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Leaf and Stem Blight on Columbine and Bleeding Heart Caused by *Streptobotrys caulophylli*

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A survey on ornamental diseases in 2000 and 2001 showed frequent occurrence of blight symptoms on leaves and stems of columbine and bleeding heart in botanical gardens of Gangwon and Chungnam provinces in Korea. A total of 65 isolates of *Streptobotrys* sp. were obtained from the infected leaves and stems of the two plants. All isolates were identified as *Streptobotrys caulophylli* based on their morphological and cultural characteristics. Blight symptoms were induced on leaves of the two plants by artificial inoculation with the isolates. This is the first report that *S. caulophylli* causes leaf and stem blight on columbine and bleeding heart in the world.

Keywords : Bleeding heart, Blight, Columbine, *Streptobotrys cauphylli*

Columbine [*Aquilegia buergeriana* var. *oxysepala* (Trautv. et Meyer) Kitamura] and bleeding heart [*Dicentra spectabilis* (L.) Lem.] are distributed in the temperate regions of the northern hemisphere (Lee, 1996). They are cultivated as ornamental garden flowers in Korea. Blight symptoms were frequently observed on their leaves and stems growing in several botanical gardens of Gangwon and Chungnam provinces in Korea during a survey on ornamental flower diseases in 2000 and 2001. The disease incidence in the two plants reached up to 80% in some botanical gardens (Table 1).

Lesions on leaves of columbine appeared as pale purple to brown spots with dark purple margins (Figs. 1A to C). The disease usually began on the leaf margins and progressed to the central portions. Sometimes, dark brown molds appeared on the entire leaves. In humid condition, the spotted lesions enlarged rapidly, and produced water-soaked lesions on the leaves. The diseased stems were brownish and rotten at the point of infection followed by withering of the plants above the lesion. Lesions on leaves of bleeding heart appeared as dark brown leaf blight with haloes at the margins (Figs. D to F). A total of 65 isolates of *Streptobotrys* sp. were obtained from the infected leaves and stems of the two plants.

Conidiophores of the fungus were erect, repetitively branching at about two-thirds from the basal portion, with an almost unswollen basal cell and usually 1.0-1.2 mm but up to 2 mm long (Fig. 2A). Their stipes were cylindrical, brown, usually 10 to 15 septate and 8-12 μm wide. The walls of branches were characteristically tightly twisted streptoform (Fig. 2B and D). Conidiogenous cells were somewhat inflated at the apics of the branches and delimited by septum (Fig. 2B and C). Conidia were borne in botryose clusters on the short pedicels of conidiogenous cells, globose to subglobose, pale brown, unicellular, warty in surface and measured 6.5-18.0 μm (mostly 8-14 μm) in diameter (Fig. 2B to D).

Sclerotia were usually produced along veins of diseased leaves and measured 0.3-0.7 × 0.4-1.5 mm (Fig 2G and H). Colonies on potato dextrose agar (PDA) at 24 °C consisted of sparse whitish gray mycelium, but produced small black sclerotia within 4 to 8 days (Fig. 2I). Sclerotia produced on PDA were round or oval to oblong and measured 0.6-1.7

Table 1. Occurrence of leaf and stem blight in major cultivation areas of columbine and bleeding heart in botanical gardens in Korea from 2000 to 2001

Plant	Province	Location	Plant diseased (%)	
			Average	Range
Columbine	Gangwon	Hongcheon	25	20-40
		Pyungchang	30	20-80
		Gapyung	15	5-30
		Yangpyung	20	10-50
		Inje	10	0-20
	Chungnam	Taean	5	0-15
Bleeding heart	Gangwon	Chuncheon	1	0-5
		Pyungchang	20	10-80

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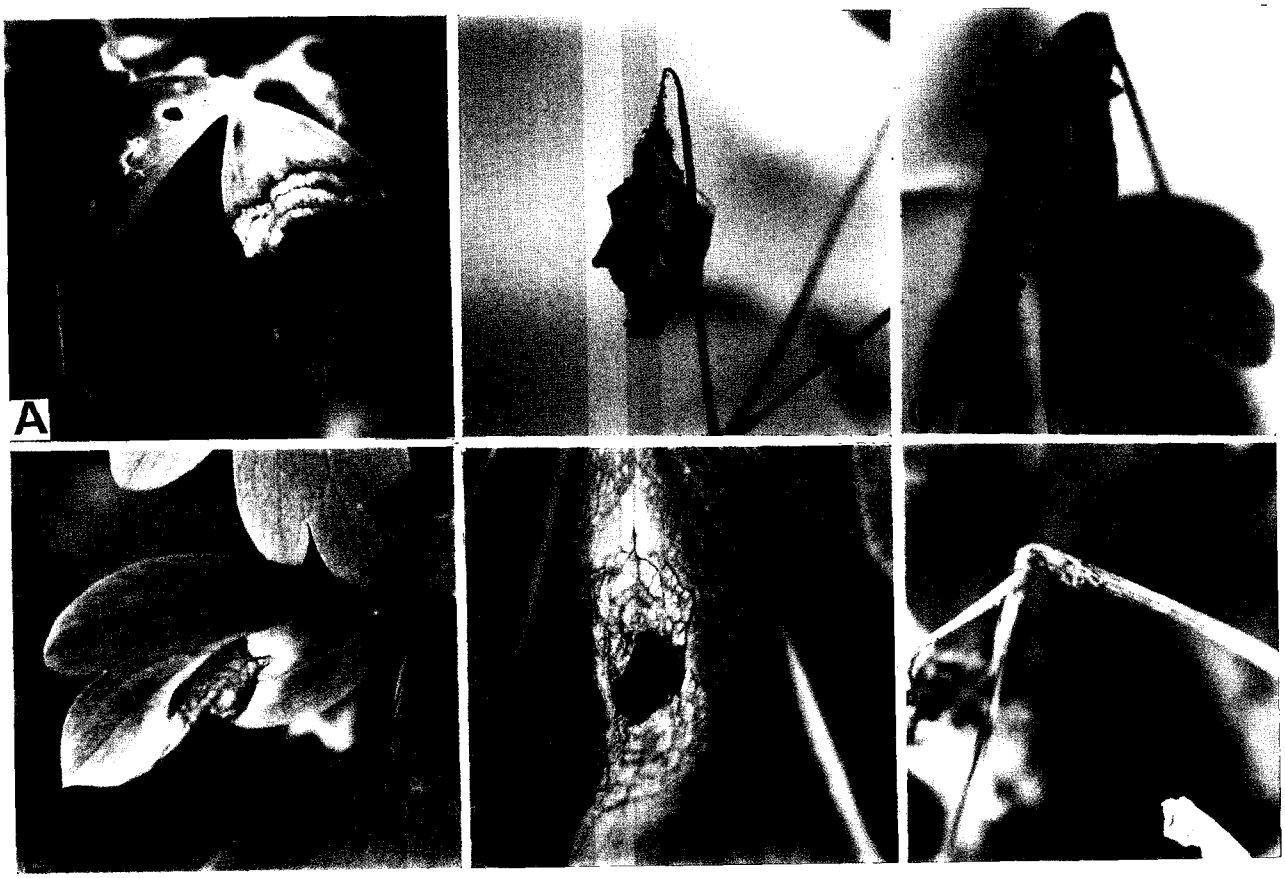

Fig. 1. Symptoms of blight on leaves and stems of columbine (A to C) and bleeding heart (D to F).

× 0.8-1.7 mm. A cross section of a sclerotium showed a poorly developed rind enclosing thin-walled medullary hyphae. Conidiophores were rarely produced at the margins of PDA plates. In this study, all the isolates were identified as *S. caulophylli* Hennebert based on their morphological and cultural characteristics (Table 2).

To prove pathogenicity of *S. caulophylli* to columbine and bleeding heart, three isolates of the fungus B0050, B0081, and B0094 were used. Mycelial plugs of each isolate were transferred to PDA in plastic petri dishes. The cultures were incubated at 21°C in darkness for 3 days and then illuminated under 12 h NUV/12 h dark light for 5 days.

Conidial suspension ($3\text{-}5 \times 10^6$/ml) was made by flooding the cultures with 10% supernatant of V-8 juice. About 30 ml of the conidial suspensions of each isolate was sprayed onto the leaves and stems of the two host plants. Inoculated plants were placed in a dew chamber at 21°C for 48 hr for disease development and then moved into a greenhouse. Control plants were sprayed with only 10% clarified V-8 juice. All the inoculated isolates induced blight symptoms on leaves and stems of the two plants but no symptoms on the control plants.

The genus *Streptobotrys* was erected by Hennebert (1973) to accommodate the conidial state of the genus *Streptotinia,* and differentiated from other *Botrytis* and *Botrytis*-like fungi by having the conidiophores with spirally twisted streptoform branches (Hennebert, 1973; Whetzel, 1945). The *Botrytis*-like fungus with streptoform branches has been recorded from many plants of Araceae, Leonticaceae, Papaveraceae and Ranunculaceae in U.S.A. and Canada (Conners, 1967; Farr et al., 1989; Ginns, 1986; Grand et al., 1975; Whetzel, 1945).

S. caulophylli occurs on many plants including *Caulophyllum thalictroides* (L.) Michx. (Conners, 1967; Ginns, 1986; Elliot, 1962, 1969). *Streptobotrys* species reported besides *S. caulophylli* are *S. arisaemae* Hennebert (now *S. arisaematis*) on *Arisaema triphyllum* (L.) Schott (Grand et al., 1975; Whetzel, 1945) and *S. streptothrix* (Cooke & Ellis) Hennebert on *Orontium* sp. (Farr et al., 1989; Hennebert, 1973). *Streptobotrys* species can be distinguished by their conidial size (Table 2). However, the conidial size varied among the isolates from columbine and bleeding heart. The conidia from the columbine collections had a spore range of 6.5-13 μm. (mostly 8-12 μm), and those from bleeding heart collections, 11-15 μm (very rarely 18 μm). Although Elliot (1962) described *S.*

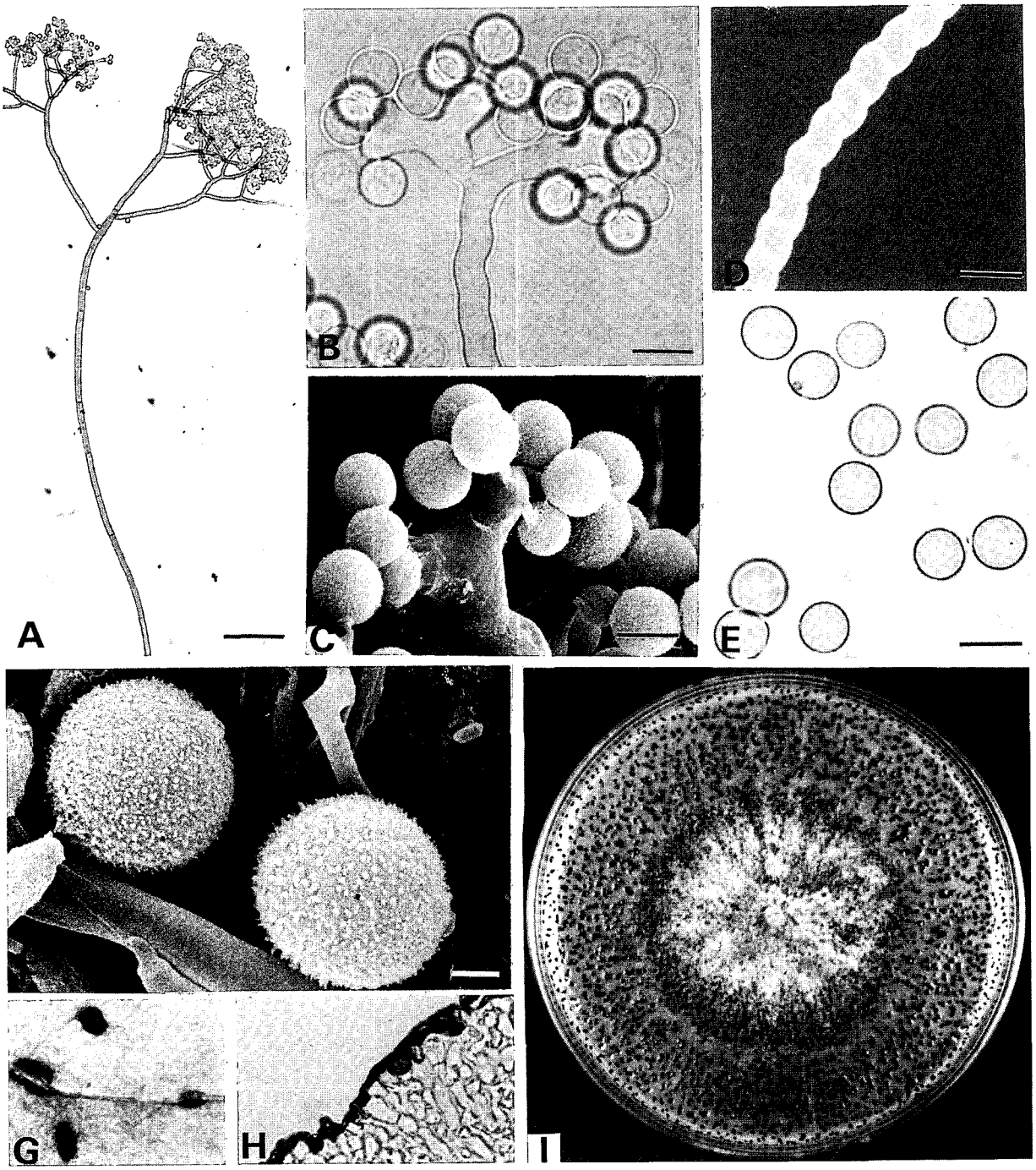

Fig. 2. Morphological and cultural features of *Streptobotrys caulophylli* isolated from leaves and stems of columbine and bleeding heart. A to C, Conidiophores bearing conidia (Scale bar in A=50 μm, B=16 μm, C=10 μm); D, conidiophore with tightly twisted streptoform branch (scale bar=10 μm); E, conidia (scale bar=15 μm); F, conidia under scanning electron microscope (scale bar=3 μm); G, sclerotia on leaf veins; H, cross section of a sclerotium; I, colony with sclerotia on PDA.

conidia measuring 6-9.5 μm from *Caulophyllum thalictroides*, he also described *S. caulophylli* isolates having a spore range of 5.5-13.0 μm from several other host collections, including *C. thalictroides* (Elliot, 1969).

Based on this study, we concluded that the conidial sizes of *Streptobotrys* isolates from columbine and bleeding heart matched those of *S. caulophylli* isolates from several host plants reported previously.

There have been no previous reports of *Streptobotrys* spp. on columbine and bleeding heart. Therefore, this is the first

Table 2. Morphological characteristics of *Streptobotrys caulophylli* compared with other *Streptobotrys* species

Characters	*Streptobotrys* sp.	*S. caulophylli* (Elliot, 1962)	*S. arisaemae* (Whetzel, 1945)	*S. streptothrix* (Hennebert, 1973)
Conidiophores				
Branching	Alternate	Alternate	Alternate	Alternate
Branch contour	Streptoform	Streptoform	Streptoform	Streptoform
Color	Pale brown	Olivaceous brown	Reddish brown	Brown
Conidia				
Shape	Globose to subglobose	Globose to subglobose	Globose	Globose
Surface	Warty	Minutely echinulate	Smooth	Smooth
Color	Pale brown	Pale olivaceous brown	Hyaline to tinted	Subhyaline to brown
Size (μm)	(6.5-)8-14(-18)	6.0-9.0(-9.5)	6-7	18
Sclerotia				
Shape	Round to oblong	Round to oblong	Round to oblong	-
Color	Black	Black	Black	-
Size (mm)	0.3-0.7 × 0.4-1.5	0.5-1.0 × 0.5-2.0	< 0.5	Small

report of leaf and stem blight on columbine and bleeding heart caused by *S. caulophylli* in the world.

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