Plant Pathol. J. 15(1) : 72-75 (1999)

The Plant Pathology Journal

A Scab Disease Caused by *Cladosporium cucumerinum* on Watermelon Seedlings

Mi-Kyung Kwon, Jeong-Rae Hong, Baik-Ho Cho, Un-Kye Ki and Ki-Chung Kim* 권기정

Applied Plant Science Division and Institute of Biotechnology, College of Agriculture, Chonnam National University, Kwangju 500-757, Korea

(Received on January 12, 1999)

A scab disease occurred on watermelon seedlings by the infection of *Cladosporium cucumerinum*. This is the first report demonstrating the scab disease on watermelon in Korea. The casual agent attacked all plant parts of the seedlings on the ground. Infection sites were initiated with sunken and dark green spots, and then suddenly developed to large lesions softened with gummy substances. When hypocotyl and leaf stalk of seedlings were infected and softened, upper parts of seedlings were broken down, dried and eventually died. Conidiophores of the fungus were characterized by pale olivaceous brown color, and variable length of about 3-5 mm in width. Conidia were formed in long branched chains, and conidium was ellipsoidal, fusiform or subspherical single cell mostly without septum. Morphological characteristics of the fungus were almost identical to *Cladosporium cucumerinum* Ellis & Authur. The fungus was also pathogenic to cucumber, squash and oriental melon, suggesting that it is a common pathogen to cucurbits. However, the fungus was not pathogenic to bottle gourd.

Keywords **:** *Cladosporium cucumerinum*, cucurbits, pathogenicity, scab, watermelon

Cladosporium cucumerinum Ellis et Authur has been known as an important pathogen which causes scab disease in cucumber all over the world (Behr, 1948; Lee et al, 1997; Pierson and Walker, 1954; Strider and Winstead, 1961; Takanashi and Iwata, 1964; Walker, 1950). Cucumber scab caused by the fungus was previously reported (Lee et al., 1997), but watermelon scab has not been reported in Korea.

An unknown disease of watermelon seedlings occurred in greenhouses located at Kwangsan and Naju areas of Chonnam Province, Korea from February to April, 1998 (Fig. 1A). The disease incidence on watermelon seedlings grafted onto bottle gourd root reached up to 75% in severely damaged commercial greenhouses, and most infected seedlings stopped growing and were stunted. *Cladosporium cucumerinum* was the major fungus isolated from the diseased seedlings and proven to be the casual agent for the symptoms. Here we identify the casual fungus, describe symptoms of the disease, and demonstrate the fungal pathogenicity to cucurbits.

*Corresponding author.
Phone) +82-62-530-2071, Fax) +82-62-530-2079
E-mail) kckim@chonnam.chonnam.ac.kr

Materials and Methods

Fungal isolates. Leaves, hypocotyls or leaf stalks of the diseased watermelon seedlings were collected from greenhouses located at Kwangsan and Naju areas of Chonnam Province, Korea from February to April, 1998. Greenish black fungal colonies were isolated from the diseased tissues, and single-spored and maintained on potato dextrose agar (PDA). To characterize the morphology of the fungus on PDA, the isolates were incubated under darkness at 20°C for 5 days. Three isolates from watermelon (CW9801, CW9802 and CW9810), an isolate obtained from Chonnam Agricultural Research and Extension Services (JW9802), and two scab pathogens from cucumber (JC9702) and oriental melon (JS9802) were used in the experiment.

Plants. A watermelon seed was sown in each paper pot of 5 cm in diameter containing sterilized medium (peat moss:vermiculite=4:1, v/v) and maintained in a growth chamber (20°C, 30,000 lux, 16hr light/8hr dark, RH 50-60%) until the first leaf was fully expanded. Water and nutrient solution (Hyponex, 100 times diluted) were supplied appropriately during the growth period.

Characterization of the fungal morphology. Morphological characteristics of the fungus were examined with light microscopy. A slide culture method was applied to investigate the formation of conidium on conidiophore.

Pathogenicity test. Pathogenicity of the four *C. cucumerinum* isolates from watermelon, a cucumber scab isolate JC9702 and a oriental melon scab isolate JS9802 were tested on watermelon, cucumber, oriental melon, squash and bottle gourd. The cucurbit seedlings of which first leaves were fully expanded, were washed with sterilized water and then sprayed with a suspension (10^6 conidia/ml) until run-off. The inoculated plants were transferred to a dew chamber (20°C), maintained for 24 hr and then replaced to the growth chamber. Three days after inoculation, the infection rate was scored by mean value (5 plants for each treatment) into 4 scales. The rate was expressed by percent of lesion area (−, no lesion; +, 1-25%; ++, 26-75%; +++, completely destroyed).

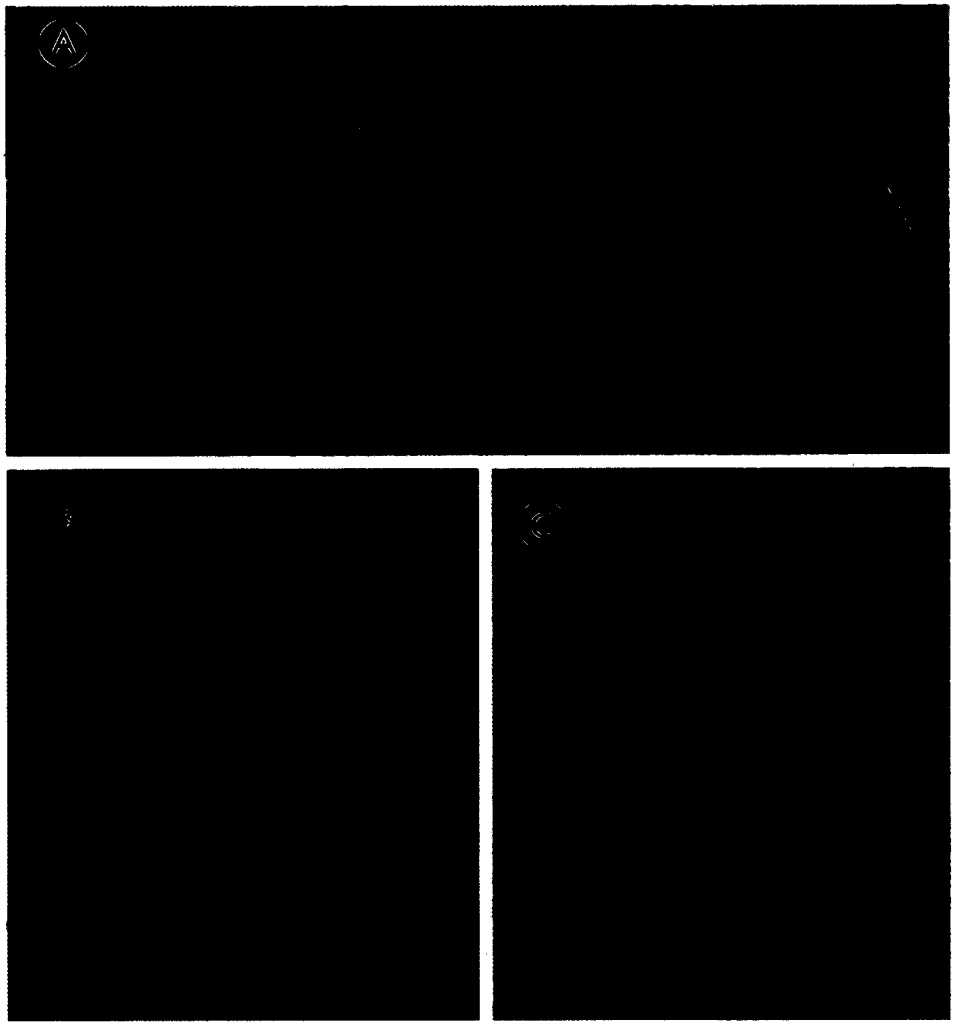

Fig. 1. (A) Watermelon seedlings seriously damaged by the infection of *Cladosporium cucumerinum* on pot-culture bed in a greenhouse. (B) Concave brown spots developed on hypocotyl and leaf stalk of a watermelon seedling. (C) Conidiophore, ramoconidia and conidia of *Cladosporium cucumerinum* produced by slide culture method.

Results

Symptom. Symptoms appeared on all plant parts (sprout, leaf, leaf stalk and hypocotyl) of watermelon seedlings on the ground, and/or of the watermelon scion grafted on bottle gourd root stock. Infection sites were initiated with sunken and dark green spots, and then rapidly developed to large lesions. When the environmental conditions were favorable for the disease development as humid and cold, gummy substances were exuded. If the environments were dry and hot, however, the lesions were not developed further and remained small and brownish (Fig. 1B). When hypocotyl and leaf stalk of seedlings were infected and softened, upper parts of seedlings were broken down, dried and eventually died. When greenish black fungal colonies appeared on the lesions, the plant stopped growing and was stunted. Such symptoms did not appear on the leaves of bottle gourd root stock or bottle gourd seedlings.

Identification of the pathogen. Since mycological characteristics of all the isolates were proven to be very similar (Table 1), the morphology of the CW9802 isolate is described as a representative in Table 2. The fungal conidiophore was characterized by pale olivaceous brown color, and variable length of about 3~5 μm in width. The ramoconidium was mostly single cell showing 9.0-27.5×2.5-5.0 μm (mean value, 15.2×4.3 μm) in length with 0~2 septa (Fig. 1C). Conidia were formed in long branched chains, and conidium was ellipsoidal, fusiform or subspherical single cell mostly without septum (occasionally with 1 septum). The length of the conidium was 5-25×2-6 μm (mean value, 10.6 ×4.1 μm). Colonies on PDA was densely packed with greenish black color. These morphological characteristics of the isolate were almost identical to *Cla-*

Table 1. Morphological characteristics of *Cladosporium* spp. isolated from watermelon seedlings and other cucurbit plants

Isolate	Host	Width of conidiophore (μm)	Ramoconidium		Conidium		
			Size (μm)	Septum	Size (μm)	Septum	Shape
CW9801	Watermelon	3~5	8.8-25.0×2.5-5.0(16.9×4.1) X[a]	0~2	5.0-16.9×2.5-5.0(8.3×3.3) X[a]	0~1	ellipsoidal, fusiform
CW9802	Watermelon	3~5	9.0-27.5×2.5-5.0(15.2×4.3) X	0~2	5.0-25.0×2.0-6.0(10.6×4.1) X	0~1	ellipsoidal, fusiform
CW9810	Watermelon	3~5	10.0-22.5×3.0-5.0(17.2×4.4) X	0~2	5.3-20.0×2.8-5.0(11.0×4.1) X	0~1	ellipsoidal, fusiform
JW9802	Watermelon	3~5	7.5-28.83×.0-5.0(16.8×4.3) X	0~2	5.0-20.0×2.5-5.0(9.7×3.7) X	0~1	ellipsoidal, fusiform
JC9702	Cucumber	3~5	7.5-27.0×3.0-5.0(13.6×4.2) X	0~2	5.5-25.0×2.8-5.0(9.1×3.7) X	0~1	ellipsoidal, fusiform
JS9802	Squash	3~5	7.0-25.0×3.0-5.0(16.3×4.2) X	0~2	4.5-25.0×2.0-6.0(8.7×3.5) X	0~1	ellipsoidal, fusiform

[a]Mean separation within column by Duncan's multiple range test, P=0.05.

Table 2. Morphological characteristics of a fungal isolate CW9802 (*Cladosporium cucumerinum*) from watermelon seedlings obtained in the present study

Morphological feature	Isolate CW9802	*C. cucumerinum*[a]
Colony color	greenish black, velvety	greenish black, velvety
Conidiophore		
color	pale olivaceous brown	pale olivaceous brown
length	7~380 μm	8~400 μm
width	3~5 μm	3~5 μm
Ramoconidium		
color	pale olivaceous brown	pale olivaceous brown
size	9-27.5×2.5-5 μm	30×3-5 μm
no. of septa	0~2 μm	0~2 μm
Conidium		
color	pale oivaceous brown	pale olivaceous brown
size	5-25×2-6 μm	4-25×2-6 μm
no. of septa	0~1 μm	0~1 μm
shape	ellipsoidal, fusiform	ellipsoidal, fusiform

[a]CMI Descriptions of Pathogenic Fungi and Bacteria No.348.

Table 3. Pathogenicity of isolated *Cladosporium* spp. on cucurbit plants

Isolate	Host plant isolated	Disease severity[a]				
		Watermelon	Cucumber	Oriental melon	Squash	Bottle gourd
CW9801	watermelon	+++	+++	+++	+++	−
CW9802	warermelon	+++	+++	+++	+++	−
CW9810	watermelon	+++	+++	+++	++	−
JW9802	watermelon	++	+++	++	++	−
JC9702	cucumber	+++	+++	++	++	−
JS9802	squash	++	+	+	++	−

[a]+++, completely destroyed; ++, severely infected; +, mildly infected; −, no infection.

dosporium cucumerinum (CMI description) (Ellis and Hollyday, 1972). Accordingly, we identify the casual agent *Cladosporium cucumerinum* Ellis & Authur.

Pathogenicity. All the isolates caused scab disease on watermelon, cucumber, squash and oriental melon, although JS9802 was less pathogenic to cucumber and oriental melon than to watermelon and squash. However, no isolates caused the disease on bottle gourd (Table 3).

Discussion

Cucumber scab has been known as a serious disease in the temperate region such as north USA, south Canada, north Europe and Sakhalin island of Russia (Behr, 1948; Takanashi and Iwata, 1964; Walker, 1950). However, the disease emerged as an important one in Korea located in temperate zone since the plants had been cultivated in the greenhouse during winter in which the environmental conditions are favorable for the growth of *C. cucumerinum*.

Scab disease has been reported in cucumber, squash and oriental melon in Korea (Cho et al., 1997; Kwon et al., 1996; Lee et al., 1997), in cucumber and pumpkin in Japan (Common Names of Economic Plant Diseases in Japan, 1980), and in cucumber, pumpkin, melon and watermelon in the U.S.A. (Farr et al., 1989). Because physiological variation of the pathogen has not been reported, *C. cucumerinum* may be a common pathogen to the cucurbit plants although bottle gourd was proven to be resistant in this experiment.

Watermelon was generally cultivated in the field during summer in Korea in the past and watermelon scab has not been noticed probably because of the disease escaping. Environmental conditions (very hot and dry) may not be favorable for growth of the scab pathogen in the field. Since greenhouse culture of watermelon as well as cucumber has been becoming widespread, occurrence of the scab disease on the plants might be expected.

In greenhouses, plants severely damaged by the pathogen in Kwangsan and Naju areas are grown under the plastic tunnel on which the thick woven texture is covered to protect drop of temperature especially during the night. During the daytime when the weather is cloudy and rainy for several days, the plants grown under the plastic film and woven texture are wetted for a long time. The plants are grown under the plastic film and woven texture in the greenhouse in which air temperature is over 25°C by heating. However, the soil temperature in not raised over 16°C even in the afternoon because air circulation is prevented by the plastic tunnel. Therefore, environmental conditions for the plant growth are humid and cold for a long time. *Cladosporium*

cucumerinum has a good growth, causing epidemics in such environmental conditions (Lee et al., 1997; Takanashi and Iwata, 1964). In addition, soil was not sterilized although watermelon had been cultivated for several years in the greenhouse.

Environmental factors favorable for the growth of *C. cucumerinum* in a greenhouse are high humidity and low soil temperature. Therefore, maintenance of the greenhouse not to be humid and cold is very important to avoid the disease. Humidity may be easily controlled simply by opening the plastic film frequently or by ventilation. The main problem is the maintenance of the soil temperature to be warm during winter. Heating by electric fan has widely used for agriculture in Korea. In the greenhouse, air temperature is easily heated by the electric fan, but diffusion of the warm air into soil is ineffective (Ki and Kim, 1985). Therefore, growth of cucurbit seedlings in the confined area where electric coil is constructed under the ground or composts are buried for heating, is recommended to protect the disease.

References

Behr, L. 1948. Histologische Untersuchungen an Kraetzekranken Gurken (*Cucumis sativus* L.) unter besonderer Beruchsichtigung des Kranksheitsverlaufes der Kraetze (*Cladosporium cucumerinum* Ell. et Arth.) an Fruchten. *Phytopathol. Z.* 15: 92-123 (in German).

Cho, W. D., Kim, W. G., Jee, H. J., Choi, H. S., Lee, S. D. and Choi, Y. C. Compendium of vegetable diseases with color plates. National Institute of Agricultural Science and Technology. 447pp (in Korean).

Ellis, M. B. and Holliday, P. 1972. *Cladosporium cucumerinum.* CMI Descriptions of Pathogenic Fungi and Bacteria, No. 348.

Farr, D. F., Bills, G. F., Chamuris, G. P. and Roseman, A. Y. 1989. Fungi on Plants and Plant Products in the United States, pp.146-147. APS Press, St. Paul, Minn.

Ki, U. K. and Kim, K. C. 1985. Possibility of soil solarization in Korea. *Korean J. Plant Prot.* 24:107-114 (in Korean).

Kwon, T. Y., Lim, Y. S., Jung, K. C., Kim, E. H. and Seo, S. J. 1996. Disease survey, pathogen characteristics, pathogenicity and fungicide selection of oriental melon scab (*Cladosporium cucumerinum*). *Korean J. Plant Pathol.* 12:500-501 (Abstr.) (in Korean).

Lee, K. Y., Youn, K. H., Kang, H. J., Ahn, K. S., Min, K. B. and Cha, B. J. 1997. Cucumber scab caused by *Cladosporium cucumerinum* in Korea. *Korean J. Plant Pathol.* 13:288-294 (in Korean).

Pierson, C. F. and Walker, J. C. 1954. Relation of *Cladosporium cucumerinum* to susceptible and resistant cucumber tissue. *Phytopathology* 44: 459-465.

Takanashi, K. and Iwata, Y. 1964. Relations of temperature and humidity in the disease incidence of cucumber scab. *Plant Protection* 18:139-143 (in Japanese).

Walker, J. C. 1950. Environment and host resistance in relation to cucumber scab. *Phytopathology* 40:1094-1102.