prepared from 20-day-old PDA cultures. Inoculations were performed by spraying a conidial suspension onto 55-day-old Chinese mallow plants grown in the pots. The same quantity of sterile distilled water was used as the control. The inoculated plants were placed in dew chambers with 100% relative humidity at 26°C for two days, then moved into the greenhouse. Disease ratings were made based on the degree of anthracnose symptoms induced on the leaves and stems 10 days after inoculation. The inoculation test was performed in three independent replicates.

All the tested isolates of *C. malvarum* induced anthracnose symptoms on the leaves and stems following artificial inoculation (Table 2), and these symptoms were similar to those observed during the greenhouse survey. The fungal species were re-isolated from the symptoms observed following artificial inoculation.

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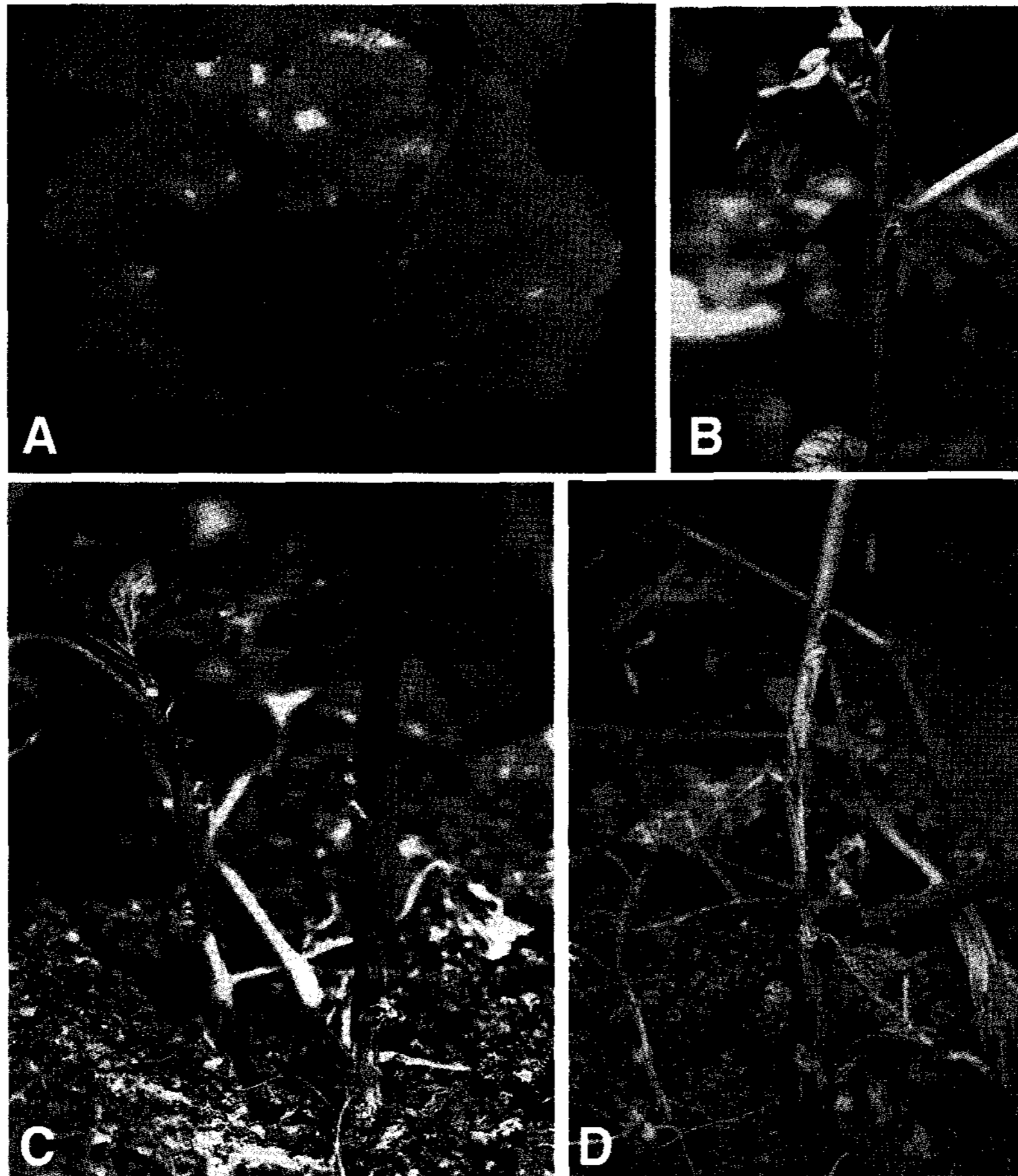


Fig. 1. Anthracnose symptoms on Chinese mallow plants observed in the greenhouse. A, grayish brown spots on the leaves; B, brown to dark brown lesions on the petioles and stems; C and D, lesions on the stems originating from the soil surface line.

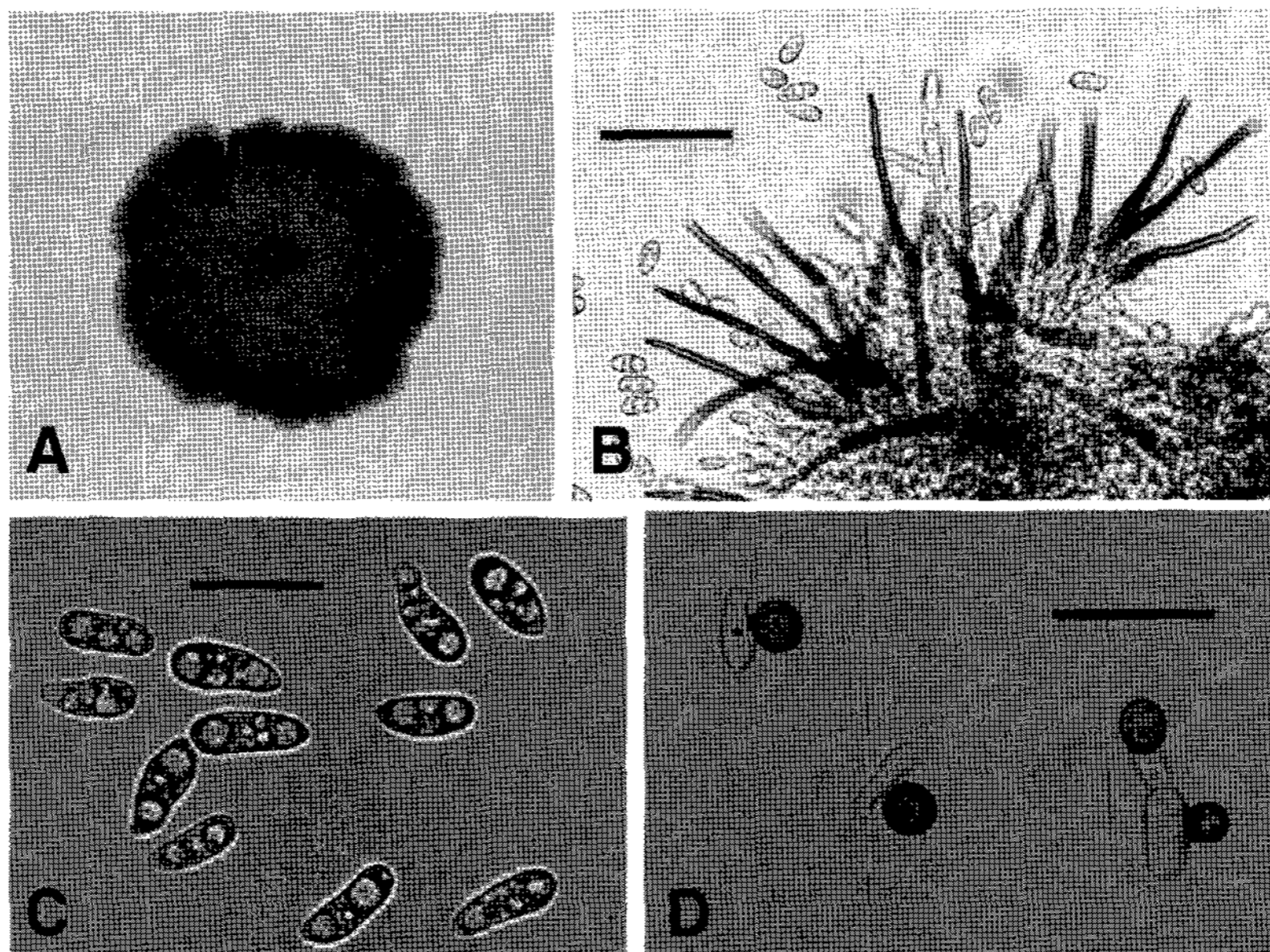


Fig. 2. Morphological and cultural features of *Colletotrichum malvarum* isolated from Chinese mallow plants. A, 20-day-old colonies grown on PDA at 24°C; B, setae and conidia produced on the lesions (scale bar = 50 μm); C, conidia (scale bar = 20 μm); D, appressoria (scale bar = 20 μm).

Table 1. Morphological characteristics of *Colletotrichum malvarum* isolated from Chinese mallow plants

Structure	Characteristics		
	Present isolates	Sutton (1992)	
Conidium	Shape	Straight or slightly irregular, cylindrical to ellipsoid, apex obtuse, base truncate	Straight or slightly irregular, cylindrical to ellipsoid, apex obtuse, base truncate
	Size (μm)	12.0~24.0 \times 4.5~7.0	12.0~24.0 \times 4.0~6.0
Appressorium	Shape	Brown to dark brown, globose, ovate to clavate, sometimes lobed	No description
	Size (μm)	5.0~12.5 \times 5.0 - 7.5	No description

Table 2. Pathogenicity of *Colletotrichum malvarum* isolates on Chinese mallow plants by artificial inoculation

Isolate	Isolate source	Virulence of isolates on host plants ^a	
		Leaf	Stem
C07-01	Stem	++	+
C07-08	Leaf	++	+
C07-17	Leaf	++	+
Control		-	-

^aDisease severity was rated 10 days after inoculation. ++, a lot of lesions produced; +, a few lesions produced; -, no symptom.

C. malvarum causes leaf spots on various Malvaceae (Arx, 1970) and is known as a species specific to this family (Arx, 1981; Sutton, 1992). The fungus has been documented as a causal agent of anthracnose of Chinese mallow in Korea (Cho and Shin, 2004). Cho *et al.* (1997) briefly described the disease symptoms of Chinese mallow caused by *C. malvarum* and the morphological characteristics of the causal fungus in a compendium. However, there has been no detailed report on mycological and pathological characteristics of *C. malvarum*

causing anthracnose of Chinese mallow. In this study, mycological and pathological characteristics of *C. malvarum* causing anthracnose of Chinese mallow were clarified.

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