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Occurrence of Sword bean Scab Caused by *Cladosporium cucumerinum* in Korea

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A black scab disease occurred on sword bean (*Canavalia gladiata*) in plastic film houses around Chinju area during the spring season of 1999. The disease started from flower bud, then moved to flower stalk, pod, petiole, cirrus, stem and leaves. The lesions started with small dark brown spots then were gradually expanded. Severely infected plants reached 37.4% of whole plant covered with scab. Numerous conidia were produced on the diseased flower disk, pod, floral axis, stem and leaves. Most of the conidia were appeared to be readily dispersed in the air, but the mycelia were not suggested causing of sooty mold by ectoparasitism. A fungus was isolated from the diseased stem, and inoculated to healthy plants to satisfy the Koch's postulates and proved the fungus was the causal agent of the disease. The isolated fungus grew on potato dextrose agar, forming greenish black to pale brown colonies. Conidia were ellipsoidal, fusiform or subspherical, mostly one-celled but occasionally septated, The conidia were 3.9~34.1×2.7~5.1 μm in size and formed in long branched chains on the erected conidiophores which were pale olivaceous brown and variable in length between 7.2~210.7 μm in size. Ramoconidia were 7.6~29.2×3.2~14.4 μm in size. The fungus was identified as *Cladosporium cucumerinum* based on the above morphological characteristics. The optimum temperature for mycelial growth and conidial formation was about 15 to 25°C. *Cladosporium* scab of sword bean caused by the fungi has not been reported in Korea previously.

KEYWORDS: ***Cladosporium cucumerinum*, Sword bean, Scab**

Cladosporium cucumerinum Ellis Arthur has been known as an important pathogen in vegetable crops including cucumber which causes a scab disease all over the world (Lee *et al.*, 1997), but the disease has not reported in sword bean in Korea (The Korean Society of Plant Pathology, 1998). In the spring season of 1999, a disease suspected as black scab in sword bean was found in greenhouses around Chinju area. The infection rate of the disease in some greenhouses reached to 37.4% and the damage was quite severe in certain scab. Through this study, we tried to identify the causal organism and characterized the scab disease of sword bean.

Diseased stems were collected from sword bean growing in the greenhouses at Chinju in the spring season of 1999. From mycelial tip of the diseased stem, greenish black fungal colonies were isolated and cultured on potato dextrose agar. This fungus was incubated in the dark at 25°C until used. Mycelium, conidia, ramoconidia and conidiophores were carefully observed under the light microscope (Nikon Fluophot, Japan). The mycelial growth of the fungus and the germination of conidia at various temperatures were examined.

The symptoms appeared on the flower bud, flower stalk, pod, petiole, cirrus, stem and leaves of sword bean (Fig. 1A~F).

The typical symptom of the disease was greenish to black or brown sooty on lesions. The infected tissue were usually surrounded by greenish to black or brown sooty on lesions. In inoculated plants, the lesions were mostly developed on the young or old plants with sunken and dark soot, followed by small and irregular lesion formation. Early symptoms appeared 7 days after inoculation. When the environmental conditions were humid and cool, the disease was favorable to development and gummy substances were exuded. But no symptoms appeared on sword bean if the weather conditions become dry and hot. The lesions formed previously were not developed further and remained small brownish soot. When seedlings of watermelon, cucumber and pumpkin were inoculated artificially, upper parts of the seedlings were softened, broken down, dried and eventually dead.

The mycological characteristics of the isolates collected from diseased sword beans were not greatly different from those reported previously (Table 1).

Colonies on PDA were densely packed with greenish black color. The conidia were formed in long branched chains, and conidium was variable in shape and size, ovoid to cylindrical and irregular, some typically lemon shaped, ellipsoidal, fusiform or subspherical single-celled, mostly aseptate but occasionally 1-septate. The length of the conidium was 3.9~34.1×2.7~5.1 μm (Fig. 2A).

The conidiophore was pale olivaceous brown, smooth, tall, dark, upright, branched variously near the apex, clustered or single, and variable in size of about 7.2×210.7 μm (Fig. 2B).

The ramoconidium was mostly single -celled, showing 7.6~29.2×3.2~14.4 μm in size with 0~2 septa (Fig. 2C).

The morphological characteristics of the isolate were almost identical to *Cladosporium cucumerinum* (Ellis and

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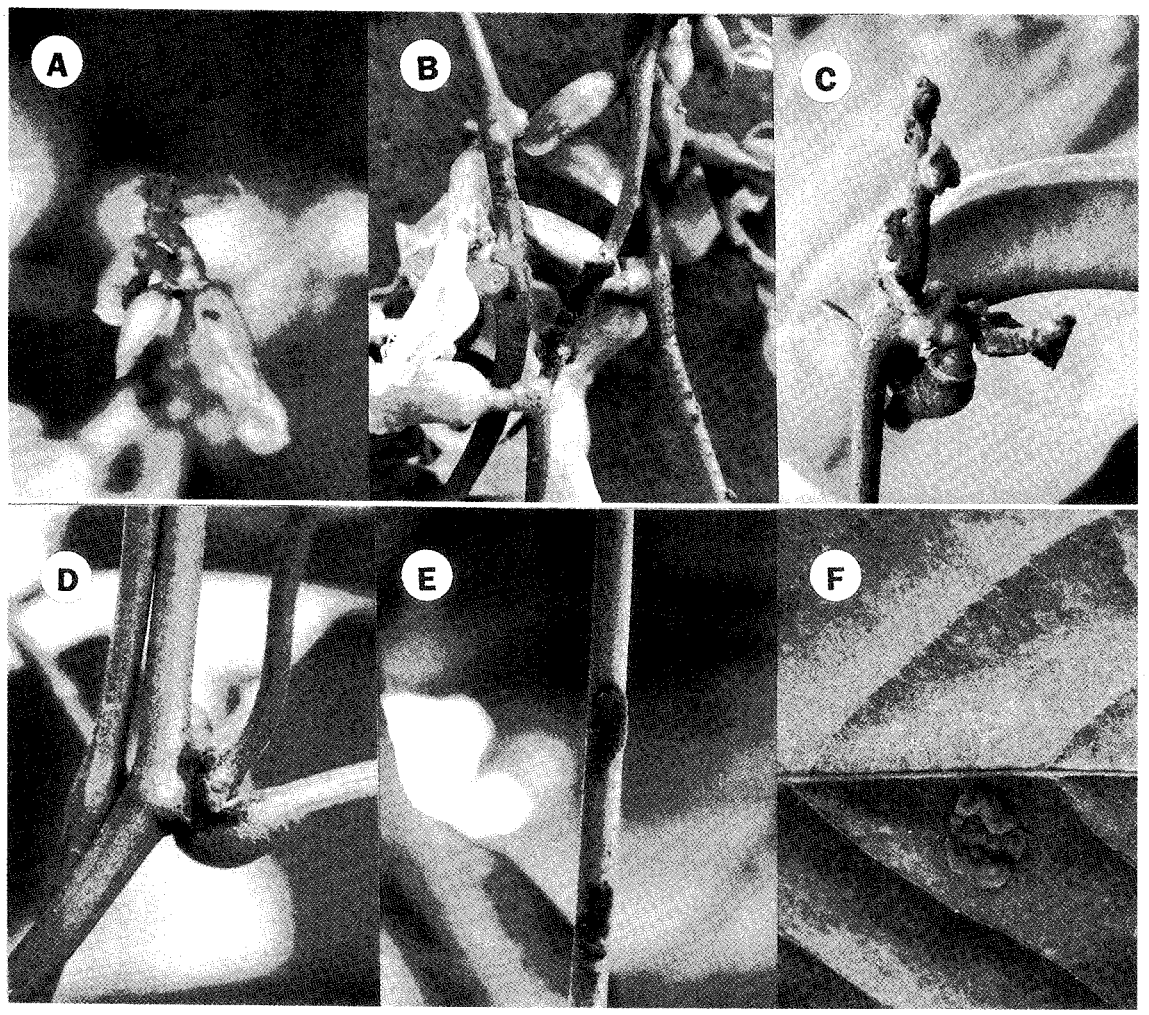

Fig. 1. Symptoms of sword bean scab by *Cladosporium cucumerinum*. Dark brown sooty surrounded by greenish black fungal on the flower bud (A), flower stalk (B), pod (C), cirrus and petiole (D), stem (E), leaf surfaces (F).

Table 1. Comparison of morphological characteristics between pathogenic fungus of scab disease of sword bean and *Cladosporium cucumerinum* described by Ellis

Morpholgical feature	Present study	*C. cucumerinum*[a)]
Colony color	greenish black, velvety	greenish black, velvety
Conidium		
color	pale olivaceous brown	pale olivaceous brown
size	3.9~34.1×2.7~5.1 μm	4~25×2~6 μm
septa	0~1	0~1
shape	ellipsoidal, fusiform	ellipsoidal, fusiform
Ramoconidium		
color	pale olivaceous brown	pale olivaceous brown
size	7.6~29.2×3.2~14.4 μm	30×3~5 μm
septa	0~2	0~2
Conidiophore		
color	pale olivaceous brown	pale olivaceous brown
length	7.2×210.7 μm	8~400 μm
width	2.7~5.9 μm	3~5 μm

[a)]Described by Ellis (1972).

Holliday, 1972). Accordingly, we identified the casual agent as *Cladosporium cucumerinum* Ellis & Arthur.

The maximum temperature for mycelial growth was 35°C. The minimum growth temperature was 5°C for most isolates. Optimum growth temperature was 15~25°C (Table 2).

All of the isolates successfully induced the typical scab symptoms on sword bean.

Characteristic spots were appeared on the infection 7 days after inoculation with conidial suspension. The symptoms were almost identical to those of naturally infected all plants. The isolated of *C. cucumerinum* weaked symptoms on sword bean. The infected flower disk, pod, floral axis and stem appeared black sooty first. Morphological characteristics of the conidia and mycelia of the fungi that were reisolated from inoculated plants were same as those of naturally infected flower flower bud, flower stalk, pod, petiole, cirrus, stem and leaves.

Cladosporium diseases are probably the most common and most widely distributed disease of vegetable, fruits, and

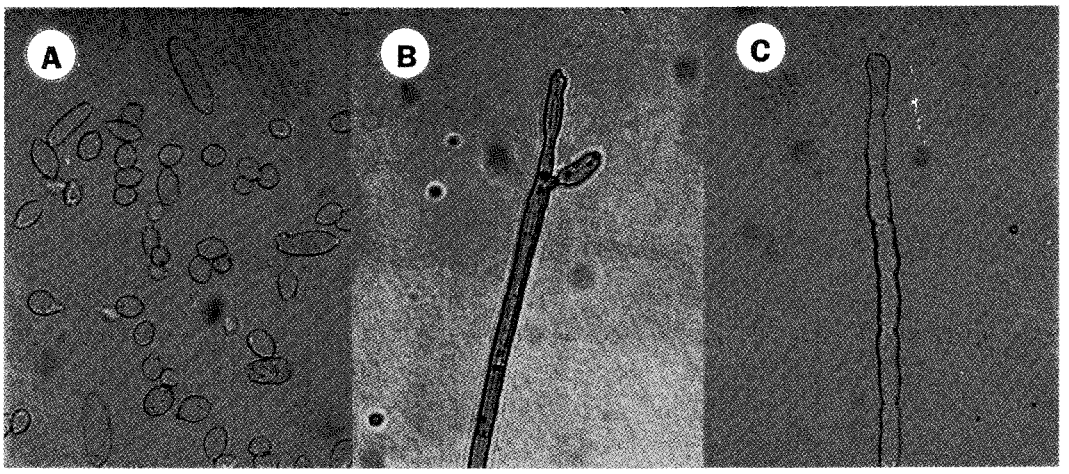

Fig. 2. Morphological characteristics of sword bean scab by *Cladosporium cucumerinum*. A: Conidia, B: Conidiophores, C: Ramoconidia.

Table 2. Effect of temperature on mycelial growth of *Cladosporium cucumerinum*, the causal fungus of sword bean scab

Investigated	Unit	Temperature (°C)							
		0	5	10	15	20	25	30	35
Mycelial growth	(mm)	0	31.8	58.1	83.3	86.7	90.0	56.6	0.0

[a]Mycelial growth was measured 22 days of incubation.

even some field crops throught the world. They are the most common diseases of green house-growth crops. Under humid conditions, the fungus produces a noticeable dark brown mold lesions on the affected tissues that is characteristic of the *Cladosporium* diseases. The fungus requires cool, damp weather for best growth, sporulation, spore realease and germination, and establishment of infection. The pathogen is active at low temperatures and high humidity. The scab disease of sword bean can cause disease by just covering the surface of the plant without deep penetration into the plant, that cause interfere of photosynthesis by ectoparasitism and attracts saprophytic organisms.

The scab diseases caused by *C. cucumerinum* in cucumber, watermelon, pumpkin and oriental melon have been already reported in Korea (Cho *et al.*, 1997; Kwon *et al.*, 1999; Lee *et al.*, 1997). But there have been no records of diseases on sword bean in Korea (The Korean Society of Plant Pathology, 1998). This may partially because the environmental conditions of sword bean-growing fields are not favorable for growth of the scab fungus. Generally, sword bean is cultivating in open fields during the summer in Korea, in which the weather is usually hot and dry. However, when the sword bean are cultivating in greenhouses or vinyl houses, the occurrence of the scab disease of sword bean was expected. Therefore, environmental conditions for the plant growth are humid and cool for extended period of time. *C. cucumerinum* grow abundantly and cause epidemics in such an environmental condition (Lee *et al.*, 1997).

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