

Taxonomic Studies on *Cercospora* and Allied Genera in Korea (VIII)

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한국산 *Cercospora* 및 관련 속의 분류학적 연구(VIII)

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ABSTRACT: This paper is the eighth contribution towards taxonomic studies on *Cercospora* and allied genera, and contains ten species of Korean cercosporoid fungi; viz., *Cercospora brassicicola*, *C. flagellaris*, *C. sesami*, *C. zinniae*, *Passalora amurensis*, *Pseudocercospora balsaminae*, *P. humuli*, *P. puderi*, *P. salicina*, and *Stenella dianthi*. Morphological characteristics of taxonomic value are described and illustrated for these species to contribute towards a mycological monograph of Korean cercosporoid fungi.

KEYWORDS: *Cercospora*, *Passalora*, *Pseudocercospora*, *Stenella*, Monograph

Seventy cercosporoid fungi from Korea, comprising 26 *Cercospora*, one *Cercosporella*, one *Distocercospora*, two *Mycovellosiella*, two *Neoramularia*, four *Passalora*, one *Phaeoisariopsis*, one *Phacellium*, one *Phaeoramularia*, 19 *Pseudocercospora*, three *Pseudocercosporella*, and nine *Ramularia* species were treated in previous contributions of this series (Kim and Shin, 1998a, 1998b, 1998c, 1998d, 1999a, 1999b, 1999c). The present paper deals with ten additional cercosporoid taxa from Korea, namely four *Cercospora*, one *Passalora*, four *Pseudocercospora*, and one *Ramularia* species that are described and illustrated. The specimens examined are preserved at the mycological herbarium (SMK) of the Department of Agricultural Biology, Korea University, Seoul, Korea.

Descriptions

1. *Cercospora brassicicola* Henn., Bot. Jahrb. 37: 166 (1906) Fig. 1
= *Cercospora bloxami* (Berk. & Broome) E. Young, Mycologia 8: 43 (1916)
= *Cercospora brassicae-campestris* Rangel, Arch. Mus. Nacion., Rio de Janeiro 18: 163 (1917)
= *Cercospora brassicae-junceae* Sawada, in Manuscr. (1944) nom. nud.!

Leaf spots amphigenous, scattered to confluent, indistinct, subcircular to irregular, fairly large, up to 10 mm diam., pale yellowish to tan centres with indefinite margins.

Caespituli amphigenous. **Mycelium** internal, hyphae septate, branched, hyaline. **Stromata** small, rudimentary to slightly developed, subglobular, brown to dark brown, 10~20 μ m diam., composed of several brown hyphal cells. **Conidiophores** 2~15 in a loose fascicle, olivaceous brown or paler towards the upper portion, substraight to slightly

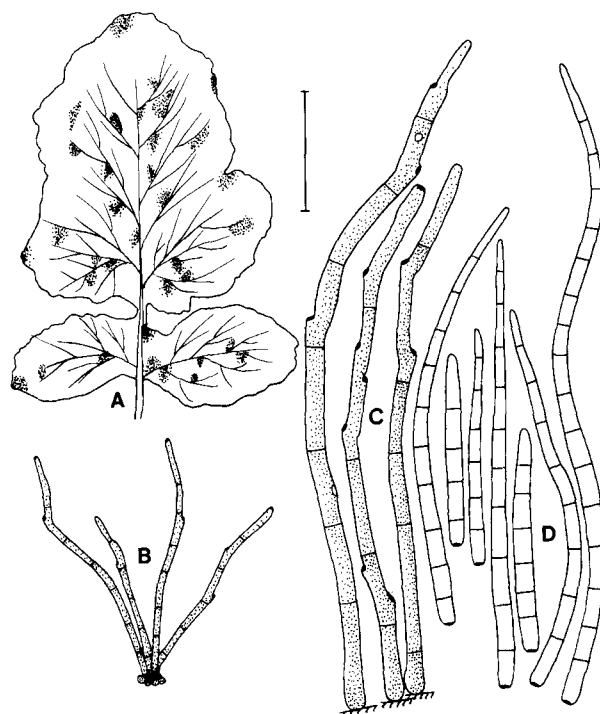


Fig. 1. *Cercospora brassicicola*. (A) Leaf spots on the upper leaf surface of *Matthiola incarna* (0.3 \times). (B) and (C) Conidiophores. (D) Conidia. Bar = 30 μ m (but 75 μ m for B).

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curved, usually not branched, but very rarely branched, 1~6 times mildly geniculate, 3~7-septate, $40\sim300\times4.0\sim6.5\ \mu\text{m}$; conidial scars large, $2.5\sim3.5\ \mu\text{m}$ wide, conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, filiform to acicular-filiform, shorter ones obclavate-cylindric, straight to mildly curved or somewhat undulate in long ones, hyaline, 3~20-septate, non-constricted at the septa, obtuse to subobtuse at the apex, truncate to subtruncate at the base, very variable in length, $45\sim220\times4.0\sim6.0\ \mu\text{m}$; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Matthiola incana* (L.) R. Br. and *Raphanus sativus* var. *hortensis* for. *acanthiformis* Makino (Cruciferae).

Specimens examined: On *Matthiola incana*, SMK 13252 (27 X 1994, Kangnung); on *Raphanus sativus* var. *hortensis* for. *acanthiformis*, SMK 14306 (27 IX 1997, Chunchon).

Distribution: Brazil, Burma, Dominican Republic, England, India, Jamaica, Japan, Korea, Malaysia, Nigeria, Philippines, Puerto Rico, Republic of South Africa, Russia, Sierra Leone, Sri Lanka, Sudan, Taiwan, Tanzania, Trinidad, and Uganda.

Notes: Chung *et al.* (1977) and Shin and Braun (1996) listed this fungus on *Raphanus sativus* and *Matthiola incana*, respectively, from Korea. Cho *et al.* (1997) added a brief morphological note. In the Korean collections, SMK 13252 is in accordance with SMK 14306, but the conidiophores are somewhat shorter (not longer than $200\ \mu\text{m}$), less geniculate (usually 1~3 times mildly geniculate) and not branched. Chupp (1954) described the characters of this species as follows: Stromata mostly a few brown cells, but occasionally as large as $50\ \mu\text{m}$ diam.; conidiophores 0~7 times geniculate, $25\sim500\times3.5\sim7\ \mu\text{m}$; conidia acicular, $25\sim200\times2\sim5\ \mu\text{m}$. For Japanese material, Katsuki (1965) described secondary external mycelia and acicular to obclavate-acicular conidia. Braun and Castañeda (1991) reported for Cuban material somewhat shorter conidiophores ($60\sim190\ \mu\text{m}$ long) arranged in fascicles and narrower conidia ($1.5\sim4.0\ \mu\text{m}$ wide). Therefore, the Korean collections fit well with these previous descriptions.

2. *Cercospora flagellaris* Ellis & G. Martin, Amer. Nat. 16: 1003 (1882) Fig. 2

Leaf spots amphigenous, scattered to confluent, circular to subcircular, 4~10 mm diam., or up to 20 mm when coalescent, pale tan to dingy greyish brown with dark or blackish brown margins. **Caespituli** amphigenous. **Mycelium** internal, hyphae septate, branched, hyaline. **Stromata** small to medium, slightly developed, dark to blackish brown, $10\sim25\ \mu\text{m}$ diam., composed of several dark brown hyphal cells. **Conidiophores** 2~15 in a divergent fascicle, em-

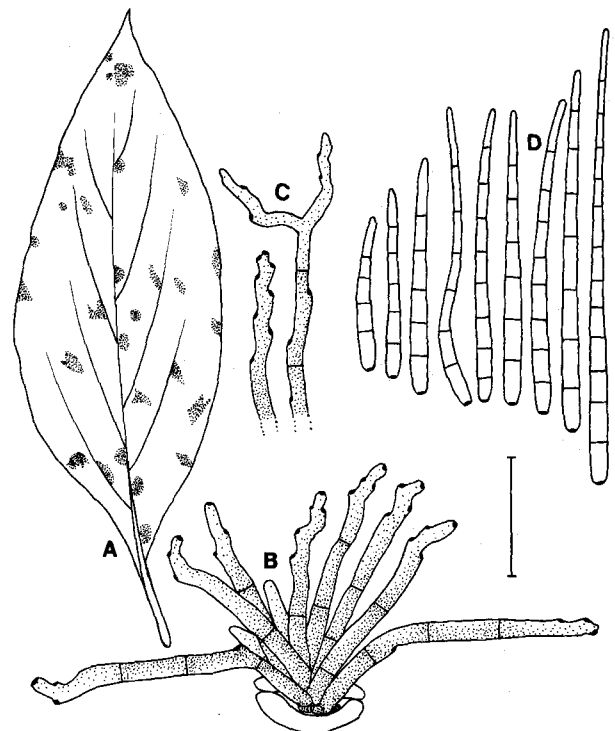


Fig. 2. *Cercospora flagellaris*. (A) Leaf spots on the upper leaf surface of *Phytolacca esculenta* ($0.4\times$). (B) Conidiophores. (C) Upper portion of conidiophores showing the apices. (D) Conidia. Bar = $30\ \mu\text{m}$.

erging through stomatal openings or the cuticle, olivaceous brown at the basal portion or paler towards the apex, straight to slightly curved, usually not branched, but very rarely branched, 1~4 times mildly or abruptly geniculate, much variable in length, $35\sim280\times3.5\sim5.0\ \mu\text{m}$, 0~3-septate; conidial scars large, $2.0\sim3.5\ \mu\text{m}$ wide, conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, acicular-filiform to filiform, sometimes even obclavate, straight to mildly curved, hyaline, 4~16-septate, non-constricted at the septa, obtuse to subacute at the apex, subtruncate to truncate at the base, variable in length, $40\sim130(\sim200)\times3.0\sim4.5\ \mu\text{m}$; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Phytolacca esculenta* V. Houtte (Phytolaccaceae).

Specimens examined: SMK 13698 (2 X 1996, Chunchon), 14811 (19 VIII 1998, Chunchon), 15060 (8 IX 1998, Suwon), 15116 (18 IX 1998, Jinju), 15197 (24 IX 1998, Pochon).

Distribution: Japan, Korea, Puerto Rico, and USA.

Notes: This is the first record of this fungus from Korea. Some Korean collections, SMK 13698 and 15060, have abundantly hypophyllous caespituli and short conidiophores ($35\sim160\ \mu\text{m}$, even not longer than $90\ \mu\text{m}$). SMK 14811 and 15116 produce mostly epiphyllous fructification, somewhat longer conidiophores (up to $280\ \mu\text{m}$ long) and

conidia (up to 200 μm long). Chupp (1954) published the following characters of this species based on the American material: Fructification chiefly epiphyllous; conidiophores rarely branched, $30\text{--}300 \times 3\text{--}6 \mu\text{m}$; conidia acicular, $30\text{--}120 \times 2\text{--}4 \mu\text{m}$. Japanese collections (Katsuki and Kobayashi, 1982) on *Phytolacca americana* are described as follows: Conidiophores 3–4-septate, $80\text{--}186 \times 3\text{--}5 \mu\text{m}$; conidia acicular, 4–6-septate, $64\text{--}75 \times 2\text{--}4 \mu\text{m}$. Therefore, the present fungus is in agreement with these previous descriptions. Although minor differences have been shown, these features fall within the variability of this fungus.

3. *Cercospora sesami* Zimm., Ber. Land-Forest. Deut.-Ostaf. 2: 28 (1904) Fig. 3

Teleomorph: *Mycosphaerella sesami* Sivan., Trans. Brit. Mycol. Soc. 85: 397 (1985)

Leaf spots amphigenous, scattered, often confluent, distinct, circular to subcircular, 1–5 mm diam., or up to 10 mm when coalescent, initially appearing brown to dingy grey, later centre becoming grey to greyish brown with narrow dark brown margins. **Caespituli** amphigenous. **Mycelium** internal, hyphae septate, branched, $2.5\text{--}3.5 \mu\text{m}$ wide. **Stromata** lacking to small, rudimentary to poorly developed, brown to dark brown, $10\text{--}20 \mu\text{m}$ diam., composed of a few brown hyphal cells. **Conidiophores** 2–8 in a loose divergent fascicle, arising from stomata or erumpent

through the cuticle, olivaceous brown or paler towards the upper portion, straight to slightly curved, 1–3 times abruptly geniculate above the middle, not branched, 3–6-septate, $40\text{--}120 \times 4.0\text{--}5.5 \mu\text{m}$; conidial scars large, $2\text{--}3 \mu\text{m}$ wide, conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, acicular-filiform, straight to mildly curved, hyaline, 5–13-septate, non-constricted at the septa, subacute at the apex, subtruncate at the base, much variable in length, $36\text{--}220 \times 3.0\text{--}5.0 \mu\text{m}$; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Sesamum indicum* L. (Pedaliaceae).

Specimen examined: SMK 10330 (16 VII 1990, Kangnung).

Distribution: Worldwide where the crop is cultivated, including China, Japan, Korea, and Taiwan.

Notes: Nakata and Takimoto (1928), Park (1958), and Yu (1981) listed this fungus from Korea as a causal agent of leaf spots on the same host species. Chupp (1954) described that the conidiophores are arranged in small fascicles or borne singly, rarely branched, and the conidia are somewhat shorter ($30\text{--}150 \mu\text{m}$ long) than in the Korean collection. Japanese collections (Katsuki, 1965) were characterized by rarely branched conidiophores, 1–3-septate, and short conidia ($42\text{--}120 \mu\text{m}$ long). Sivanesan (1985) gave the following morphological characters for this species: Conidiophores up to $200 \times 4\text{--}5 \mu\text{m}$, conidial scars thickened but not protuberant, conidia acicular, $90\text{--}150 \times 3\text{--}4 \mu\text{m}$, up to 15-septate. Therefore, the Korean collection agrees well with these previous descriptions. There are several species of cercosporoid taxa reported on *Sesamum*, including the present species, *C. sesami* var. *somalensis* Curzi (1932), *C. sesamigena* J.M. Yen & Lim (1973), *Cercoseptoria sesami* (Hansf.) Deighton (1976), *Pseudocercospora atrovelutina* Deighton (1976), *P. sesami-indici* U. Braun (1994), and *Pseudocercospora sesami* Purkay. & Mallik (1976). *C. sesami* var. *somalensis* differs from the present fungus as follows: Leaf spots concentric zonate; conidiophores much shorter and somewhat wide, $27\text{--}40 \times 3\text{--}7 \mu\text{m}$; conidia cylindric, rather short, and narrow, $40\text{--}70 \times 3.0\text{--}3.5 \mu\text{m}$. *C. sesamigena* is distinguished from it by very long ($75\text{--}490 \mu\text{m}$ in length) and multiseptate (up to 32-septa) conidia. *Cercoseptoria sesami* is easily distinguishable by well-developed stromata, unthickened conidial scars, and somewhat narrower conidia ($1.5\text{--}4.0 \mu\text{m}$ wide). *P. atrovelutina* is clearly different from the Korean collection in many respects: Stromata very well-developed, up to $75 \mu\text{m}$ wide; conidiophores very short (only $50\text{--}60 \mu\text{m}$ long); conidial scars unthickened. *P. sesami-indici* is characterized by subhyaline to pale olivaceous brown superficial hyphae, very short solitary conidiophores ($5\text{--}20$

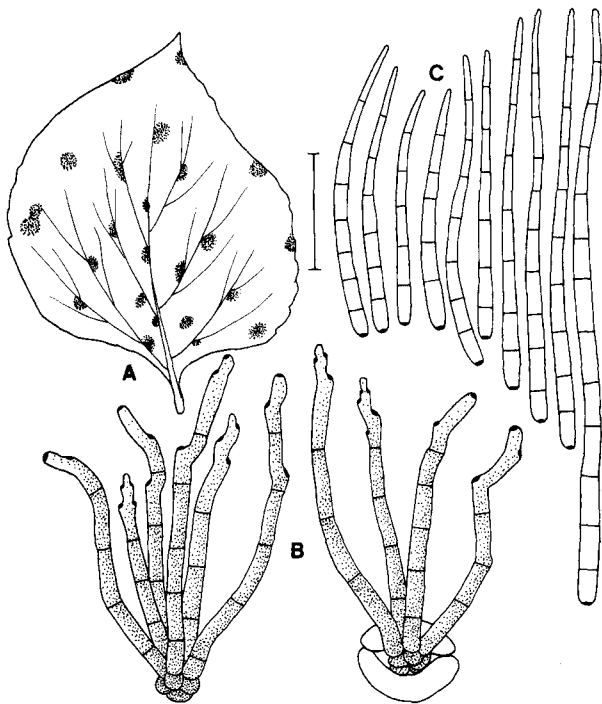


Fig. 3. *Cercospora sesami*. (A) Leaf spots on the upper leaf surface of *Sesamum indicum* ($0.7\times$). (B) Conidiophores. (C) Conidia. Bar = $30 \mu\text{m}$.

μm long), and acicular-filiform to subcylindric conidia. *P. sesami* is different from it in several aspects: Conidiophores hyaline, $7\text{--}37 \times 2\text{--}5 \mu\text{m}$; conidia hyaline, obclavate to cylindrical, up to 10-septate, $18\text{--}174 \times 2\text{--}5 \mu\text{m}$.

4. *Cercospora zinniae* Ellis & G. Martin, J. Mycol. 1: 20 (1885) Fig. 4
= *Cercospora atricineta* Heald & F.A. Wolf, Mycologia 3: 14 (1911)

Leaf spots amphigenous, scattered, often confluent, distinct, circular to irregular, usually small, 1–5 mm diam., pale to dingy grey centre with dark or purplish brown margins. **Caespituli** amphigenous, but abundantly epiphyllous, later appearing greyish white due to heavy fungal fructification. **Mycelium** internal, hyphae septate, branched, hyaline, 2–3 μm wide. **Stromata** lacking to small, rudimentary to poorly developed, brown to dark brown, irregular, 8–16 μm diam., composed of a few swollen hyphal cells. **Conidiophores** 5–15 in a divergent fascicle, mostly erumpent through the cuticle, pale olivaceous brown to dark brown at the basal portion or paler towards the apex, straight to slightly curved, 1–3 times mildly geniculate, not branched, 2–4-septate, $(20\text{--})30\text{--}110 \times 4.0\text{--}5.0 \mu\text{m}$; conidial scars large, 2–3 μm wide, conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, acicular-filiform to obclavate, straight to mildly curved, hyaline, 4–14-septate, non-constricted at the septa, subacute to subobtuse at the apex, truncate to sub-

truncate or obconically truncate at the base, $50\text{--}150 \times 3.5\text{--}5.0 \mu\text{m}$; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Zinnia elegans* Jacq. (Compositae).

Specimens examined: SMK 10455 (24 IX 1990, Kangnung), 10584 (21 X 1990, Kangnung), 10585 (21 X 1990, Kangnung).

Distribution: Worldwide where the plant is growing, including China, Japan, and Korea.

Notes: Shin and Braun (1993) first listed this fungus from Korea. SMK 10455 produces somewhat shorter (only 20–60 μm long) conidiophores. Chupp (1954) described that conidiophores are sometimes guttulate, branched, $10\text{--}120 \times 4\text{--}6 \mu\text{m}$, and conidia are acicular to obclavate, $20\text{--}140 \times 2\text{--}4 \mu\text{m}$. For Japanese collections, Katsuki (1965) mentioned vein-limited leaf spots, 0–3-septate, not branched conidiophores, $48\text{--}115 \times 4.0\text{--}5.0 \mu\text{m}$, and 5–13-septate conidia, $60\text{--}120 \times 3.5\text{--}5.0 \mu\text{m}$. *C. zinniae* collected from Taiwan (Hsieh and Goh, 1990) was described to have unbranched conidiophores. Therefore, the Korean collections match with these previous descriptions.

5. *Passalora amurensis* (Zilling) H.D. Shin & U. Braun, Mycotaxon 58: 162 (1996) Fig. 5

= *Cercospora amurensis* Zilling, Acta Inst. Acad. Sci. U. R. S. S. II (Pl. Cryptog.) 3: 696 (1936)

Leaf spots amphigenous, scattered to confluent, subcircular to angular, sometimes vein-limited, 2–8 mm diam., or up to 20 mm when coalescent, yellowish brown to greyish brown with brown margins. **Caespituli** hypophyllous, minute black dots when viewed under a hand lens. **Mycelium** internal, hyphae septate, branched, hyaline, 2.5–3.5 μm wide. **Stromata** lacking to small, rudimentary to slightly developed, 10–15 μm diam., composed of a few brown hyphal cells. **Conidiophores** 3–10 in a divergent fascicle, emerging through stomata, olivaceous brown to brown at the base or paler towards the upper portion, straight to mildly curved, not branched, sometimes irregularly sinuous, several times (usually 1–2 times) irregularly geniculate at the apical portion, 0–1-septate, $30\text{--}75 \times 4.5\text{--}6.0 \mu\text{m}$; conidial scars very small, 0.5–1.0 μm wide, not very conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, cylindrical to narrowly obclavate-cylindric, sometimes slightly attenuated towards the apex, non-constricted at the septa, substraight to mildly curved, subhyaline to very pale olivaceous brown, 0–4-septate, but usually 2–3-septate, obtuse to subobtuse at the apex, subtruncate to subobtuse at the base, $10\text{--}64 \times 4.0\text{--}6.5 \mu\text{m}$; hilum minute, very slightly thickened, somewhat darkened, and non-protuberant.

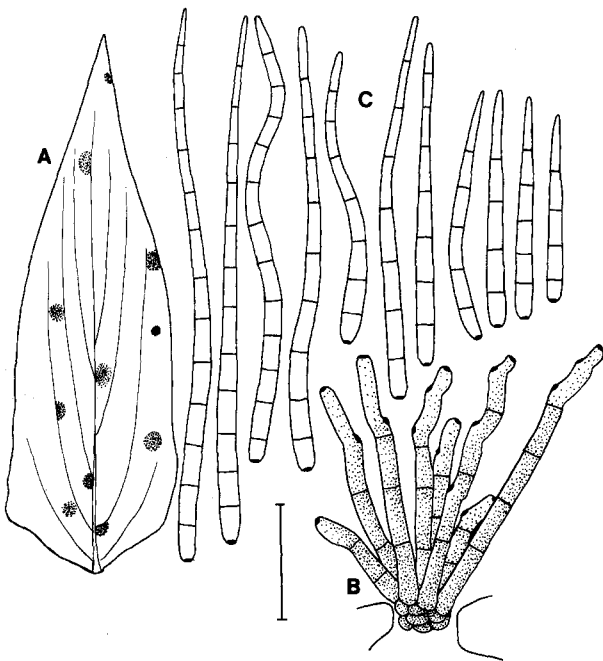


Fig. 4. *Cercospora zinniae*. (A) Leaf spots on the upper leaf surface of *Zinnia elegans* (0.7 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μm .

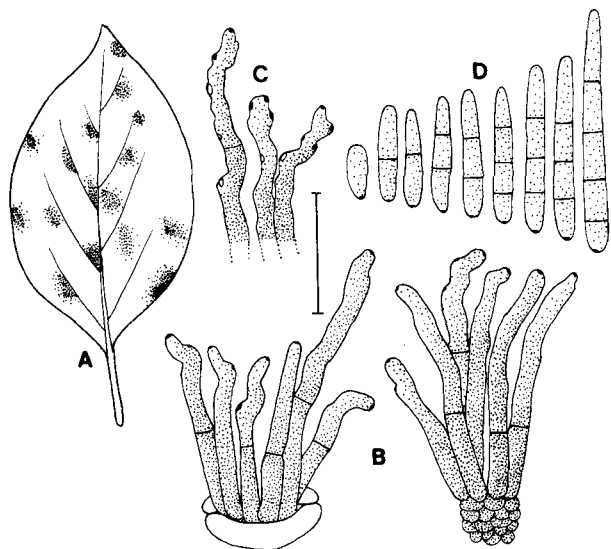


Fig. 5. *Passalora amurensis*. (A) Leaf spots on the lower leaf surface of *Syringa reticulata* var. *mandshurica* (0.7 \times). (B) Conidiophores. (C) Upper portion of conidiophores showing the apices. (D) Conidia. Bar = 30 μ m.

Habitat: *Syringa reticulata* var. *mandshurica* (Max.) Hara (Oleaceae).

Specimen examined: SMK 12488 (1 VII 1993, Jongsun).

Distribution: Korea and Russia.

Notes: Shin and Braun (1996) first reported this fungus as a new combination from Korea. In the Korean collection, the conidial scars on conidiogenous cells are very slightly thickened, but visible. The conidia are pigmented, cylindric to narrowly obclavate-cylindric, and usually 2~3-septate. Therefore, this species was re-allocated to *Passalora* (Shin and Braun, 1996). Chupp (1954) described this fungus as *Cercospora amurensis* with pale olivaceous, cylindric or slightly attenuated and 3~4-septate conidia. *Pseudocercospora lilacis* (Desmaz.) Deighton (1987) on *Syringa vulgaris* differs from the present fungus in having large and well-developed stromata (30~60 μ m diam.), somewhat shorter conidiophores (8.5~25 μ m long), and narrower conidia (2.5~4.0 μ m wide). *Cercospora macroculans* Heald & F.A. Wolf (Chupp, 1954) on *Syringa* species is clearly different from it as follows: Fructification amphigenous; conidiophores somewhat long (50~160 μ m in length); conidia hyaline, acicular to obclavate, somewhat longer and narrower (25~120 \times 2.0~3.5 μ m).

6. *Pseudocercospora balsaminae* (Syd.) Deighton, Mycol. Papers 140: 139 (1976)

Fig. 6

\equiv *Cercoseptoria balsaminae* Syd., Anns Mycol. 33: 69 (1935)

Leaf spots amphigenous, scattered to confluent, distinct, angular to irregular, usually vein-limited, 2~10 mm diam.,

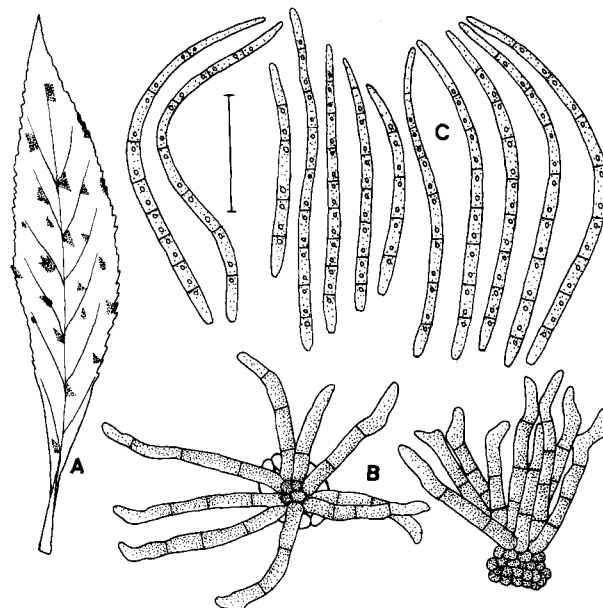


Fig. 6. *Pseudocercospora balsaminae*. (A) Leaf spots on the upper leaf surface of *Impatiens balsaminae* (0.7 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μ m.

initially appearing brown to greyish brown, later centre becoming tan to dingy grey without definite margins. **Caespituli** amphigenous. **Mycelium** internal, hyphae septate, branched, hyaline, 2~3 μ m wide. **Stromata** small, slightly developed, subglobular, brown to dark brown, 10~20 μ m diam., composed of a few brown hyphal cells. **Conidiophores** 6~25 in a loose fascicle, emerging through stomatal openings or erumpent through the cuticle, olivaceous brown to brown, irregular in width, substraight to mildly curved or somewhat sinuous, not geniculate, not branched, slightly narrower at the apical portion, 1~3-septate, 20~56 \times 2.5~4.0 μ m; conidial scars inconspicuous. **Conidia** solitary, filiform to narrowly obclavate, substraight to moderately curved, subhyaline, guttulate, 4~8-septate, non-constricted at the septa, subobtuse to subacute at the apex, obconically truncate to truncate at the base, 54~105 \times 2.0~3.5 μ m; hilum unthickened, not darkened.

Habitat: On living leaves of *Impatiens balsamina* L. and *I. textori* Miq. (Basaminaceae).

Specimens examined: On *Impatiens balsamina*, SMK 13268 (29 X 1994, Chunchon), 14928 (26 VII 1998, Kyungju); on *I. textori*, 15180 (24 IX 1998, Pochon).

Distribution: Worldwide where the host is growing, including China and Korea.

Notes: This is the first record of this fungus from Korea. In SMK 13268, the conidiophores are abundant on the lower surface. Guo and Liu (1992) described the following characters of the present fungus: Secondary mycelium superficial; conidiophores arranged in loose to dense fascicle or arising singly from the external mycelial

hyphae, 0~2-septate, $6.5\text{--}40 \times 2.5\text{--}4.0 \mu\text{m}$; conidia narrowly obclavate, 3~11-septate, $25\text{--}90 \times 1.5\text{--}3.0 \mu\text{m}$. Therefore, the Korean collections match well with Chinese descriptions (Guo and Liu, 1992; Guo and Hsieh, 1995), though the secondary mycelium is not observed in all Korean specimens. Several species of *Cercospora* and allied genera are known on *I. balsamina*, namely *Cercospora fukushiana* (Matsuura) W. Yamam., *C. balsamiana* J.M. Yen & Lim, *Cercoseptoria balsaminicola* (J.M. Yen & Lim) J.M. Yen, *Passalora campi-silii* (Speg.) U. Braun, and *Pseudocercospora nojimae* (Togashi & Kaysuki) Y.L. Guo & X.J. Liu. *C. balsaminicola* is confusable with this species, but differs in several respects: Stromata large, well-developed, $20\text{--}60 \mu\text{m}$ diam.; conidiophores arranged in dense fascicle, once geniculate, much shorter and somewhat narrower, $10\text{--}27.6 \times 2.5\text{--}3.6 \mu\text{m}$; conidia filiform, somewhat longer and wider, $45.6\text{--}132 \times 2.0\text{--}2.5 \mu\text{m}$. *C. balsamiana* is clearly distinguishable from it by having epiphyllous fructification, aseptate conidiophores, very long ($66\text{--}307 \mu\text{m}$ in length), and 5~17-septate conidia. *P. campi-silii* on *I. noli-tangerae* was described with conidia which are broadly obclavate-subcylindric, $4\text{--}7 \mu\text{m}$ wide, and 1~6-septate. Deighton (1976) believed that this species is the same as *C. nojimae* Tagashi & Katsuki (\equiv *Pseudocercospora nojimae*), but, according to the original description, *C. nojimae* had epiphyllous fructification, 0~1-septate conidiophores, and elongate-obclavate conidia. *P. nojimae*, described and illustrated from Korea by Kim and Shin (1999a) is confusable with the present fungus, but distinguished from the latter species as follows: Secondary mycelium developed, conidiophores and conidia somewhat wider.

7. *Pseudocercospora humuli* (Hori) Y.L. Guo & X.J. Liu, Acta Mycol. Sinica Suppl. 1: 345 (1986) Fig. 7

\equiv *Cercospora humuli* Hori, J. Bot. Lond. 61: 135 (1923)

= *Cercospora humuli-japonici* Sawada, Taiwan Agric. Rev. 38: 697 (1942) and Taiwan Agric. Res. Inst. Rept. 85: 108 (1943) (nomen non rite publicatum, sine descriptione latina)

\equiv *Pseudocercospora humuli-japonici* (Sawada) Goh & W.H. Hsieh, in Hsieh & Goh, *Cercospora* and Similar Fungi from Taiwan. p. 239 (1990)

Leaf spots amphigenous, scattered to confluent, sub-circular to angular, usually vein-limited, 3~10 mm diam., or up to 20 mm when coalescent, initially appearing tan to pale brown, later centre becoming greyish brown to dark brown with or without definite purplish brown raised margins on the upper surface, greyish brown to pale brown or reddish brown with dark brown border lines on the lower

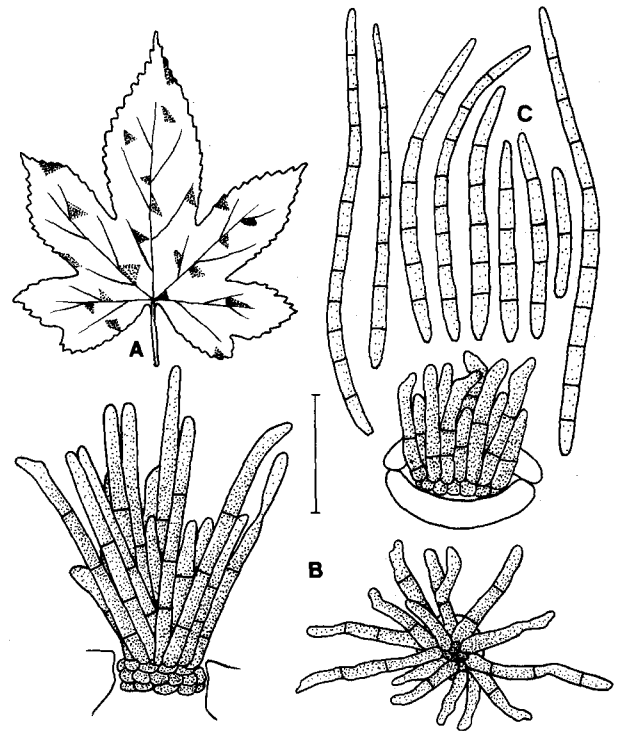


Fig. 7. *Pseudocercospora humuli*. (A) Leaf spots on the upper leaf surface of *Humulus japonicus* (0.5 \times). (B) Conidiophores. (C) Conidia. Bar = $30 \mu\text{m}$.

surface, finally showing yellowish haloes on both surfaces. **Caespituli** amphigenous, later appearing as pale fuliginous angular patches. **Mycelium** internal, hyphae septate, angular branched, hyaline, $2\text{--}3 \mu\text{m}$ wide. **Stromata** small to large, slightly to well developed, subglobular to somewhat elongated, brown to dark brown, $15\text{--}40 \mu\text{m}$ diam., composed of several brown hyphal cells. **Conidiophores** $10\text{--}35$ (~50) in a dense fascicle, arising from stomata and emerging through the cuticle, pale olivaceous brown to olivaceous brown throughout, substraight to mildly curved, not branched, not geniculate, somewhat denticulate at the apical portion, slightly bulbous at the basal portion, 0~3-septate, $20\text{--}80 \times 3.0\text{--}4.5 \mu\text{m}$; conidial scars inconspicuous. **Conidia** solitary, filiform to cylindric or obclavate-cylindric, substraight to mildly curved, subhyaline to very pale greenish, 1~11-septate, non-constricted at the septa, obtuse to subobtusate at the apex, subtruncate to obconically truncate at the base, $30\text{--}128 \times 3.0\text{--}4.5 \mu\text{m}$; hilum unthickened, not darkened.

Habitat: On living leaves of *Humulus japonicus* S. & Z. (Moraceae).

Specimens examined: SMK 10892 (18 VII 1991, Kangnung), 10941 (7 VIII 1991, Kangnung), 11082 (20 IX 1991, Kangnung), 11182 (1 X 1991, Kangnung), 12487 (1 VIII 1993, Kangnung), 13061 (25 IX 1994, Kangnung), 13180 (18 X 1994, Kangnung), 13346 (5 XI 1994, Suwon), 14165 (14 IX 1997, Chunchon), 14410 (12 X 1997, Dongduchon).

Distribution: China, Korea, and Taiwan.

Notes: Park (1967) and Shin and Braun (1996) listed this fungus from Korea as *Cercospora humuli* and *Pseudocercospora humuli-japonici*, respectively. In SMK 10892, the caespituli are amphigenous but mostly hypophyllous. In SMK 14165, yellowish haloes sometimes appear on both surfaces and conidia are somewhat shorter (30~80 μm long). Chupp (1954) characterized *C. humuli* as follows: Conidiophores arranged in dense to divergent fascicle, rarely branched; conidia subhyaline to pale olivaceous, obclavate-cylindric. Guo and Liu (1986) transferred *C. humuli* to *Pseudocercospora humuli* and added the following characters: Stromata 20~40 μm diam., conidiophores short (only 10~35 μm long), and conidia somewhat narrower (2~4 μm wide). Therefore, the Korean collections are undoubtedly indistinguishable with these previous descriptions. *C. humuli-japonici*, which was placed into *C. humuli* by Chupp (1954) and Katsuki (1965), was re-allocated as *Pseudocercospora humuli-japonici* (Hsieh and Goh, 1990). The description of *P. humuli-japonici* is very similar to the Chinese collections of *P. humuli* except that conidia are somewhat wider (3.0~5.0 μm wide). Therefore, Guo & Hsieh (1995) suggested that *P. humuli-japonici* and *P. humuli* are indistinguishable and conspecific. *P. cantuariensis* (E.S. Salmon & Wormald) U. Braun, which was described in a previous paper (Kim and Shin, 1999b) from Korea, is clearly distinguishable from it by having gigantic conidiophores and conidia.

8. *Pseudocercospora puderi* Deighton, Mycol. Papers 140: 90 (1976) Fig. 8

\equiv *Cercospora puderi* B.H. Davis, Mycologia 30: 291 (1938) "*puderi*", nom. inval.! (nomen non rite publicatum, sine descriptione latina)

Leaf spots amphigenous, scattered to often confluent, distinct, circular to subcircular, 2~5 mm diam., brown to greyish brown on the lower surface, dark greyish brown with definite purplish brown raised margins on the upper surface. **Caespituli** amphigenous. **Primary mycelium** internal, hyphae septate, branched, hyaline, 1.5~3.0 μm wide. **Secondary mycelium** external, creeping on the leaf surface, hyphae septate, branched, pale olivaceous brown to brown, 1.5~2.0 μm wide. **Stromata** small to large, well-developed, subglobular to globular, brown to dark brown, 10~45 μm diam. **Conidiophores** 5~20 in a dense fascicle, emerging through stomata and the cuticle or arising singly as lateral branches from external mycelium, pale olivaceous brown to brown at the basal portion or paler towards the apex, straight to mildly curved, not branched, not geniculate, slightly bulbous near the basal parts, 0~1-septate, 8~24 \times 2.0~3.5 μm ; conidial scars inconspicuous.

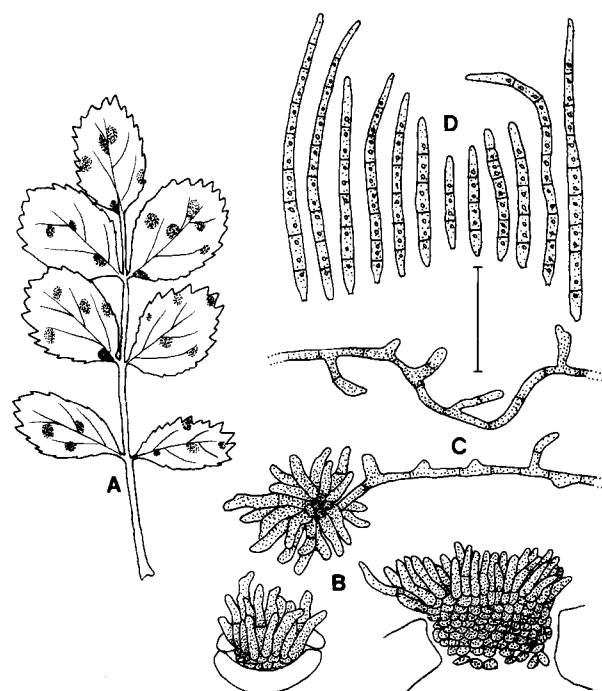


Fig. 8. *Pseudocercospora puderi*. (A) Leaf spots on the upper leaf surface of *Rosa multiflora* (0.7 \times). (B) Conidiophores. (C) Secondary conidiophores borne on the external mycelium. (D) Conidia. Bar = 30 μm .

Conidia solitary, obclavate-cylindric to narrowly obclavate, straight to mildly curved, subhyaline to very pale olivaceous, guttulate, 2~9-septate, usually non-constricted, but occasionally constricted at some septa, obtuse to subobtuse at the apex, obconically truncate to subtruncate at the base, 25~82(~108) \times 2.5~3.5 μm ; hilum unthickened, not darkened.

Habitat: On living leaves of *Rosa multiflora* Thunb. (Rosaceae).

Specimens examined: SMK 12997 (13 IX 1994, Chonju), 13816 (26 V 1997, Samchok), 14194 (1 IX 1997, Seoul).

Distribution: China, Cuba, India, Korea, Malaysia, and North America (USA).

Notes: Shin and Braun (1996) first listed this fungus from Korea. In SMK 14104, the immature conidia are sometimes hyaline and somewhat shorter (20~50 μm long). In SMK 13816, secondary mycelia are not developed at the hypophyllous leaf spots. Dense fascicles of short conidiophores on both leaf surfaces and pigmented narrower conidia are uniformly formed in all Korean specimens. *Cercospora puderi* (Chupp, 1954) has chiefly epiphyllous fructification and obclavate conidia. Deighton (1976) described the features of this species as follows: Fructification chiefly epiphyllous, secondary mycelium sometimes developed, conidiophores up to 30 \times 2.5~4.0 μm , conidial scars about 1 μm diam., conidia obclavate-filiform. A

Chinese collection (Guo and Hsieh, 1995) was characterized by amphigenous fructification, branched conidiophores, and somewhat constricted conidia. The conidiophores of a Cuban collection (Castañeda and Braun, 1989) were occasionally much larger, up to 120 μm , and the conidia were subcylindric-fusiform, narrowly obclavate and somewhat narrower (1.5–3.5 μm wide). Therefore, the Korean collections generally agree with these previous descriptions.

9. *Pseudocercospora salicina* (Ellis & Everh.) Deighton, Mycol. Papers 140: 94 (1976) Fig. 9

= *Cercospora salicina* Ellis & Everh., J. Mycol. 3: 19 (1887)

= *Cercospora populina* Ellis & Everh., J. Mycol. 3: 20 (1887)

= *Cercospora sessilis* Ellis & Everh., J. Mycol. 8: 71 (1902), non *C. sessilis* Sorokine, (1892)

= *Cercospora reducta* Syd. & P. Syd., Anns Mycol. 1: 178 (1903)

= *Cercospora babylonica* Sawada, Taiwan Agric. Res. Inst. Rept. 87: 79 (1944) (nomen non rite publicatum, sine descriptione latina)

= *Cercospora salicicola* Sawada, Taiwan Agric. Res. Inst. Rept. 87: 87 (1944) (nomen non rite publicatum, sine descriptione latina)

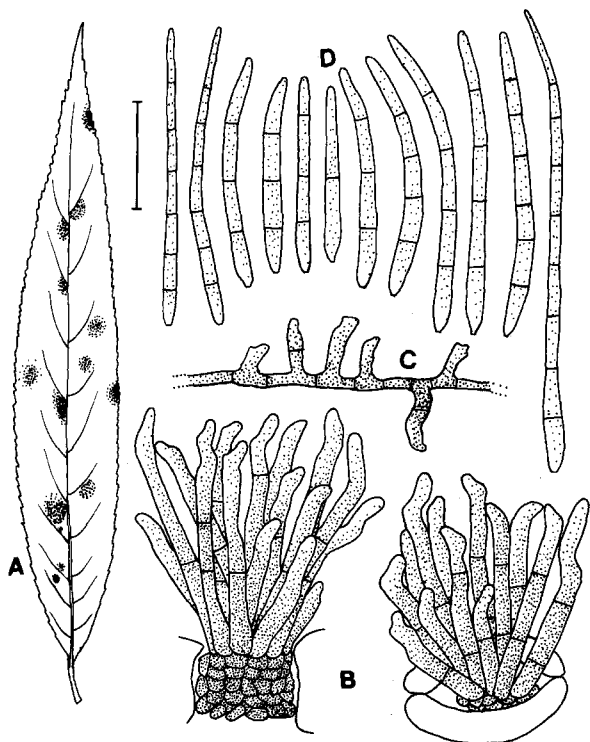


Fig. 9. *Pseudocercospora salicina*. (A) Leaf spots on the upper leaf surface of *Salix* sp. (0.7 \times). (B) Conidiophores. (C) Secondary conidiophores borne on the external mycelium. (D) Conidia. Bar = 30 μm .

= *Cercospora minutipes* J.M. Yen, Rev. Mycol. 31: 128 (1966)

= *Cercospora salicis-babylonicae* J.M. Yen, Rev. Mycol. 31: 138 (1966)

Teleomorph: *Mycosphaerella togashiana* K. Ito & Tak. Kobay., Bull. Govt. For. Exp. Stat. Meguro 59: 23 (1953)

Leaf spots amphigenous, scattered to confluent, distinct, circular to irregular, 0.5–5 mm diam., initially appearing pale to brown, later centre becoming pale grey to greyish black and surrounded by a dark brown to blackish line at the margins on the upper surface, olivaceous brown to greyish brown on the lower surface. **Caespituli** amphigenous. **Primary mycelium** internal, hyphae septate, branched, hyaline, 2–3 μm wide. **Secondary mycelium** external, creeping on the leaf surface, hyphae septate, branched, very pale olivaceous brown to hyaline, 2–3 μm wide. **Stromata** lacking to small, poorly or slightly developed, globular to subglobular, 10–20 μm diam., composed of a few brown hyphal cells. **Conidiophores** 10–30 in a loose to dense fascicle, emerging through stomata and the cuticle, but occasionally produced singly as lateral branches from secondary hyphae, pale olivaceous brown, uniform in colour, straight to mildly curved, slightly geniculate or geniculate-sinuous, very rarely branched, sometimes narrower towards the upper portion, 0–2(–3)-septate, 20–60 \times 3.5–5.0 μm ; conidial scars inconspicuous. **Conidia** solitary, filiform or narrowly obclavate to obclavate-cylindric, straight to mildly curved, subhyaline to very pale olivaceous brown, 1–8-septate, non-constricted at the septa, obtuse to subobtuse at the apex, obconically truncate at the base, 30–110 \times 2.5–4.0 μm ; hilum unthickened, not darkened.

Habitat: On living leaves of *Salix* sp. (Salicaceae).

Specimens examined: SMK 10459 (24 IX 1990, Kangnung), 13556 (16 VI 1995, Kangnung), 13717 (9 X 1996, Kangnung), 14227 (24 IX 1997, Namyangju), 14931 (26 VIII 1998, Kyungju)

Distribution: Argentina, Burma, Canada, China, India, Japan, Korea, Singapore, Taiwan, and USA.

Notes: *Cercospora populina* and *Cercospora* sp. were listed from Korea on *Populus* and *Salix*, respectively (Anonymous, 1991). The characters of the *Cercospora* species on *Salix* were described as follows: Conidiophores olivaceous brown to brown, 20–28 \times 3.0–4.0 μm , and conidia filiform, 1–8-septate (usually 5–7-septate), 25–118 \times 3–4 μm . The identity of the specimens concerned can, however, not be proven, since they are not preserved. In the Korean collections, the secondary mycelia are very variable. In SMK 13556, secondary mycelium was not observed on both leaf surfaces. In SMK 10447 and 13717, some secondary hyphae were epiphyllous only. In SMK 14227 and 14931, secondary mycelium was plentiful, but

sometimes observed only on the lower surface. In all Korean collections, epiphyllous conidiophores are numerous in a dense fascicle and usually not branched. Hypophyllous conidiophores are sometimes arising from small stromata and sometimes stromata are little developed or absent. *Pseudocercospora salicina* (Deighton, 1976) has been described in detail: Caespituli amphigenous, but usually more on the upper surface; secondary mycelium developed; conidiophores sometimes branched near the base, occasionally very slightly geniculate or sinuous, denticulate, $7\sim 20 \times 2.5\sim 3.0 \mu\text{m}$; conidia pale olivaceous, usually obclavate-cylindric, 1~6-septate, commonly 3-septate, $12\sim 45 \times 2\sim 3(\sim 3.5) \mu\text{m}$. Hsieh and Goh (1990) described the following features of this species based on collection from Taiwan: Secondary mycelium developed on the upper surface; conidiophores rarely branched, 0~2-septate; conidia narrowly obclavate or linear, 3~11-septate. The following characters of Chinese material (Guo and Hsieh, 1995) were added: Conidiophores branched, 0~4-septate; conidia narrowly obclavate to cylindric, 3~11-septate (mostly 3~5-septate). Therefore, the Korean collections are in accordance with these previous descriptions. According to Chupp (1954), the North American *Cercospora salicis* Chupp & H.C. Greene differs from it in possessing epiphyllous fructification, lacking stromata, non-developed secondary mycelium, and cylindric conidia. *C. populicola* Tharp (Chupp, 1954) is easily differentiated by much longer ($60\sim 200 \mu\text{m}$ in length) conidiophores and somewhat longer ($60\sim 150 \mu\text{m}$ in length), acicular conidia with acute apex.

10. *Stenella dianthi* H.D. Shin & U. Braun, Mycotaxon 49: 359 (1993) Fig. 10

Leaf spots amphigenous, scattered to confluent, indistinct, circular, usually marginal, 1~3 mm diam., or up to 5 mm when coalescent, pale tan to brown centre with dark reddish brown margins. **Caespituli** amphigenous. **Primary mycelium** internal, hyphae septate, branched, forming substomatal stromata, especially hypophyllous. **Secondary mycelium** external, hyphae septate, branched, creeping on the leaf surface, very pale olivaceous brown, finely verruculose, producing lateral conidiophores, $1.5\sim 3.0 \mu\text{m}$ wide. **Stromata** small, well-developed, brown to dark brown, subglobular, $10\sim 20 \mu\text{m}$ diam., composed of several swollen hyphal cells. **Conidiophores** up to 20 in a divergent fascicle or borne singly as lateral branches from secondary external mycelium, olivaceous brown or paler towards the upper portion, straight to mildly sinuous, not branched, 3~9-septate in hypophyllous conidiophores, but 0~3(~5)-septate in epiphyllous ones, $25\sim 90 \times 2.5\sim 3.5 \mu\text{m}$; conidial scars small, ca. $1 \mu\text{m}$, but conspicuous at the apical portion. **Conidia** solitary, filiform to subcylindric or cylindric-

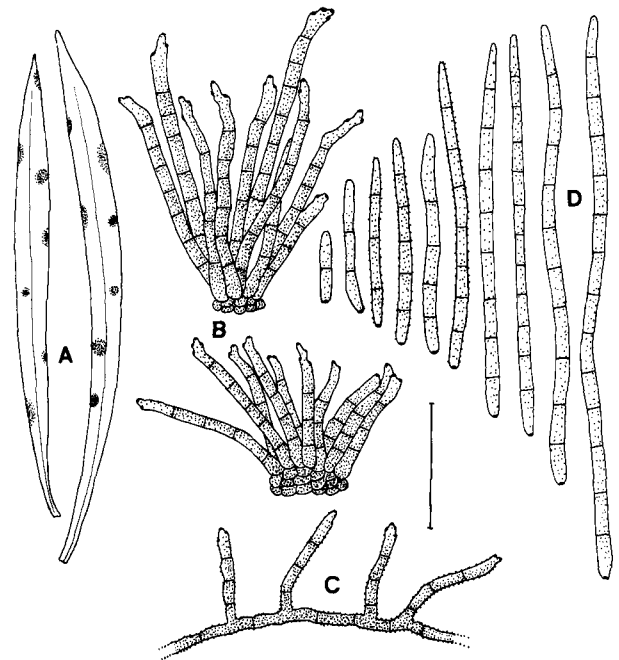


Fig. 10. *Stenella dianthi*. (A) Leaf spots on the upper leaf surface of *Dianthus sinensis* ($0.7\times$). (B) Conidiophores. (C) Secondary conidiophores borne on the external mycelium. (D) Conidia. Bar = $30 \mu\text{m}$.

obclavate, straight to slightly curved in long ones, hyaline, but occasionally very pale olivaceous brown, 1~14-septate, non-constricted at the septa, smooth to verruculose, subobtuse at the apex, subtruncate at the base, $16\sim 155 \times 2.0\sim 3.5 \mu\text{m}$; hilum slightly thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Dianthus sinensis* L. (Caryophyllaceae).

Specimen examined: SMK 10953 (28 VIII 1991, Kangnung) (holotype).

Distribution: Known only from type locality, Korea.

Notes: Shin and Braun (1993) first recorded this fungus from Korea as new a species with full morphological description and detailed illustration. The hyphomycetes genus *Stenella* Syd. mainly consists of tropical, foliicolous fungi. The generic circumscription was discussed and emended by Deighton (1971, 1979). Von Arx (1983) reduced *Stenella* to synonymy with *Cladosporium*. These genera are, indeed, allied, but easily distinguishable by quite distinct conidial scars (David, 1997) and a set of additional features (Braun, 1995). *Stenella* species form abundant secondary mycelium with conspicuously verruculose hyphae which differentiate this genus from *Mycovellosiella* as well as taxa of *Ramularia* with superficial hyphae. It differs from *Cladosporium* in possessing rough-walled external mycelial hyphae and more *Cercospora*-like conidia. Therefore, this fungus was described in *Stenella*. The Korean fungus is distinguished from all known *Stenella* species by its

predominantly solitary conidia. *Cercospora dianthi* T. Müll. & Chupp (Chupp, 1954; Katsuki, 1965) is different from it by having much longer and wider conidiophores, 75~250×4.0~6.0 μm; hyaline, acicular, very long conidia (75~300 μm in length).

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적 요

본 연구는 1990년부터 국내에서 채집하여 고려대학교 농생물학과 진균표본보관소(SMK)에 보존하고 있는 *Cercospora* 및 관련 속의 진균을 대상으로 분류학적 연구를 실시한 결과의 여덟 번째 보고이다. 이번 보고에서는 *Cercospora* 4종, *Passalora* 1종, *Pseudocercospora* 4종, 그리고 *Stenella* 1종에 대한 균학적 특징을 기재·묘사하였다. 스토크와 무우에서 *Cercospora bassicicola*, 자리공에서 *C. flagellaris*, 참깨에서 *C. sesami*, 백일홍에서 *C. zinniae*, 개회나무에서 *Passalora amurensis*, 봉선화와 물봉선에서 *Pseudocercospora balsaminae*, 환삼덩굴에서 *P. humuli*, 찔레꽃에서 *P. puderi*, 버드나무류에서 *P. salicina*, 그리고 패랭이꽃에서 *Stenella dianthi*를 각각 동정하였다.

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