

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

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한국산 *Cercospora* 및 관련 속의 분류학적 연구(X)

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ABSTRACT: This paper is the tenth contribution towards taxonomic studies on *Cercospora* and allied genera, and contains ten species of Korean cercosporoid fungi; viz., *Cercospora coreopsisidis*, *C. hydrangeae*, *C. physalidis*, *C. ricinella*, *C. volkammeriae*, *Pseudocercospora abelmoschi*, *P. cruenta*, *P. varia*, *Pseudocercospora paridicola*, and *Ramularia grevilleana* var. *grevilleana*. Morphological characteristics of taxonomic value are described and illustrated for these species to contribute towards a mycological monograph of Korean cercosporoid fungi.

KEYWORDS: *Cercospora*, *Pseudocercospora*, *Pseudocercospora*, *Ramularia*, Korea, Monograph

Ninety cercosporoid fungi from Korea, comprising 35 *Cercospora*, one *Cercospora*, one *Distocercospora*, three *Mycovellosiella*, two *Neoramularia*, five *Passalora*, one *Phaeoisariopsis*, one *Phacellium*, one *Phaeoramularia*, 26 *Pseudocercospora*, three *Pseudocercospora*, ten *Ramularia*, and one *Stenella* species were treated in previous contributions of this series (Kim and Shin, 1998a, 1998b, 1998c, 1998d, 1999a, 1999b, 1999c, 1999d, 1999e). The present paper deals with ten additional cercosporoid taxa from Korea, namely five *Cercospora*, three *Pseudocercospora*, one *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 coreopsisidis* Ray, Mycologia 33: 174 (1941)

Fig. 1

Leaf spots amphigenous, scattered to confluent, distinct, circular to subcircular, usually 2~10 mm diam., or up to 20 mm when coalescent, initially appearing pale to brown, later centre becoming grey to dirty grey with raised greyish brown margins. **Caespituli** amphigenous, later appearing fuliginous patches. **Mycelium** internal, hyphae septate, branched, 2.0~3.5 μ m wide. **Stromata** lacking to very small, rudimentary to poorly developed, brown to dark brown, less

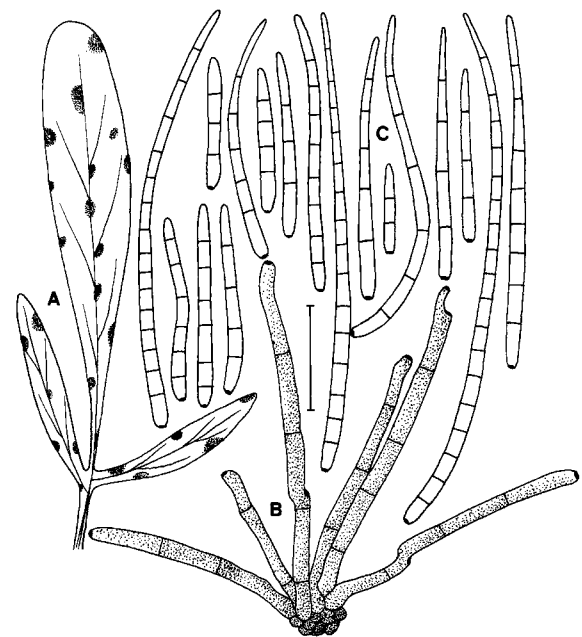


Fig. 1. *Cercospora coreopsisidis*. (A) Leaf spots on the upper leaf surface of *Coreopsis lanceolata* (0.7 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μ m.

than 20 μ m diam., composed of a few swollen hyphal cells. **Conidiophores** 4~20 in a divergent fascicle, arising from substomatal stromata or emerging through the cuticle, olivaceous brown to brown or paler towards the apex, straight to mildly curved, 1~2 times slightly geniculate, not branched, 2~4(~6)-septate, 40~104 \times 3.5~5.5 μ m; conidial scars medium, 2~3 μ m wide, conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, acicular-filiform, shorter ones narrowly obclavate,

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straight to mildly curved, hyaline, 2~18-septate, non-constricted at the septa, obtuse to subobtuse at the apex, subtruncate to truncate at the base, $28\sim180\times3\sim5\ \mu\text{m}$; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Coreopsis lanceolata* L. (Compositae).

Specimens examined: SMK 14258 (27 IX 1997, Chunchon), 14451 (17 X 1997, Suwon), 14752 (12 VIII 1998, Chunchon), 14848 (19 VIII 1998, Chunchon), 14987 (1 IX 1998, Suwon), 15108 (18 IX 1998, Jinju), 15425 (9 X 1998, Chunchon).

Distribution: Burma, Korea, and USA.

Notes: This is the first record of this species from Korea. Chupp (1954) described this species in detail as follows: Fructification mostly epiphyllous; conidiophores arranged in dense fascicles, 1~3-septate, straight to tortuous, once geniculate, $15\sim75\times4\sim6\ \mu\text{m}$; conidia obclavate to cylindrical or even acicular, $15\sim100\times2\sim4\ \mu\text{m}$. The Korean collections are in accordance with his description. However, most collections (SMK 14258, 14752, 14848, 14987, 15108) are evenly amphigenous in caespituli, and some collections (SMK 14451 and 15425) have long (70~104 μm), 2~6-septate conidiophores. This species seems to be more variable than the characteristics described by Chupp (1954). Two additional species of *Cercospora* have been recorded on *Coreopsis* spp. *C. bidentis* Tharp (Chupp, 1954) and *C. umbrata* Ellis & Holw. (Thaug, 1984) are not related to the present fungus.

2. *Cercospora hydrangeae* Ellis & Everh., J. Mycol. 8: 71 (1902) Fig. 2

= *Cercosporina hydrangeicola* Speg., Anal. Mus. Nac. Buenos Aires 20: 426 (1910)

= *Cercospora hydrangeana* Tharp., Mycologia 9: 110 (1917)

= *Cercospora arborescentis* Tehon & E. Daniels, Mycologia 17: 246 (1925)

Leaf spots amphigenous, scattered to confluent, distinct, circular to subcircular, 1~10 mm diam., or up to 20 mm when coalescent, initially appearing pale brown to brown, later centre becoming greyish brown to dingy grey with reddish brown or blackish brown margins. **Caespituli** amphigenous, but abundantly epiphyllous. **Mycelium** internal, hyphae septate, branched, hyaline, 2.0~3.5 μm wide. **Stromata** lacking to small, rudimentary to slightly developed, subglobular to globular, brown to dark brown, 10~20 μm diam., composed of a few swollen hyphal cells. **Conidiophores** 3~15 in a loose fascicle, emerging through the cuticle or occasionally arising from substomatal stromata, brown to deep brown throughout, irregular in width, straight to slightly curved, 1~5 times geniculate, usually 1~2 times

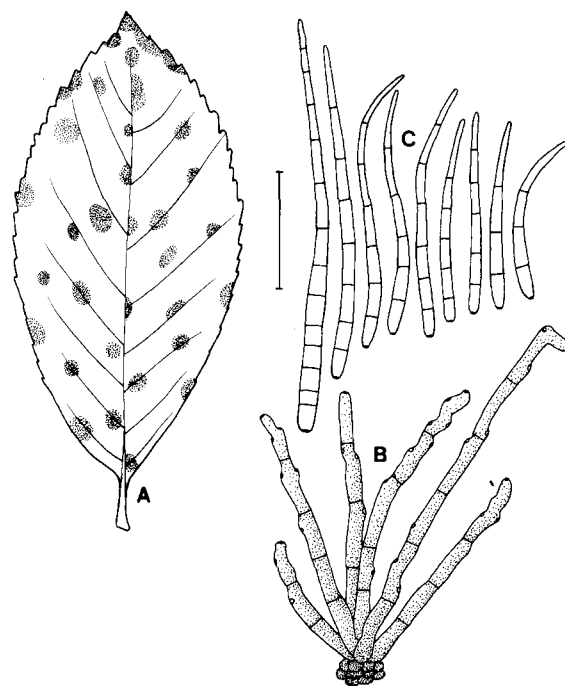


Fig. 2. *Cercospora hydrangeae*. (A) Leaf spots on the upper leaf surface of *Hydrangea macrophylla* for. *otaksa* (0.7 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μm .

abruptly geniculate, not branched, 2~5-septate, obtuse to subtruncate at the apex, $38\sim112(\sim200)\times3.0\sim4.5\ \mu\text{m}$; conidial scars small, 1~2 μm wide, conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, acicular to obclavate-cylindrical, substraight to mildly curved, hyaline, 2~13-septate, non-constricted at the septa, subacute to obtuse at the apex, subtruncate to truncate, $48\sim116\times3\sim5\ \mu\text{m}$; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Hydrangea macrophylla* for. *otaksa* (Sieb. & Zucc.) Wils. and *H. serrata* for. *acuminata* (Sieb. & Zucc.) Wils. (Saxifragaceae).

Specimens examined: On *Hydrangea macrophylla* for. *otaksa*, SMK 15292 (1 X 1998, Suwon), 15332 (4 X 1998, Yangku), 15403 (8 X 1998, Suwon); on *H. serrata* for. *acuminata*, SMK 15456 (9 X 1998, Chunchon).

Distribution: Brunei, Burma, China, Japan, Korea, Malaysia, Philippines, Puerto Rico, Russia, Taiwan, USA, Virgin Islands, and Zimbabwe.

Notes: This is the first record of this species from Korea. Yen (1967) described the following characters of this fungus: Fructification amphigenous; stomata forming globular to irregular; conidiophores tortuous, 2~20 in fascicles, but sometime solitary, $48\sim160\times4.5\sim7.0\ \mu\text{m}$; conidia acicular to obclavate-acicular, $84\sim176\times3.6\sim4.8\ \mu\text{m}$. Several species of *Cercospora* were also recorded on *Hydrangea*, including *C. obtegens* Syd. & P. Syd., *C. holobrunnea* J.M. Yen, *C. hyalofilispora* J.M. Yen, *C. katonegensis* J.M. Yen, *C.*

triseptispora J.M. Yen, and *C. yakushimensis* Togashi & Katsuki. *C. obtegens* (Chupp, 1954) differs by its much longer (40~300 μm in length) conidiophores and undulate conidia. *C. yakushimensis* (Togashi and Katsuki, 1952) is distinguished by possessing mostly hypophyllous fructification, non-geniculate conidiophores, pigmented and somewhat shorter (50~65 μm long) conidia. Furthermore, Yen and Lim (1980) redeposited *C. holobrunnea*, *C. hyalofilispora* and *C. triseptispora* into *Mycovellosiella*, and *C. katonegensis* into *Pseudocercospora*. Therefore, the Korean collections agree well with *C. hydrangeae*.

3. *Cercospora physalidis* Ellis, Am. Nat. 16: 810 (1882) emend. U. Braun & Melnik, Trudy Bot. Inst. im. V. L. Komarova (St. Petersburg) 20: 79 (1997) Fig. 3
 = *Cercosporina physalidis* (Ellis) Miura, South Manch. Railway Co. Agric. Rept. 27: 525 (1928)
 = *Cercospora solanicola* G.F. Atk., J. Elisha Mitchell Sci. Soc. 8: 53 (1892)
 = *Cercospora nicotianae* Ellis & Everh., Proc. Acad. Sci. Phila 45: 170 (1893)
 = *Cercospora physalicola* Ellis & Barthol., Erythea 4: 28 (1896)
 = *Cercospora raciborskii* Sacc. & Syd., Syll. Fung. 16: 1070 (1902)
 = *Cercosporina daturicola* Speg., Anal. Mus. Nac. Buenos Aires 20: 425 (1910)
 = *Cercospora daturicola* (Speg.) Vassiljevsky, in Vassiljevsky and Karakulin, Fungi imperfecti parasitici. I. Hy-

phomycetes. p. 347 (1937)

= *Cercospora abchasica* Siemaszko, Bull. du Musée du Caucase 12: 26 (1919)

= *Cercospora melongenae* Welles, Phytopath. 12: 63 (1922)

= *Cercospora atropae* Kvashn., Bull. North Caucasian Plant Prot. Stat. 4: 37 (1928)

= *Cercospora petuniae* Muller & Chupp, Arch. Inst. Bio. Veg. Rio de Janeiro 3: 96 (1936)

= *Cercosporina petuniae* Saito, Trans. Tottori Soc. Agric. Sci. 3: 272 (1931)

= *Cercospora pentuniae* Sandu-Ville & Serea, in Sandu-Ville *et al.*, Lucr. Sti. Inst. Agron. 1962: 94 (1962) (homonym)

= *Cercospora petuniae* var. *brevipedicellata* Chidd., Indian Phytopath. 12: 120 (1959) (nomen non rite publicatum, sine descriptione latina)

Leaf spots amphigenous, scattered, occasionally confluent, subcircular to irregular, 5~10 mm diam., or up to 15 mm when coalescent, pale to yellowish brown with dark brown border lines on the upper surface, brown to greyish brown on the lower surface. **Caespituli** amphigenous, but abundantly hypophyllous. **Mycelium** internal, hyphae septate, branched, hyaline, 2~3 μm wide. **Stromata** small to medium, slightly to moderate developed, subglobular to angular, dark brown to blackish brown, 15~35 μm diam., composed of several swollen, dark brown hyphal cells. **Conidiophores** 4~16 in a divergent to dense fascicle, mostly arising from substomatal stromata or borne singly on the upper surface, olivaceous brown to brown, uniform in colour, straight to mildly curved, 1~4 slightly geniculate, not branched, usually obtuse at the apex, 1~6-septate, 62~192 \times 4.5~5.5 μm ; conidial scars large, 2.0~3.5 μm wide, conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, filiform to narrowly obclavate-cylindrical, straight to mildly curved, hyaline, 3~15-septate, non-constricted at the septa, obtuse to subobtuse at the apex, subtruncate to subobtuse at the base, 32~200 \times 3.0~5.5 μm ; hilum conspicuously thickened, darkened, and non-protruberant.

Habitat: On living leaves of *Physalis alkekengi* var. *franchetii* (Masters) Hort. (Solanaceae).

Specimens examined: SMK 14826 (19 VIII 1998, Chunchon), 14849 (21 VIII 1998, Chunchon), 15331 (4 X 1998, Yangku), 15454 (9 X 1998, Chunchon).

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

Notes: This is the first record of this species from Korea. In SMK 15454, the caespituli are evenly amphigenous, and the conidiophores are occasionally borne singly on the upper surface. Chupp (1954) described this species as follows: Fructification amphigenous; conidiophores 20~250 \times

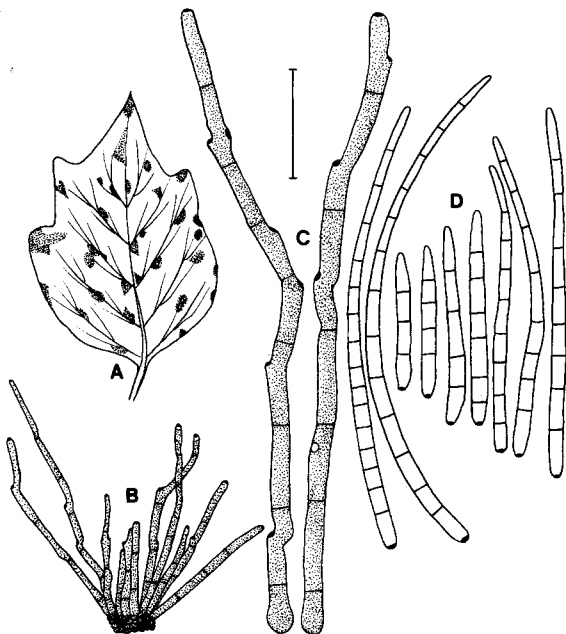


Fig. 3. *Cercospora physalidis*. (A) Leaf spots on the lower leaf surface of *Physalis alkekengi* var. *franchetii* (0.7 \times). (B) and (C) Conidiophores. (D) Conidia. Bar = 30 μm (but 75 μm for B).

4~6.5 μm , borne singly or in dense fascicles; conidia 25~220 \times 3~5 μm , acicular to cylindrical. The Japanese collections (Katuski, 1965) possessed somewhat smaller conidiophores (40~110 \times 4~5 μm) and conidia (30~120 \times 3~5 μm) than those of the present fungus. These characters belong to the variation of this species. Therefore, the Korean collections are in accordance with these previous descriptions. Several species of cercosporoid fungi have been described on *Physalis* spp.; viz., *C. physalidicola* Speg., *C. physalidis-angulatae* J.M. Yen, *C. diffusa* Ellis & Everh., *Pseudocercospora physalidis-minimae* Pavgi & U.P. Singh as well as the present fungus. *C. physalidicola* (Chupp, 1954), *C. physalidis-angulatae* (Yen, 1971), *C. diffusa* (Chupp, 1954) and *P. physalidis-minimae* (Deighton, 1976) are easily distinct from it in many respects. *Cercospora physalidis* was transferred to *Cercosporina* by Miura (1928), and he considered all dimensions of the two species, *Cercosporina physalidis* and *Cercosporina physalidicola*, to be different. Vassiljevsky and Karakulin (1937) placed *Cercosporina physalidis* in *Cercospora*. *C. physalidis* is accepted by Viégas (1946) and Chupp (1954) as the name for the common species on *Physalis* which is of worldwide distribution. However, Ellis (1971) reduced *C. physalidis* to synonymy with *C. apii*. Braun and Melnik (1996) examined various collections on *Aropa*, *Datura*, *Hyscaymus*, *Nicotiana*, *Petunia*, *Solanum*, etc. All of them were morphologically indistinguishable. So, Braun and Melnik (1997) stated that *C. physalidis* is the *C. apii*-like counterpart on hosts belonging to the Solanaceae. A more complete type study is required to elucidate the position of *C. physalidis*.

4. *Cercospora ricinella* Sacc. & Berl., Atti R. Ist. Ven. Sci. Lett. Arti. VI. 3: 721 (1885) Fig. 4
 = *Cercosporina ricinella* (Sacc. & Berl.) Speg., Anal. Mus. Nac. Buenos Aires 20: 429 (1910)
 = *Cercospora albido-maculans* G. Winter, Hedwigia 24: 202 (1885) and J. Mycol. 1: 124 (1885)
 = *Cercospora ricini* Speg., Anal. Mus. Nac. Buenos Aires, Ser. II, 3: 343 (1899)

Leaf spots amphigenous, scattered to confluent, circular to angular, 1~10 mm diam., or up to 15 mm when coalescent, at first appearing yellowish brown to deep brown, later centre becoming greyish white to greyish brown with reddish brown margins, finally turning dingy to dark grey with definite border lines. **Caespituli** amphigenous, but abundantly hypophyllous, punctiform. **Mycelium** internal, hyphae septate, branched, hyaline, 2~3 μm wide. **Stromata** lacking to small, rudimentary to slightly developed, sub-circular to angular, brown to dark brown, 10~30 μm diam., composed of a few swollen hyphal cells. **Conidiophores** 3~15 in a loose to dense fascicle, usually arising from sub-

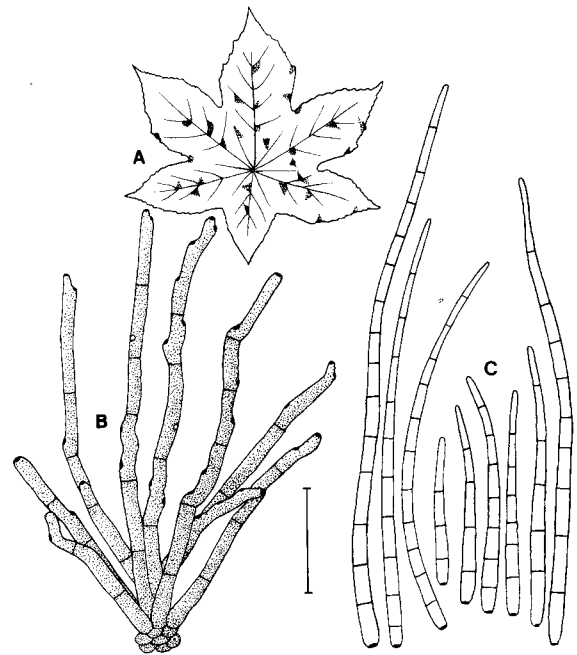


Fig. 4. *Cercospora ricinella*. (A) Leaf spots on the lower leaf surface of *Ricinus communis* (0.3 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μm .

stomatal stomata or sometimes emerging through the cuticle, olivaceous brown, fairly uniform in colour and width, 1~8 times mildly geniculate above the middle, not branched, straight to slightly curved, truncate at the apex, 1~5-septate, 50~140 \times 3.5~5.0 μm ; conidial scars large, 2.0~3.5 μm wide, conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, acicular-filiform to obclavate or obclavate-cylindric, straight to mildly curved, hyaline, 3~14-septate, non-constricted at the septa, obtuse to subobtuse at the apex, truncate to subtruncate at the base, 44~176 \times 3.0~4.5 μm ; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Ricinus communis* L. (Euphorbiaceae).

Specimens examined: SMK 15427 (9 X 1998, Chunchon), 15431 (9 X 1998, Chunchon).

Distribution: Worldwide where the host plant is growing or cultivated, including China, Japan, Korea, and Taiwan.

Notes: Nakata and Takimoto (1928) and Park (1958) listed this fungus from Korea. Chupp (1954) published this species with the following characters: Stromata lacking to 50 μm diam.; conidiophores arranged in dense fascicles, 1~2 times geniculate; conidia acicular to obclavate or cylindrical. Katsuki (1965) described somewhat shorter (28~70 μm long), 0~1-septate conidiophores, acicular to obclavate conidia with subconical-truncate bases. Bagynarayana *et al.* (1991) reported that an Indian collection possesses pigmented conidiophores and colourless, partly catenate conidia. These characters are, however, somewhat variable in

this species. Therefore, the Korean collections are in agreement with these previous descriptions.

5. *Cercospora volkameriae* Speg., Rev. Mus. Plata 15: 47 (1908) Fig. 5

Leaf spots amphigenous, scattered to confluent, subcircular to irregular, often vein-limited, 2~5 mm diam., or up to 10 mm when coalescent, centre appearing brown with dark reddish brown border lines, sometimes becoming greyish brown with dark brown margins. **Caespituli** amphigenous. **Mycelium** internal, hyphae septate, branched, hyaline, 2~3 μm wide. **Stromata** lacking to small, rudimentary to slightly developed, subcircular to irregular, brown to dark brown, 8~15 μm diam., composed of a few brown hyphal cells. **Conidiophores** 3~15 in a divergent fascicle, arising from substomatal stromata and emerging through the cuticle, pale olivaceous brown to olivaceous brown throughout, irregular in width, straight to slightly or even tortuous, 0~5(~10) times mildly geniculate, not branched, truncate to subtruncate at the apex, 1~6-septate, very variable in length, 24~240 \times 3.5~5.5(~7.0) μm ; conidial scars large, 2~3 μm wide, conspicuous, apical or on shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary, acicular to filiform, straight to mildly curved or undulate, hyaline to subhyaline, acute to subacute at the apex, truncate to subtruncate, 6~22-septate, non-constricted at the septa, very variable in length, 70~260 \times 3.0~4.5 μm ; hilum conspicuously thickened, darkened, and non-protuberant.

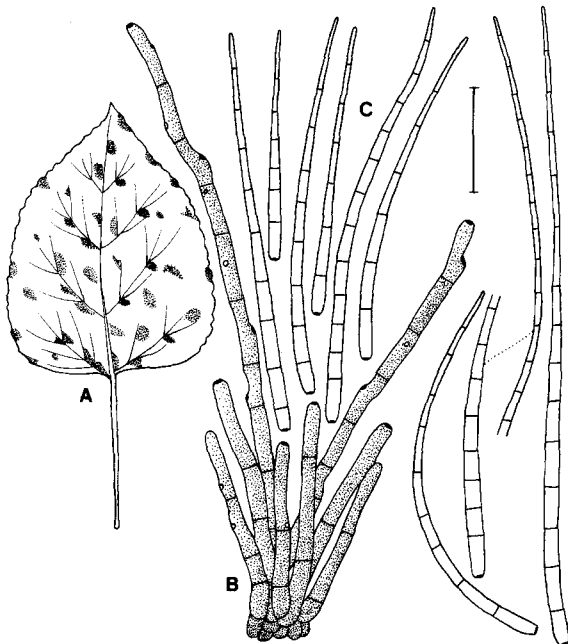


Fig. 5. *Cercospora volkameriae*. (A) Leaf spots on the upper leaf surface of *Clerodendron trichotomum* (0.7 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μm .

Habitat: On living leaves of *Clerodendron trichotomum* Thunb. (Verbenaceae).

Specimens examined: SMK 14203 (16 IX 1998, Seoul), 15351 (5 X 1998, Chunchon), 15448 (9 X 1998, Chunchon), 15524 (20 X 1998, Seoul).

Distribution: Brazil, Brunei, China, Cuba, Ghana, Guinea, India, Jamaica, Java, Korea, Nigeria, Sierra Leone, Sudan, Taiwan, and Tanzania.

Notes: This is the first record of this species from Korea. In SMK 15448, the conidiophores are much longer, wider, tortuous, and more geniculate (up to 10 times) than those of other specimens. American collections (Chupp, 1954) were characterized by having tortuous and shorter (30~150 μm long) conidiophores, obclavate to acicular conidia. Based on Taiwanese collections, Hsieh and Goh (1990) described the following features of this species: Conidiophores erect or tortuous near the apex, constricted at the septa; conidia straight to undulate and somewhat narrower (only 1.5~3 μm wide). Nevertheless, the Korean collections are very close to *C. volkameriae*. Some *Cercospora* species have been reported on *Clerodendron*, namely *C. bakeri* Syd. & P. Syd., *C. clerodendri* Miyake, and *C. kashotoensis* W. Yamam. *C. bakeri* possessed cylindrical, pigmented, and very short (30~60 μm long) conidia. *C. clerodendri* was characterized by obclavate conidia and much shorter (10~70 μm in length) conidiophores. *C. kashotoensis* had solitary branched conidiophores from procumbent threads and obclavate-cylindrical conidia. Therefore, they are not related to the present fungus.

6. *Pseudocercospora abelmoschi* (Ellis & Everh.) Deighton, Mycol. Papers 140: 138 (1976) Fig. 6

= *Cercospora abelmoschi* Ellis & Everh., J. Inst. Jamaica 1: 347 (1893)

= *Cercospora hibisci-manihotis* Henn., Hedwigia 43: 146 (1904)

Leaf spots amphigenous, scattered, angular to irregular, 2~4 mm diam., vein-limited, initially appearing as indistinct discolourations, later becoming greyish brown to dingy grey without definite border lines on the upper surface, dirty grey to dark grey on the lower surface. **Caespituli** amphigenous, effuse, fuliginous. **Mycelium** internal, hyphae septate, branched, hyaline, 2~3 μm wide, secondary mycelium absent. **Stromata** large, well-developed, dark brown to blackish brown, globular, 50~78 μm diam., composed of some swollen hyphal cells. **Conidiophores** up to 50 in a loose to very dense fascicle, emerging through stomatal openings or occasionally erumpent through the cuticle, olivaceous brown to brown throughout, straight to mildly curved, sometimes 1~2 mildly geniculate at the upper portion, usually not branched, but rarely branched,

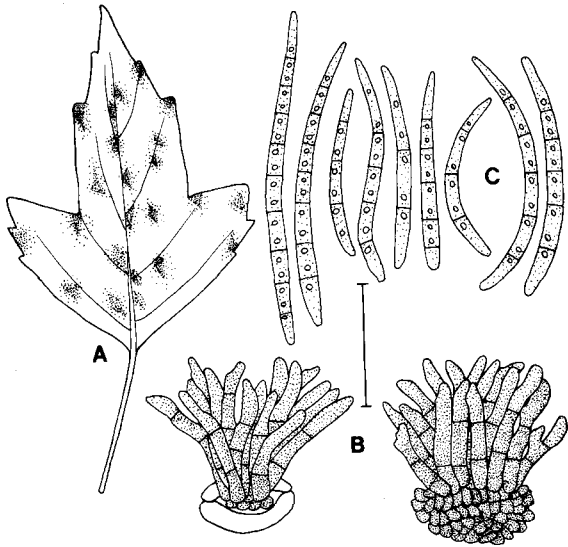


Fig. 6. *Pseudocercospora abelmoschi*. (A) Leaf spots on the lower leaf surface of *Hibiscus syriacus* (0.7 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μ m.

obtuse to subobtuse at the apex, 0~3-septate, 12~38 \times 3.0~5.5 (~6.5) μ m; conidial scars inconspicuous. **Conidia** solitary, obclavate-cylindric to filiform, straight to slightly curved, subhyaline due to a few oil drops, guttulate, subobtuse to obtuse at the apex, obconic to subtruncate, 1~9-septate, non-constricted at the septa, 12~88(~100) \times 3.0~5.0 μ m; hilum unthickened, not darkened.

Habitat: On living leaves of *Hibiscus syriacus* L. (Malvaceae).

Specimens examined: SMK 13138 (2 X 1994, Yangku), 14854 (21 VIII 1998, Hongchon), 14867 (25 IX 1998, Hongchon), 15322 (4 X 1998, Yangku).

Distribution: Burma, China, Cuba, India, Korea, Malaysia, and Taiwan.

Notes: This is the first record of this species from Korea. In SMK 14854, conidiophores are rarely branched. The epiphyllous conidiophores in SMK 15322 are in a loose to dense fascicle, the hypophyllous ones are arranged in a very dense fascicle. Several species of *Pseudocercospora* have been described earlier on the host genus *Hibiscus*; viz., *P. hibisci-canabina* (Sawada) Deighton (1976), *P. hibiscina* (Ellis & Everh.) Y.L. Guo & X.J. Liu (1989), *P. hibiscigena* P.N. Singh, S.K. Singh & S.C. Tripathi (1996), *P. minuta* S.R. Chowdhury & Chandal (1986), *P. mutabilis* (S.H. Sun) J.M. Yen (1981) as well as *P. abelmoschi*. *P. abelmoschi* is common and widespread on *Hibiscus* in the tropics and temperate areas. There are much variation in the length of conidiophores and in the shape of conidia which may be obclavate-cylindric or even filiform. Chupp (1954) and Yen and Lim (1970) described that *C. abelmoschi* possesses much longer conidiophores (20~140 μ m and 32~100 μ m, respectively) and obclavate to cylindric

conidia. Chinese (Guo and Hsieh, 1995) and Taiwanese (Hsieh and Goh, 1990) collections of *P. abelmoschi* have been characterized by forming well-developed superficial secondary mycelia. Furthermore, Chupp (1954) reduced *Cercospora hibisci* and *C. hibisci-canabini* to synonymy with *C. abelmoschi*. However, *C. hibisci* is probably an *Helminthosporium* (see Chupp, 1954) and *C. hibisci-canabini* seems to represent a distinct species (Deighton, 1976). Hsieh and Goh (1990) and Guo and Hsieh (1995) followed Deighton's concept. *P. hibiscina*, *P. hibiscigena*, and *P. hibisci-mutabilis* are clearly different from the present species. *P. minuta*, as evident from the original illustrations (conidiophore and conidia bearing distinct scars and hila respectively), does not appear to be a *Pseudocercospora*, and will probably be re-allocated in an appropriate segregate of the *Cercospora* s. lat. other than *Pseudocercospora*. Therefore, the Korean collections agree well with *P. abelmoschi*.

7. *Pseudocercospora cruenta* (Sacc.) Deighton, Mycol. Papers 140: 142 (1976) Fig. 7

- = *Cercospora cruenta* Sacc., *Michelia* 2: 149 (1880)
- = *Cercospora phaseolorum* Cooke, *Grevillea* 12: 30 (1883)
- = *Cercospora vignae* Ellis & Everh., *J. Mycol.* 3: 19 (1887)
- = *Cercospora vignae* Racib., *Zeit. Pflanzenkr.* 8: 66 (1898)
- = *Cercospora lusoniensis* Sacc., *Ann. Mycol.* 12: 314 (1914)

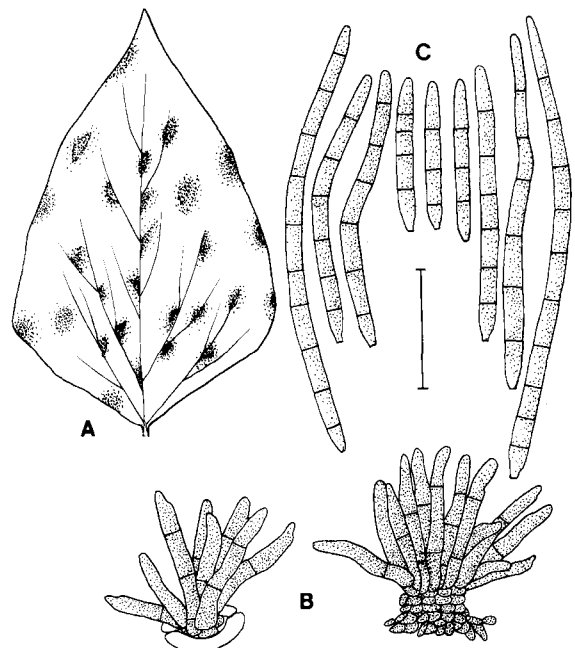


Fig. 7. *Pseudocercospora cruenta*. (A) Leaf spots on the upper leaf surface of *Vigna sinensis* (0.7 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μ m.

= *Cercospora raciborskii* T. Matsumoto & Nagai, J. Plant Protect. (Byochugaizashi) 18: 714 (1931)

= *Cercospora vignae-sinensis* F.L. Tai & C.T. Wei, Sinensia 4: 126 (1933)

= *Cercospora neovignae* W. Yamam., Trans. Sapporo Nat. Hist. Soc. 13: 142 (1943)

= *Cercospora vignae-sinensis* Sawada, Taiwan Agric. Res. Inst. Rept. 85: 125 (1943), nom. nud.!

Teleomorph: *Mycosphaerella cruenta* Latham, Mycologia 26: 516 (1934)

Leaf spots amphigenous, scattered to confluent, indistinct to distinct, circular to irregular, 1~15 mm diam., or up to 20 mm when coalescent, initially appearing yellowish brown without definite margins, later becoming reddish brown to pale rusty brown, sometimes centre turning pale yellowish brown to reddish grey with yellowish brown to brown border lines on the upper surface, pale yellowish brown to reddish brown without definite margins on the lower surface. **Caespituli** amphigenous, but mostly hypophyllous. **Mycelium** internal, hyphae septate, branched, hyaline, 2~3 μm wide. **Stromata** small, slightly developed, subglobose to angular, brown to dark brown, 10~20 μm diam., composed of a few swollen hyphal cells. **Conidiophores** 3~15 in a loose to dense fascicle, mostly arising from substomatal stromata, pale olivaceous to olivaceous brown throughout, usually narrower towards the apex, straight to mildly curved, 0~2 times geniculate, rarely branched, obconic at the apex, 0~3-septate, 15~50 \times 3.0~5.0 μm ; conidial scars inconspicuous. **Conidia** solitary, obclavate-cylindric to cylindric, straight to mildly curved, subhyaline, subobtuse to obtuse at the apex, obconically truncate to subtruncate, 3~11-septate, non-constricted at the septa, 40~150 \times 3.5~5.0 μm ; hilum unthickened, not darkened.

Habitat: On living leaves of *Vigna sinensis* King (Leguminosae).

Specimen examined: SMK 15099 (13 IX 1998, Seoul).

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

Notes: Park (1958) listed *Cercospora cruenta* on *Phaseolus vulgaris* and *P. angularis* and *Mycosphaerella cruenta* on *Vigna sinensis* from Korea. Chupp (1954) described the following characters of *C. cruenta*: Fructification amphigenous, but much more abundant below; conidiophores arranged in dense fascicles, straight to sinuous, 1~3 times geniculate, occasionally branched, 0~2-septate, 10~75 \times 2.5~5.0 μm ; conidia obclavate-cylindric, sharply obconic at the base, obtuse to subacute at the tip, 25~150 \times 2.0~5.0 μm . However, Deighton (1976) re-allocated *C. cruenta* into *Pseudocercospora* because of inconspicuous conidial scars. Therefore, the present fungus agrees well with *Pseudocercospora cruenta*. Cuban material (Castañada and Braun,

1989) possessed somewhat longer and wider (up to 150 \times 2~6 μm) conidiophores than those of the Korean collection. Several species of *Pseudocercospora* on *Vigna*, which are well distinguished, have been recorded. *P. dolichi* (Ellis & Everh.) J.M. Yen (1981), *P. vignigena* J.M. Yen, A.K. Kar & B.K. Das (1982), *P. mungo* Deighton (1976), and *P. vignae-reticulatae* Deighton (1976) are not related to the present species.

8. *Pseudocercospora varia* (Peck) J.K. Bai & M.Y. Cheng, Acta Mycol. Sinica 11: 123 (1992) Fig. 8

= *Cercospora varia* Peck, N.Y. State Mus. Ann. Rept. 35: 141 (1884)

Leaf spots amphigenous, scattered to confluent, circular to irregular, 1~5 mm diam., or up to 13 mm when coalescent, centre becoming greyish white to reddish brown with blackish brown margins, brown to dark brown with pale yellowish brown haloes on the upper surface, greyish brown to pale brown with indistinct border lines on the lower surface. **Caespituli** hypophyllous. **Mycelium** internal, hyphae septate, branched, hyaline, 1.5~3.0 μm wide. **Stromata** small to medium, well-developed, subglobose to globose, dark brown to brown, 20~50 μm diam., composed of several dark brown, swollen hyphal cells. **Conidiophores** 10~30 in a dense fascicle, emerging through stomatal openings, olivaceous brown throughout, straight to mildly curved, slightly narrower towards the apex, not geniculate, usually not branched, but rarely branched, 0~3-septate, 10~

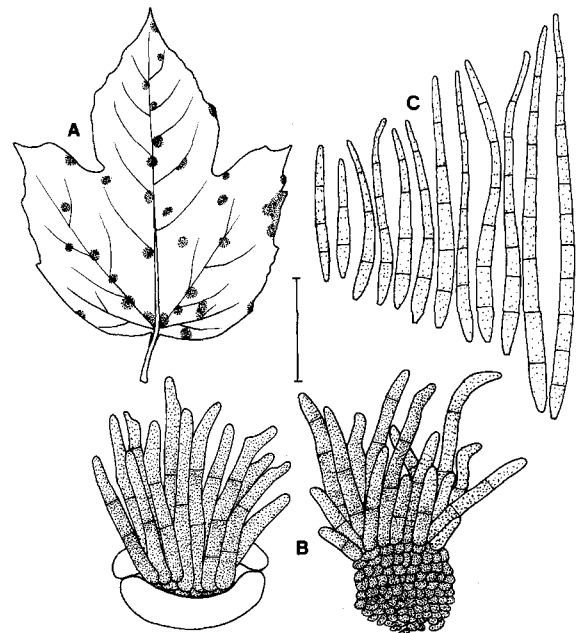


Fig. 8. *Pseudocercospora varia*. (A) Leaf spots on the lower leaf surface of *Viburnum sagentii* (0.5 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μm .

72×3.5–5.5 μm ; conidial scars inconspicuous. **Conidia** solitary, obclavate to obclavate-cylindric, straight to mildly curved, subhyaline to hyaline, eguttulate, obtuse at the apex, obconically truncate to subtruncate at the base, 2–11-septate, non-constricted at the septa, 35–124×3.5–5.5 μm ; hilum unthickened, not darkened.

Habitat: On living leaves of *Viburnum sagentii* Köhne (Caprifoliaceae).

Specimen examined: SMK 14011 (25 VIII 1997, Pyongchang).

Distribution: China and Korea.

Notes: Park (1958) listed *Cercospora varia* on the same host species for the first time from Korea. Chupp (1954) published that *C. varia* has amphigenous fructification and catenate, hyaline conidia. Bai and Cheng (1992) re-allocated *C. varia* to *Pseudocercospora* because of pigmented conidia and inconspicuous conidial scars, and described hypophyllous caespituli. Some cercosporoid taxa have been reported on *Viburnum*: viz., *Cercospora penicillata* (Ces.) Fresen., *C. viburnicola* Ray, *Cercostigmina tinea* (Sacc.) U. Braun, *Pseudocercospora viburni-cylindrici* (M.C. Tai) U. Braun, and *Pseudophaeoramularia opuli* (Höhn.) U. Braun, in Braun and Melnik (1997). *C. penicillata*, *C. viburnicola*, *Cercostigmina tinea*, and *Pseudophaeoramularia opuli* are clearly different from the present species. *Pseudocercospora viburni-cylindrici* is akin to this species, but differs by its somewhat longer (50–150 μm in length), coremoid conidiophores and somewhat narrower (2.5–4.0 μm in width) conidia. Therefore, the Korean collection is most close to *P. varia*.

9. *Pseudocercospora paridicola* H.D. Shin & U. Braun, Mycotaxon 49: 357 (1993) Fig. 9

Leaf spots amphigenous, scattered to confluent, subcircular to circular or sometimes irregular, 10–15 mm diam., or up to 20 mm when coalescent, initially appearing pale greenish grey, later becoming pale tan to yellowish brown with dark brown margins. **Caespituli** amphigenous. **Mycelium** internal, hyphae septate, branched, hyaline, 2–3 μm wide. **Stromata** lacking to very small, rudimentary to poorly developed, hyaline to very pale olivaceous brown, 5–10 μm diam., composed of a few swollen hyphal cells. **Conidiophores** solitary or 2–10 in a loose fascicle, but occasionally up to 20 in a dense fascicle, arising through stomata and emerging through the cuticle, bottle-shaped to cylindric or subcylindric-ampulliform, hyaline, straight to slightly curved, usually not geniculate, but rarely once geniculate at the upper portion, not branched, usually aseptate and rarely uniseptate, 10–32×4.5–9.0 μm ; conidial scars inconspicuous. **Conidia** solitary, obclavate-cylindric to cylindric-fusiform or filiform, straight to mildly curved, hyaline,

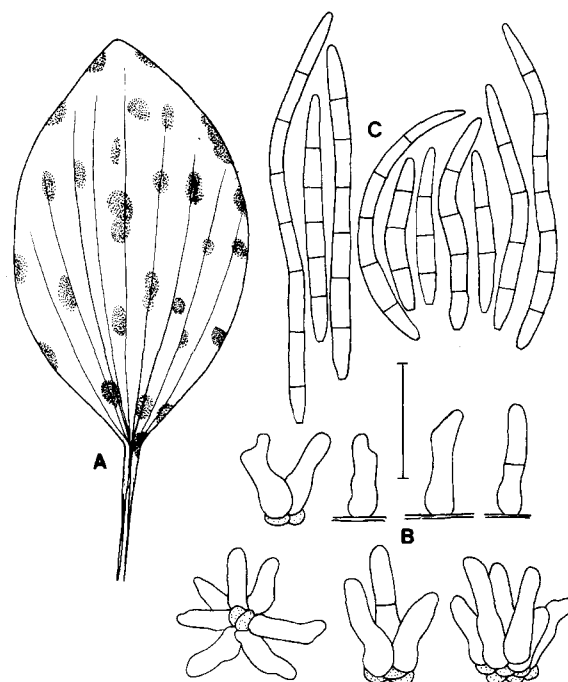


Fig. 9. *Pseudocercospora paridicola*. (A) Leaf spots on the upper leaf surface of *Paris verticillata* (0.7×). (B) Conidiophores. (C) Conidia. Bar = 30 μm .

obtuse to subobtuse at the apex, narrowly obconically truncate to subtruncate, 2–7-septate, non-constricted at the septa, 45–160×3.5–6.0 μm ; hilum unthickened, not darkened.

Habitat: On living leaves of *Paris verticillata* Bieb. (Liliaceae).

Specimens examined: SMK 11653 (6 VI 1992, Pyongchang) (holotype), 11759 (7 VII 1992 Pyongchang) 12400 (19 V 1993, Kangnung).

Distribution: Known only from the type locality, Korea.

Notes: Shin and Braun (1993) first recorded this fungus as a new species with full morphological description and detailed illustrations. Other Korean collections, SMK 11759 and 12400, agree well with the holotype, although the conidia are somewhat wider and occasionally moderately curved, and the conidiophores are sometimes uniseptate and usually plentiful on the upper surface. Shin and Braun (1993) mentioned that this fungus is related to *Pseudocercospora inconspicua* (G. Winter) U. Braun on *Lilium* and *P. sublineolata* (Thüm.) U. Braun on *Veratrum* which were reported in previous papers of this series by Kim and Shin (1998d, 1999a), but are different by its much smaller stromata and conidiophores produced singly or in small group. *P. paridicola* is a very unusual fungus. It is distinguished from all known *Pseudocercospora* species by solitary conidiophores, erumpent through the cuticle.

10. *Ramularia grevilleana* (Tul. & C. Tul.) Jørst., Meld. Stat. Pflanzenpatol. Inst. 1: 17 (1945) var. *grevilleana* emend.

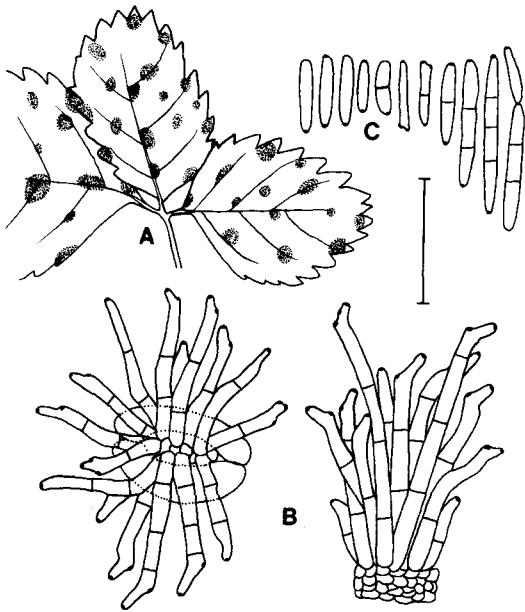


Fig. 10. *Ramularia grevilleana* var. *grevilleana*. (A) Leaf spots on the lower leaf surface of *Fragaria ananassa* (0.7 \times). (B) Conidiophores. (C) Conidia. Bar = 30 μ m.

- U. Braun Fig. 10
 = *Cylindrosporium grevilleanum* Tul. & C. Tul., Select. Fung. Carpol. 2: 288, Paris (1863)
 = *Ramularia tulasnei* Sacc., Michelia 1: 536 (1879), nom. superfl.!
 = *Isariopsis grevilleana* (Tul. & C. Tul.) J. Schröt., in Cohn., Krypt.-Fl. Schles., Pilze II: 495, Breslau (1897)
 = *Ramularia martianoffiana* Thüm., Bull. Soc. Imp. Nat. Moscou 53: 208 (1878)
 = *Ramularia fragariae* Peck, Ann. Rep. N.Y. State Mus. Nat. Hist. 32: 43 (1879)
 = *Ramularia modesta* Sacc., Fungi ital. del. Tab. 999 (1881)
 = *Ramularia arvensis* Sacc., Fungi ital. del. Tab. 1000 (1881)
 = *Ramularia anserina* Allesch., Ber. Bayr. Bot. Ges. 4: 38 (1896)
 = *Ramularia waldsteiniae* Ellis & Davis, in Davis, Trans. Wis. Acad. Sci. Art. Lett. 14: 99 (1903)
 = *Ramularia punctiformis* Sacc., in Harrim., Alaska Exp. Cryptog.: 16 (1904)
 = *Ramularia tulasnei* var. *fragariae-vescae* C. Massal., Osserv. fitol. in Madonna Verona II: 9 (1908)
 Teleomorph: *Mycosphaerella fragariae* (Tul.) Lindau, in Potebnja, K istorii razvitija nekotoryh askomicetov. 1. *Mycosphaerella*. 2. *Gnomonia*, *Glomerella*. 3. *Pseudopeziza*. Charkov (1908)

Leaf spots amphigenous, scattered, subcircular to irregular, 1~10 mm diam., initially appearing pale yellowish

brown to brown with reddish brown margins, later becoming greyish white with reddish brown or purplish brown border lines. **Caespituli** hypophyllous, punctiform to effuse. **Mycelium** internal, hyphae septate, branched, hyaline, 2~4 μ m wide. **Stromata** small, slightly developed, very pale olivaceous to colourless, 10~20 μ m diam., composed of a few swollen hyphal cells. **Conidiophores** 5~15 in a loose to dense fascicle, arising from substomatal stromata, hyaline, straight to mildly curved, 1~2 times geniculate, not branched, 1~3-septate, 16~65 \times 2.5~4.0 μ m; conidial scars minute, 1.0~1.5 μ m, slightly conspicuous, apical or on small shoulders of conidiogenous cells caused by geniculation. **Conidia** solitary or in short (1~2) branched or unbranched chains, subcylindric to fusiform or ellipsoid, hyaline, subobtuse to somewhat pointed at the each end, 0~3-septate, non-constricted at the septa, 12~45 \times 2.0~3.5 μ m; hilum slightly thickened, somewhat darkened, and non-protuberant.

Habitat: On living leaves of *Fragaria ananassa* Duchesne (Rosaceae).

Specimen examined: SMK 14618 (7 VI 1998, Yangku).

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

Notes: Park (1958) first listed *Mycosphaerella fragariae* as teleomorph of this species from Korea. Braun (1998) emended and described this species as follows: Caespituli hypophyllous; stromata forming small to moderately large, 10~50 μ m diam.; conidiophores arranged in a loose to dense fascicle, 10~40 \times 1.5~5.0 μ m; conidia narrowly ellipsoid-ovoid, subcylindric-fusiform, smooth to verruculose, 0~2-septate, 15~45 \times 2.5~4.5 μ m. Therefore, the present fungus fits well with Braun's description. Although in the Korean collection conidiophores are 1~3-septate, and conidia are not verruculose and 1~3-septate, these features are within the variation of this fungus. *R. grevilleana* var. *cercosporioides* (U. Braun & Rogerson) U. Braun is morphologically very close to the present fungus, but differs in possessing solitary or catenate, very long, often filiform, *Cercospora*-like conidia. The differences are, however, only gradual and sometimes overlap the morphological data in *R. grevilleana* var. *grevilleana*. Therefore, the former species is only considered a separate variety of the latter ones (Braun, 1998).

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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 열 번째 보고이다. 이번 보고에서는 *Cercospora* 5종, *Pseudocercospora* 3종, *Pseudocercospora* 1종 및 *Ramularia* 1종에 대한 균학적 특징을 기재·묘사하였다. 큰금계국에서 *Cercospora coreopsidis*, 수국과 산수국에서 *C. hydrangeae*, 파리에서 *C. physalidis*, 피마자에서 *C. ricinella*, 누리장나무에서 *C. volkammeriae*, 무궁화에서 *Pseudocercospora abelmoschi*, 동부에서 *P. cruenta*, 백당나무에서 *P. varia*, 샷갓나무에서 *Pseudocercospora paridicola*, 그리고 딸기에서 *Ramularia grevilleana* var. *grevilleana*를 각각 동정하였다.

References

- Bai, J. K. and Cheng, M. Y. 1992. Some new combinations of the genus *Cercosporidium*, *Mycovelosiella*, *Pseudocercospora* in China. *Acta Mycol. Sinica* **11**(2): 120-121.
- Bagyanarayana, G., Jagadeeswar, P. and Braun, U. 1991. Miscellaneous notes on Indian Cercosporae. *Mycotaxon* **42**: 319-326.
- Braun, U. 1998. A Monograph of *Cercospora*, *Ramularia* and Allied Genera (Phytopathogenic Hyphomycetes). Vol. 2. IHW-Verlag, Eching. 493 p.
- Braun, U. and Melnik, V. A. 1996. An annotated list of *Cercospora* types deposited in herbarium of All-Russian Institute for Plant Protection (LEP). *Mikol. i Fitopatol.* **30**: 1-9.
- Braun, U. and Melnik, V. A. 1997. Cercosporoid fungi from Russia and adjacent countries. *Trudy Bot. Inst. im. V. L. Komarova* (St. Petersburg) **20**: 1-130.
- Casta eda, R. R. and Braun, U. 1989. *Cercospora* and allied genera of Cuba (I). *Cryptog. Bot.* **1**: 42-55.
- Chowdhury, S. R. and Chandal, D. S. 1986. Notes on fungi occurring at Durg (M.P.). I. *Proceedings of the National Academy of Science. India Section B.* **56**: 81-84.
- Chupp, C. 1954. A Monograph of the Fungus Genus *Cercospora*. Ithaca, New York. 667 pp.
- Deighton, F. C. 1976. Studies on *Cercospora* and allied genera. VI. *Pseudocercospora* Speg., *Pantospora* Cif. and *Cercoseptoria* Petr. *Mycol. Papers* **140**: 1-168.
- Ellis, M. B. 1971. Dematiaceous Hyphomycetes. Kew. 608 p.
- Guo, Y. L. and Hsieh, W. H. 1995. The Genus *Pseudocercospora* in China. *Mycosystema Monographicum Series* No. **2**. 338 p.
- Guo, Y. L. and Liu, X. J. 1989. Studies of the genus *Pseudocercospora* in China I. *Mycosystema* **2**: 225-240.
- Hsieh, W. H. and Goh, T. K. 1990. *Cercospora* and Similar Fungi from Taiwan. Maw Chang Book Co., Taipei. 376 p.
- Katsuki, S. 1965. Cercosporae of Japan. *Trans. Mycol. Soc. Japan*, Extra Issue No. 1. 100 p.
- Kim, J. D. and Shin, H. D. 1998a. Taxonomic studies on *Cercospora* and allied genera in Korea (I). *Kor. J. Mycol.* **26**: 327-341.
- Kim, J. D. and Shin, H. D. 1998b. Taxonomic studies on *Cercospora* and allied genera in Korea (II). *Kor. J. Mycol.* **26**: 342-353.
- Kim, J. D. and Shin, H. D. 1998c. Taxonomic studies on *Cercospora* and allied genera in Korea (III). *Kor. J. Mycol.* **26**: 424-436.
- Kim, J. D. and Shin, H. D. 1998d. Taxonomic studies on *Cercospora* and allied genera in Korea (IV). *Kor. J. Mycol.* **26**: 437-449.
- Kim, J. D. and Shin, H. D. 1999a. Taxonomic studies on *Cercospora* and allied genera in Korea (V). *Kor. J. Mycol.* **27**: 44-53.
- Kim, J. D. and Shin, H. D. 1999b. Taxonomic studies on *Cercospora* and allied genera in Korea (VI). *Kor. J. Mycol.* **27**: 54-62.
- Kim, J. D. and Shin, H. D. 1999c. Taxonomic studies on *Cercospora* and allied genera in Korea (VII). *Kor. J. Mycol.* **27**: 138-146.
- Kim, J. D. and Shin, H. D. 1999d. Taxonomic studies on *Cercospora* and allied genera in Korea (VIII). *Kor. J. Mycol.* **27**: 145-157.
- Kim, J. D. and Shin, H. D. 1999e. Taxonomic studies on *Cercospora* and allied genera in Korea (IX). *Kor. J. Mycol.* **27**: 211-219.
- Miura, M. 1928. Flora of Manchuria and East Mongolia. Part III. Cryptogams, Fungi. *South Manch. Railway Co. Agric. Rept.* **27**: 517-534.
- Nakata, K. and Takimoto, K. 1928. List of diseases of cultivated plants in Korea. *Bull. Agric. Exp. Stat. Korea* **15**: 1-146.
- Park, J. S. 1958. Fungous Diseases of Plants in Korea (1). *Coll. Agric., Chungnam Nat. Univ. Bull.* No. **1**. 106 p.
- Shin, H. D. and Braun, U. 1993. Notes on Korean Cercosporae and allied genera (I). *Mycotaxon* **49**: 351-362.
- Singh, P. A., Singh, S. K. and Tripathi S. C. 1996. New species of *Pseudocercospora* causing leaf spots of forest plant of Nepal. *Mycol. Res.* **100**: 1129-1132.
- Thaung, M. M. 1984. Some fungi of *Cercospora* complex from Burma. *Mycotaxon* **19**: 425-452.
- Togashi, K. and Katsuki, S. 1952. New or noteworthy Cercosporae from Japan. *Bot. Mag. Tokyo* **65**: 18-26.
- Vassiljevsky, N. I. and Karakulin, B. P. 1937. Parazitnye nesovershennye griby, Chast, 1. Gifomicety (Parasitic imperfect fungi. Part. 1. Hyphomycetes). Publishing House of the Academy of Science of the USSR, Moskva, Leningrad. 517 p.
- Viégas, A. P. 1946. Alguns fungos do Brazil XIII. *Hifomicetos. Bragantia* **6**: 353-442.
- Yen, J. M. 1967. Étude sur les champignons parasites du Sud-Est Asiatique. VII. Quatrieme note sur quelques *Cercospora* et *Stenella* de Singapour (Malaisie). *Rev. Mycol.* **32**: 177-202.
- Yen, J. M. 1971. Les *Cercospora* du Gabon. III. *Cah. Maboké* **9**: 101-115.
- Yen, J. M. 1981. Étude sur les champignons parasites du Sud-Est Asiatique. XXXIV. Les *Cercospora* de Formose. VII. *Bull. Soc. Mycol. Fr.* **97**: 149-155.

- Yen, J. M. and Lim, G. 1970. Étude sur les champignons parasites du Sud-Est Asiatique. XII. Septième note sur les *Cercospora* de Malaisie. *Cah. Pacifique* **14**: 87-104.
- Yen, J. M. and Lim, G. 1973. Étude sur les champignons parasites du Sud-Est Asiatique. XX. Dixième note sur les *Cercospora* de Malaisie. *Cah. Pacifique* **17**: 95-114.
- Yen, J. M. and Lim, G. 1980. *Cercospora* and allied genera of Singapore and the Malay Peninsula. *Gardens' Bull. Singapore* **33**: 152-263.
- Yen, J. M., Kar, A. K. and Das, B. K. 1982. Studies on hyphomycetes from west Bengal, India. I. *Cercospora* and allied genera of west Bengal. 1. *Mycotaxon* **16**: 35-57.