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

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

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ABSTRACT: This paper is a third contribution towards taxonomic studies on *Cercospora* and allied genera, and contains ten species of Korean cercosporoid fungi; viz. *Cercospora achyranthis*, *C. canescens*, *C. fukushiana*, *C. polygonacea*, *Cercosporella virgaureae*, *Pseudocercospora fukuokaensis*, *P. puerariicola*, *Ramularia cynarae*, *R. inaequalis*, and *R. rubella*. Morphological characteristics of taxonomic value are described and drawn for these species to contribute towards a mycological monograph of Korean cercosporoid fungi.

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

In previous contributions of this series (Kim and Shin, 1998a, 1998b), 20 cercosporoid fungi from Korea including 8 species belonging to *Cercospora*, 1 to *Distocercospora*, 2 to *Mycovellosiella*, 3 to *Passalora*, 1 to *Phaeoisariopsis* and 5 to *Pseudocercospora* have been reported. In the present paper, based on Korean specimens, 10 cercosporoid fungi, 4 species belonging to *Cercospora*, 1 to *Cercosporella*, 2 to *Pseudocercospora* and 3 to *Ramularia* are described and illustrated. The specimens examined are preserved at the mycological herbarium (SMK) at the Department of Agricultural Biology, Korea University, Seoul, Korea.

Descriptions

1. *Cercospora achyranthis* Syd. & P. Syd. (Fig. 1)
Annls Mycol. 7: 171 (1909)

Leaf spots on the upper surface invisible to pale greenish, angular; on the lower surface scattered to confluent, indistinct, at first irregular and effuse, later becoming vein-limited, 2~10 mm diam., without definite margin, dingy to dark gray. **Caespituli** hypophyllous, effuse, fluccose-velutinous, grayish to dark gray, sometimes appearing like symptoms of downy mildews due to abundant fructification of the fungus. **Mycelium** internal, hyphae septate, branched. **Stromata** lacking or rudimentary, composed of a few swollen brown hyphal cells. **Conidiophores** 2~8 in a loose fascicle, emerging through stomatal opening, olivaceous brown throughout or paler upwards, 3~14-septate, straight to 1~8 times mildly to abruptly geniculate, sometimes branched, 75~420×4.0~6.0 μm, conidial scars medium, conspicuous, apical or on shoulders caused by geniculation. **Conidia** solitary, filiform or somewhat acicular, shorter ones usually cylindric, straight to mildly curved, hyaline, 5~18-septate, usually non-constricted, occasionally very slightly constricted at some septa of shorter conidia,

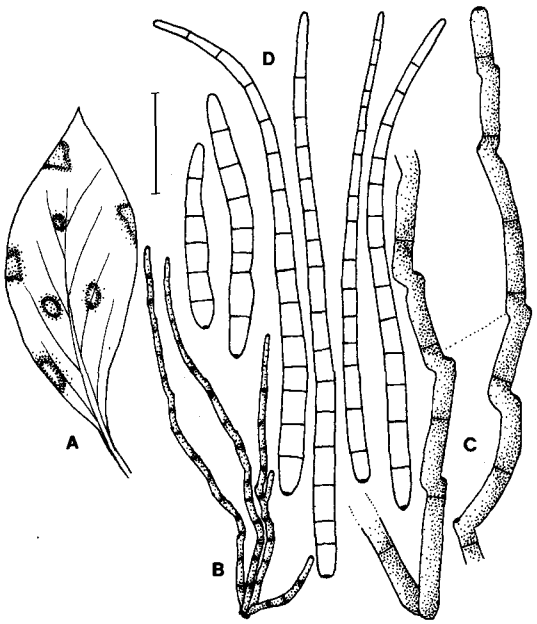

Fig. 1. *Cercospora achyranthis*: A, Leaf spots on the lower leaf surface of *Achyranthes japonica* (0.5×); B, Conidiophores; C, Conidiophore; D, Conidia. Bar=30 μm (but 75 μm for B).

subobtuse to rounded at the apex, subtruncate to obconically truncate at the base, variable in length, 36~174×5.0~8.0 μm; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Achyranthes japonica* (Miq.) Nakai (Amaranthaceae).

Specimens examined: SMK 13005 (13 IX 1994, Chonju), 15120 (18 IX 1998, Jinju).

Distribution: Puerto Rico, China, India, Japan, Korea and Taiwan.

Notes: Shin (1995) recorded this fungus for the first time from Korea and provided a brief morphological description. Shin and Braun (1996) listed the second Korean record on *Achyranthes japonica*. Katsuki (1965) described this fungus on the same host species as having short conidiophores (30~227 μm) and conidia (34~87 μm). Chupp (1954) and Hsieh and Goh (1990) described very narrower conidia, 3.5~5.0 and 3.0~5.0 μm, respectively. The measurements of conidiophores and conidia are usually of little taxonomic importance, since these structures are greatly variable. We think this variabilities are correlated with environmental influence, for example, temperature, humidity, etc.

2. *Cercospora canescens* Ellis & G. Martin (Fig. 2)

Am. Nat. 16: 1003 (1882), emend. M.B. Ellis, in Ellis M.B., More Dematiaceous Hyphomycetes: 264, Kew (1976)

= *Cercospora latens* Gonz. Frag., Boll., R. Soc. Espan. Hist. Nat. 21: 97 (1921), non Ellis and Everh.

= *Cercospora vignicaulis* Tehon, Mycologia 29: 436 (1937)

= *Cercospora psoraleae-bituminosae* Săvul. & Sandu, Mem. Sec. St. Acad. Rom., Ser. 3, 15(17): 397 (1940)

= *Cercospora europea* (Gonz. Frag.) Constant., Rev. Mycol. 32: 106 (1967)

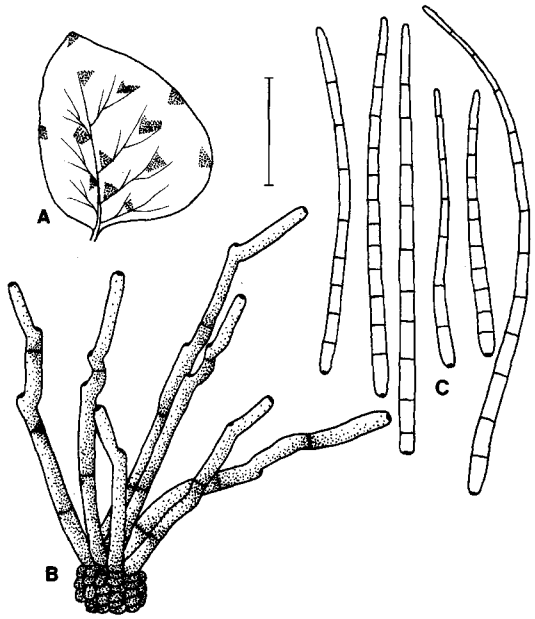

Fig. 2. *Cercospora canescens*: A, Leaf spots on the lower leaf surface of *Phaseolus angularis* (0.5×); B, Conidiophores; C, Conidia. Bar= 30 μm.

Leaf spots scattered to confluent, distinct, subcircular to irregular, 2~10 mm diam., tan to dingy gray, center whitish gray to blackish brown with reddish brown margin. **Caespituli** amphigenous, but mostly hypophyllous, later appearing with blackish brown due to abundant fructification of the fungus. **Mycelium** internal, hyphae septate, branched, hyaline. **Stromata** medium, well-developed. **Conidiophores** 3~16 in a divergent fascicle, brown to dark brown at the base and apical portion pale brown, 0~4-septate, straight to 1~2 times abruptly geniculate at the upper portion, not branched, 40~128×4.5~6.5 μm, conidial scars large and conspicuous, apical or on shoulders caused by geniculation. **Conidia** solitary, acicular to filiform, straight to mildly curved, hyaline, 3~16-septate, usually non-constricted, but very rarely slightly constricted at the septa of shorter conidia, subacute at the apex, subtruncate to truncate at the base, greatly variable in length, 45~264×3.0~5.0 μm; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Phaseolus angularis* W.F. Wight (Leguminosae).

Specimen examined: SMK 11958 (12 IX 1992, Yangku).

Distribution: Nearly throughout the world wherever the crop is cultivated, including China, Japan, Korea and Taiwan.

Notes: *Cercospora canescens* was recorded as a member of Korean cercosporoid fungi from *Phaseolus radiatus*(Park, 1958; Chung *et al.*, 1977; Kwon and Oh, 1981) and *P. angularis* (Shin and Braun, 1993). *C. cruenta* (≡*Pseudocercospora cruenta*) was reported on *P. vulgaris* (Nakata and Takimoto, 1928; Park, 1958; Chung *et al.*, 1977) and *P. angularis* (Nakata and Takimoto, 1928; Park, 1958) from Korea. *C. cruenta* (Nakata and Takimoto, 1928; Park, 1958) on *P. angularis* is well-known as a causal agent of brown leaf spot in red beans and in accordance with this species. The identify of the specimen concerned can, however, not be proven, since it is not preserved.

C. canescens on *P. trilobus* from India (Thirumalachar and Govindu, 1957) possesses narrow conidiophores (2.8~4.2 μm) and conidia (2.4~3.5 μm). *C. canescens* on *Heylandia* sp. described by Bagyanarayana *et al.* (1991) from an Indian collection is characterized by having conidiophores up to 180×4.0~6.0 μm, solitary or in small fascicles, and conidia 50~120×2.5~4.0 μm, short and narrow. The conidiophores and conidia are very variable, and the conidiophores are formed in relatively loose fascicles. The characters of conidiophores and conidia are, however, generally variable in species of *Cercospora* s. str.

Deighton (1976) distinguished *C. canescens* from *C. phaseolina* by much longer conidia with multisepta and roundly truncate bases. *C. chamaecristae* on *Cassia chamaecrista* is characterized by having small stromata, 0~2-septate conidiophores, narrowly obclavate, subhyaline to olivaceous conidia, 15~55×5.0~7.0 μm (Chupp, 1954; Brown and Morgan-Jones, 1977). Brown and Morgan-Jones (1977) noted this species to be an atypical *Cercospora*. Therefore, Braun and Melnik (1997) re-allocated this species to *Passalora*.

3. *Cercospora fukushiana* (Matsuura) W. Yamam. (Fig. 3)

J. Soc. Trop. Plant Prot. Agric. 6: 601 (1934)
≡*Cercosporina fukushiana* Matsuura, J. Plant Prot. 14: 699 (1927)
=*Cercospora balsaminae* Mendoza, Philipp. J. Sci. 75: 166 (1941)

Leaf spots scattered, circular to subcircular, 1~7 mm diam., at first uniformly brown or reddish brown, later dingy gray, center blackish brown with a dark or reddish brown margin, often causing shot-hole effect. **Caespituli** amphigenous. **Mycelium** internal, hyphae

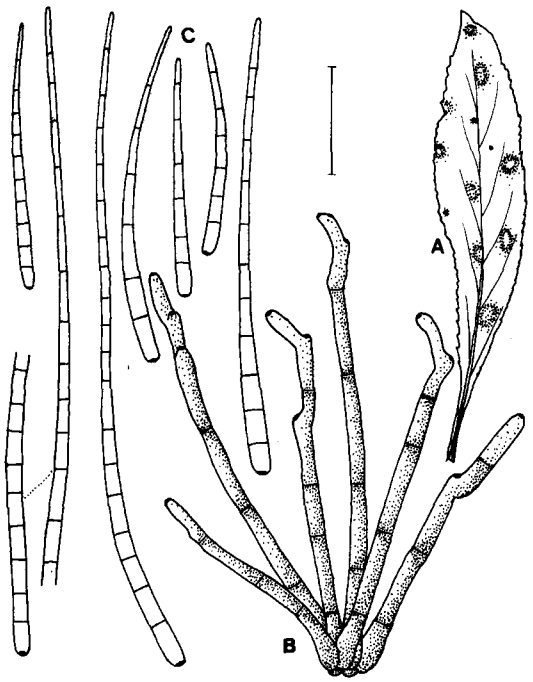

Fig. 3. *Cercospora fukushiana*: A, Leaf spots on the upper leaf surface of *Impatiens balsamina* (0.5×); B, Conidiophores; C. Conidia. Bar=30 μm.

septate, branched. **Stromata** small, slightly developed, composed of only a few swollen hyphal cells. **Conidiophores** 3~18 in a somewhat dense fascicle, olivaceous brown throughout or paler upwards, 1~4-septate, not branched, straight to mildly flexuous or 1~2 times geniculate, slightly bulbose at the basal portion, 30~220×3.5~5.0 μm, conidial scars conspicuous, apical or on shoulders caused by geniculation. **Conidia** solitary, acicular, straight to mildly curved, hyaline, 3~22-septate, non-constricted, subacute to obtuse at the apex, truncate at the base, variable in length, 35~310×3.5~5.0 μm; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Impatiens balsamina* L. (Balsaminaceae).

Specimens examined: SMK 13019 (14 IX 1994, Chongju), 14869 (21 VIII 1998, Suwon), 15296 (1 X 1998, Suwon), 15406 (8 X 1998, Suwon).

Distribution: Brunei, Burma, China, Cuba, India, Indonesia, Japan, Korea, Malaysia, Mauritius, Nepal, Sierra Leone, Sudan, Taiwan, Tanzania, USA and Zimbabwe.

Notes: Shin and Braun (1996) recorded this fungus on *Impatiens balsamina* from Korea. A Cuban collection (Braun and Castañeda, 1991) agrees well with our material, although the conidia are generally shorter and narrower (80~120×2.0~3.5 μm). Hsieh and Goh (1990) reported this fungus with shorter conidiophores (20~110 μm) and conidia (20~185 μm). Our collection is in accordance with Chupp's description (1954), although conidiophores are rather long (30~220 μm). But the variations of length are only of little taxonomic value, since these differences are due to the variability of this species.

4. *Cercospora polygonacea* Ellis and Everh. (Fig. 4)

J. Mycol. 1: 24 (1885)

= *Cercospora avicularis* var. *sagittati* Atk., J. Elisha Mitchell Sci. Soc. 8: 48 (1892)

= *Cercospora polygoni-caespitosi* Sawada, Taiwan Agric. Rev. 38(9): 700 (1942) (nomen non rite publicatum, sine descriptione latina)

= *Cercospora polygoni-blumeri* Sawada, Taiwan Agric. Res. Inst. Rept. 85: 120 (1943) (nomen non rite publicatum, sine descriptione latina)

Leaf spots scattered to confluent, distinct, circular to subcircular, 1~5 mm diam., pale tan to dingy gray, with narrow purplish brown margin, later center yellowish gray with dark brown margin, after coalescing border line unclear. **Caespituli** amphigenous, but chiefly epiphyllous. **Mycelium** internal, hyphae septate, branched. **Stromata** slightly to moderately developed, composed of a few swollen brown hyphal cells. **Conidiophores** 3~16 in a divergent fascicle, olivaceous brown

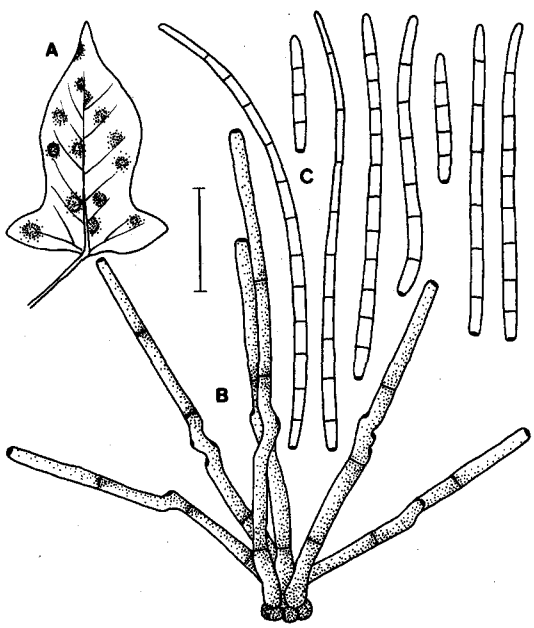

Fig. 4. *Cercospora polygonacea*: A, Leaf spots on the upper leaf surface of *Persicaria thunbergii* (0.5×); B, Conidiophores; C, Conidia. Bar=30 μm.

throughout, or paler upwards, 1~4-septate, straight or 1~3 times geniculate near middle part, not branched, 50~170×4.0~5.5 μm, conidial scars large and conspicuous, apical or on shoulders caused by geniculation. **Conidia** solitary, acicular to cylindric, straight or mildly curved, hyaline, 4~21-septate, usually non-constricted, sometimes very slightly constricted at some septa, obtuse at the apex, truncate to subtruncate at the base, variable in length, 50~190×4.0~5.5 μm; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Persicaria thunbergii* (S. & Z.) H. Gross, *P. blumei* H. Gross and *P. vulgaris* Webb & Miq. (Polygonaceae).

Specimens examined: On *Persicaria thunbergii*, SMK 11825 (2 VIII 1992, Kangnung), 11997 (20 IX 1992, Hongchon); On *P. blumei*, SMK 11987 (20 IX 1992, Hongchon); On *P. vulgaris*, SMK 13358 (8 XI 1994, Kangnung).

Distribution: USA, China, Japan, Korea, Taiwan and Somalia.

Notes: Shin and Braun (1993) first recorded this fungus on *Persicaria blumei* and *P. thunbergii* from Korea. The Korean collections agree well with Chupp's description (1954), although the conidiophores are in a divergent fascicle and usually simple. Katuski (1965) described the caespituli of *C. polygonacea* on the same host species from Japan, but mostly hypophyllous, and with denticulate conidiophores in dense fascicle. Taiwanese collections (Hsieh and Goh, 1990) are mentioned as somewhat narrower conidia (2~4 μm). These features are, however, generally variable and of little taxonomic importance.

5. *Cercosporella virgaureae* (Thüm.) Allesch. (Fig. 5)

Hedwigia 34: 286 (1895)

≡*Ramularia virgaureae* Thüm., Fungi austriaci 1072 (1874), with description!

≡*Ovularia virgaureae* (Thüm.) Sacc., Syll. Fung. 4: 142 (1886)

≡*Cylidrospora virgaureae* (Thüm.) Schroet., in Cohn, Krypt.-Fl. Schles., 3: 489, Breslau (1987)

=*Cercospora cana* Sacc., N. Giorn. Bot. Ital. 8: 188 (1876)

≡*Cercosporella cana* (Sacc.) Sacc., Michelia 2(6): 20 (1880)

≡*Cercospora virgaureae* (Thüm.) Allesch.: Oudem., Ned. Kruidk, Archf. Ser. 3, 2: 315 (1901)

≡*Septocylindrium canum* (Sacc.) Schroet., in Cohn, Krypt.-Fl. Schles., 3: 493, Brealau (1897)

=*Fusidium canum* Pass., in Thüm., Mycoth. Univ. 378 (1876)

=*Cercospora fulvescens* Sacc., N. Giorn. Bot. Ital. 8: 189 (1876)

=*Cercosporella griseëlla* Peck, Rep. N. Y. St. Mus. Nat. Hist. 33: 29 (1880)

=*Cercosporella reticulata* Peck, Rep. N. Y. St. Mus. Nat. Hist. 34: 47 (1881)

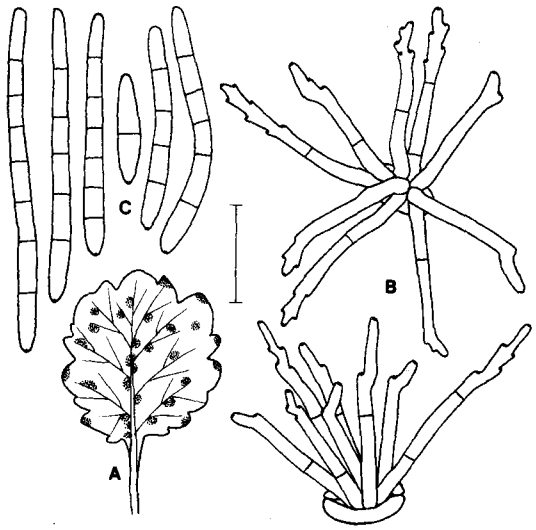

Fig. 5. *Cercosporella virgaureae*: A, Leaf spots on the lower leaf surface of *Erigeron annuus* (0.5×); B, Conidiophores; C, Conidia. Bar= 30 μm.

≡*Cercosporella reticulata* (Peck) Ellis & Everh., J. Mycol. 1: 61 (1885)

=*Cercosporella asterina* Speg., An. Mus. nac. B. Aires 6: 335 (1899)

=*Cercosporella virgaureae* Oudem., Ned. kruidk. Arch., Ser. 3, 2: 315 (1901)

=*Cercosporella ontariensis* Sacc., Annls Mycol. 11: 551 (1913)

=*Cercosporella dearnessii* Bubák & Sacc., Annls Mycol. 11: 552 (1913)

=*Cercosporella cana* var. *gracilis* J.J. Davis, Trans. Wis. Acad. Sci. Art. Lett. 19: 675 (1919)

=*Cercospora viminei* Tehon, Mycologia 16: 141 (1924)

=*Ramularia erigerontis* Gonz. Frag., Bol. r. Acad. Cienc. Exact., Fis. Nat., Madrid 5, 5: 39 (1917)

=*Cercosporella eupatorii* Sawada, Taiwan Agric. Res. Inst. Rept. 86: 160 (1943)

≡*Cercosporella eupatorii* Goh & Hsieh, in Hsieh and Goh, *Cercospora* and Similar Fungi from Taiwan: 70, Taipei (1990)

=*Ramularia erigerontis-annui* Sawada, Bull. Govt. For. Exp. Stat. Tokyo 105: 86 (1958)

=*Cercosporella curva* Diedicke, in herb.

=*Cercospora grindeliae* Ellis & Everh., Proc. Acad. Nat. Sci. Phil. 1985: 439 (1895)

Leaf spots angular to irregular, vein-limited, 2~9 mm diam.; on the upper surface, at first indefinite yellowish discolorations; on the lower surface, pale greenish, yellowish to brown, later grayish brown to brown without definite margin. **Caespituli** hypophyllous, velvety, appearing as white to pale tan patches, similar to symptoms of downy mildews, without definite margin. **Mycelium** internal, hyphae septate, branched. **Stromata** small, but well-developed, composed of several swollen brown hyphal cells. **Conidiophores** 2~20 (~32) in a divergent fascicle from stomatal opening, hyaline, 0~2-septate, straight to mildly sinuous, sometimes apically swollen due to compact conidial scars, geniculate in the upper portion, not branched, 32~90×3.5~5.0 μm, conidial scars cup-like and conspicuous, apical or on small shoulders caused by geniculation. **Conidia** solitary, filiform to obclavato-cylindric, straight to mildly curved, hyaline to subhyaline due to dense cytoplasm, 1~8-septate, non-constricted at the septa, obtuse to subobtuse at the apex, long obconic to obconically truncate at the base, 22~140×5.0~6.5 μm; hilum conspicuously thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Erigeron annuus* (L.) Pers. and *E. canadensis* L. (Compositae).

Specimens examined: On *Erigeron annuus*, SMK 13370 (8 XI 1994, Kangnung); On *E. canadensis*, 14732 (30 VII 1998, Seoul).

Distribution: Argentina, Canada, USA, Virgin Islands, Puerto Rico, Russia, Korea and Taiwan.

Notes: Shin and Braun (1996) first reported this fungus from Korea. Gilman and Archer (1929) mentioned various synonyms of *C. virgaureae* (Thüm.) Allesch., including *Cercospora virgaureae* Thüm., *Ramularia virgaureae*

Thüm., *Cercospora virgaureae* Oudem., *Septoria virgaureae* Oudem., *Cercospora reticulata* Peck, *Cercosporella ontariensis* Sacc., *Cercosporella dearnessii* Bub. & Sacc. and *Ramularia tenuis* Davis. They remarked that further study of *Cercosporella cana* on *Erigeron* will probably result in the synonymy of this form with that on *Solidago*.

Deighton (1973) reported two species, *C. cana* and *C. virgaureae*, cannot be distinguished by their conidia which vary considerably in length, width and septation. Therefore, he added *C. cana* as a synonym of *C. virgaureae*. *C. asterina* differs only in that its caespituli are mostly epiphyllous, and *R. asteris* is distinguished from our collection by having usually shorter, narrower conidia (15~80×3.0~5.0 μm). *Cercospora fulvescens* is only very young material of *Cercosporella virgaureae* as has been described by Lindau (1907). Braun (1995) explained that young conidia of *C. virgaureae* are similar to *Ramularia erigerontis*. Chupp (1954) found no colour of *Cercospora grindeliae* and suggested it be considered a *Cercosporella*. Therefore, Braun (1998) reduced this species to synonymy with *C. virgaureae*.

6. *Pseudocercospora fukuokaensis* (Chupp) X.J. Liu & Y.L. Guo (Fig. 6)

Mycosystema 5: 103 (1992)

≡*Cercospora fukuokaensis* Chupp, Yokohama Nat. Univ. Sci. Rep. II. 1: 2 (1952)

Leaf spots scattered to confluent, subcircular to irregular, sometimes vein-limited, 1~3 mm diam., sometimes up to 10 mm, brown to reddish brown without definite margin, on the upper surface pale reddish brown to brown with a yellowish or reddish brown border line. **Caespituli** amphigenous, mostly epiphyllous. **Mycelium** internal, hyphae septate, branched. **Stromata** large, well-developed, 20~45 μm diam., forming swollen brown hyphal cells through the cuticle. **Conidiophores** ca. 20~50 in a dense coral-shaped fascicle, olivaceous brown and paler upwards, 0~1-septate, not branched, substraight, not geniculate, 12~35×2.0~3.5 μm, conidial scars inconspicuous. **Conidia** solitary, acicular to filiform, shorter ones narrowly obclavate to cylindric, straight to mildly curved, subhyaline to pale olivaceous brown, guttulate, 2~8-septate, non-constricted at the septa, subacute to subobtuse at the apex, obconically truncate to subtruncate at the base, 35~85×2.5~3.5 μm; hilum inconspicuous.

Habitat: On living leaves of *Styrax japonica* S. & Z. (Styracaceae).

Specimens examined: SMK 12995 (13 IX 1994, Chonju), 14131 (5 IX 1997, Seoul), 14209 (17 IX 1997, Pusan), 15103 (14 IX 1998, Seoul).

Distribution: China, Japan and Korea.

Notes: Shin and Braun (1996) listed this fungus for the first time from Korea, and Shin (1997) provided a brief morphological description based on Korean material. The

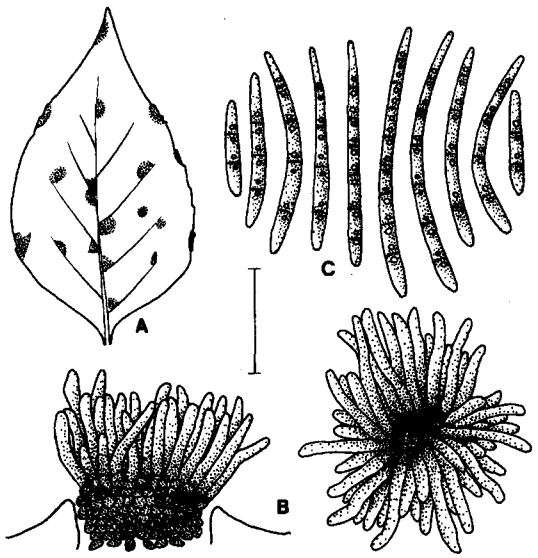

Fig. 6. *Pseudocercospora fukuokaensis*: A, Leaf spots on the upper leaf surface of *Styrax japonica* (0.5×), B, Conidiophores; C, Conidia. Bar=30 μm.

Korean material is in accordance with Chupp's original description and Chinese collections (Guo and Hsieh, 1995). *Cercospora styracia* Chupp on *Styrax americana* Lam. differs from this fungus in having longer and wider (40~220×3.0~5.0 μm), multiseptate, geniculate conidiophores and cylindric-obclavate, shorter and wider conidia (20~50×3.0~5.0 μm).

7. *Pseudocercospora puerariicola* (Yamam.) Deighton (Fig. 7)

Mycol. Papers 140: 151 (1976)

≡*Cercospora puerariicola* Yamam., Trans. Sapporo Nat. Hist. Soc. 13: 142 (1934)

Teleomorph: *Mycosphaerella puerariicola* Weimer & Luttrell, Phytopathology 38: 250 (1948)

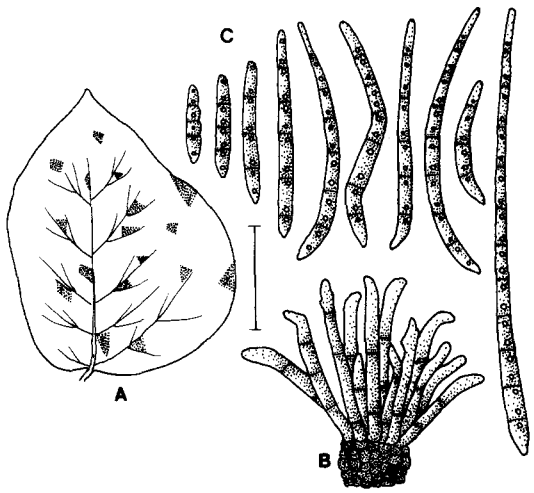

Fig. 7. *Pseudocercospora puerariicola*: A, Leaf spots on the upper leaf surface of *Pueraria thunbergiana* (0.2×); B, Conidiophores; C, Conidia. Bar=30 μm.

Leaf spots scattered, sometimes confluent, distinct, circular to subcircular, 2~10 mm diam., when confluent up to 10 mm, center grayish to dull brown without definite margin. **Caespituli** epiphyllous. **Mycelium** internal, hyphae septate, branched. **Stromata** large, well-developed, globular, dark brown, 15~30 μm diam. **Conidiophores** 10~30 in a dense fascicle, pale olivaceous brown to grayish brown throughout, and paler upwards, 0~3-septate, not branched, straight to slightly curved, tortuous, rarely geniculate, denticulate, rounded to obconic at the apex, 24~56×3.0~4.5 μm, conidial scars inconspicuous. **Conidia** solitary, acicular to obclavato-cylindric, straight to slightly curved, very pale olivaceous brown, guttulate, 3~15-septate, non-constricted at the septa, but sometimes constricted in shorter ones, subacute to broadly rounded at the apex, subtruncate to obconically truncate at the base, greatly variable in length, 40~140×3.0~5.5 μm; hilum inconspicuous.

Habitat: On living leaves of *Pueraria thunbergiana* Benth. (Legumonosae).

Specimens examined: SMK 11279 (9 X 1991, Kangnung), 11331 (15 X 1991, Kangnung).

Distribution: China, Japan, Korea, Singapore and Taiwan.

Notes: Shin and Braun (1993) first listed this fungus from Korea, and Shin (1997) added a brief morphological description based on Korean material. From Chinese collections, Guo and Hsieh (1995) described well-developed external mycelium. In all Korean materials, secondary mycelium could not be observed, but the formation of external hyphae is often variable in *Pseudocercospora*. The conidial scars are sometimes denticle-like, situated on small shoulders caused by sympodial proliferations.

8. *Ramularia cynarae* Sacc. (Fig. 8)

Michelia 1: 536 (1879)

=*Ramularia cardui* P. Karst., Meddel. Soc. Fauna Fl. Fenn. 14: 109 (1888)

=*Ramularia cirsii* Allesch., Ber. Bayr. Bot. Ges. 2: 18 (1892)

=*Ramularia cardui* var. *personatae* Allesch., Hedwigia 34: 285 (1895)

=*Ramularia onopordi* C. Massal., Comm.

Acc. Sci. med. Nat. Ferrara 1899: 28 (1899)
=*Ramularia jurineae* Hollós, Ann. Mus. Nat. Hung. 5: 467 (1907)
=*Ramularia cirsii* var. *cirsii-arvensis* C. Massal., Osserv. fitol. in Madonna Verona II: 8 (1908)
=*Ramularia balcanica* Bubák & Ranoj., Annls Mycol. 8: 396 (1910)
=*Ramularia carthami* Zaprom., Bolez. Rast. 15(3): 142 (1926) and Mat. po Mikofl. sredn. Azii I: 32 (1926)
=*Ramularia cousiniae* Vasjagina, in Švarcman *et al.*, Fl. Spor. Rast. Kazakhstana 8, Fungi imperfecti (Deuteromycetes), 1. Moniliales: 459, Alma-Ata (1973)

Leaf spots scattered to confluent, distinct, circular to subcircular, 2~5 mm diam., center dingy gray with a narrow dark brown border line or without definite margin. **Caespituli** hypophyllous, appearing as grayish fungal patches. **Mycelium** internal, hyphae septate, branched, hyaline. **Stromata** small to large, well-developed, 10~40 μm diam., composed of swollen brown hyphal cells. **Conidiophores** ca. 20~30 in a dense fascicle, arising through stomata, hyaline throughout, 1~3-septate, straight to slightly curved, not branched, not geniculate, but occasionally geniculate, 20~44×2.5~4.0 μm, irregular in width, irregularly tapered at the apex, conidial scars somewhat conspicuous, apical or on small shoulders caused by slight geniculation. **Conidia** solitary to catenate, occasionally in branched chains, cylindric to ellipsoidal, subcylindric-fusiform, hyaline, mostly aseptate or uniseptate, but sometimes 2~3-septate, ends obtuse to pointed, 9~40×2.5~4.5 μm; hilum minute, slightly thickened, darkened, and non-protuberant.

Habitat: On living leaves of *Cephalonoplos segetum* (Bunge) Kitamura (Compositae).

Specimens examined: SMK 11446 (2 XI 1991, Chunchon), 11740 (28 VI 1992, Chunchon), 13270 (29 X 1994, Chunchon).

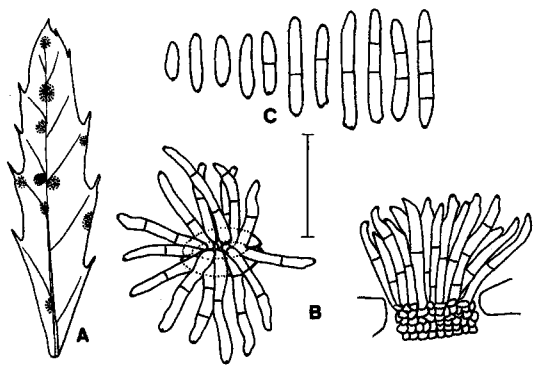

Fig. 8. *Ramularia cynarae*: A, Leaf spots on the lower leaf surface of *Cephalonopos sagetum* (0.5×); B, Conidiophores; C, Conidia. Bar= 30 μm.

Distribution: USA, Europe, Russia, Sweden, Central Asia, China, Iran, India, Israel and Korea.

Notes: Shin and Braun (1993, 1996) first listed this fungus as *Ramularia cirsii* and *R. cynarae* from Korea, and Shin (1995) added a brief morphological description based on Korean material. Braun (1998) announced *R. cynarae* occurs on numerous host plants of various genera of the Cynareae and the morphological features are uniform. Therefore, *R. cirsii* was reduced to synonymy with *R. cynarae*. He described the following characters of the species: Caespituli are amphigenous; conidiophores are in loose to dense fascicles and simple to rarely branched, 6~60×2~7 μm; conidia are smooth to faintly rough, 10~35×2~5 μm; leaf spots are amphigenous, mainly epiphyllous. Our collections are, however, within the variability of this species, and most taxonomic characters agree well with Braun's description (1998).

9. Ramularia inaequalis (Preuss) U. Braun (Fig. 9)

A Monograph of *Cercosporella, Ramularia* and Allied Genera (Phytopathogenic Hyphomycetes) Vol. 2: 68 (1998)

Fusoma inaequale Preuss, Linnaea 26: 706 (1855)

Ramularia lineola Peck, Ann. Rep. N.Y. State Mus. 32: 43 (1879)

Ramularia taraxaci P. Karst., Hedwigia 23: 7 (1884)

Cylindrospora taraxaci (P. Karst.) J. Schroet., in Cohn, Krypt.-Fl. Schles., Pilze II: 489, Breslau (1897)

Ramularia lampsanae f. *taraxaci* Sacc., Atti Ist. Ven., 6, Ser. II: 449 (1884)

Ramularia thrinciae Sacc. & Berl., Atti Ist. Ven., 6, Ser. III: 735 (1885)

Ramularia taraxaci f. *italica* C. Massal., N. Giorn. Bot. Ital. 21: 169 (1889)

Ramularia filaris var. *hieracii* Bäumler, Verh. Zool.-Bot. Ges. Wien. 41: 673 (1891)

:*Ramularia hieracii* (Bäumler) Jaap, Annls Mycol. 6: 216 (1908)

:*Ramularia picridis* Fautrey & Roum., Rev. Mycol. 14: 10 (1892) and in Roum., F., sel. exs. 5990 (1892)

:*Ramularia hypochoeridis* Magnus, Verh. Bot. Ver. Prov. Brandenh. 37: 83 (1895)

:*Entylomella hypochoeridis* (Magnus) Cif., Omagiu lui Traian Savulescu: 176 (1959)

:*Ramularia picridis* f. *italica* C. Massal., Atti Acc. d'Agric. Art. Comm. Verona, 4 Ser. III: 70 (1902)

:*Ramularia picridicola* Lindr., Acta Soc. Fauna Fl. Fenn. 23(3): 39 (1902)

:*Ramularia corcontica* Bubák & Kabát, Sbr. k. b hm. Akad. Wiss., 2. Kl., Math.-Nat., 1903: 7 (1903)

=*Ramularia conspicua* Syd., Annls Mycol. 1: 538 (1903)

=*Ramularia subalpina* Bubák, Sbr. k. böhm. Akad. Wiss., 2. Kl., Math.-Nat., 1903: 19 (1903)

=*Ramularia taraxaci* var. *epiphylla* Briosi & Cav., F. paras., Fasc. XV, No. 362 (1904)

=*Ramularia helvetica* Jaap & Lindau, in Lindau, in Rabenh., Krypt.-Fl. Deutschl., Oesterrich u. d. Schwiez. Zweite Aufl., Erster Bd: Pilze Deutschl., Oesterreichs u. d. Schweiz. VIII. Abt.: Fungi imperfecti: Hyphomycetes (Erste Hälfe): 527, Leipzig (1906)

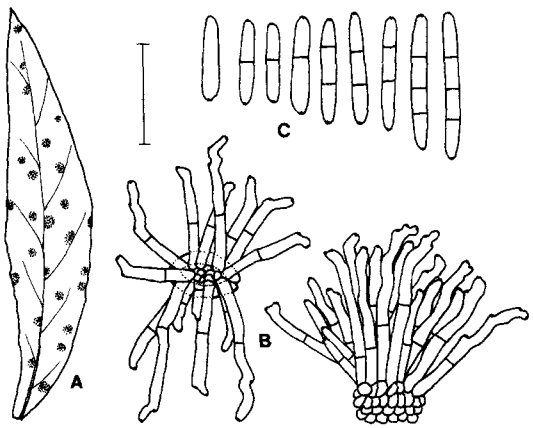

Fig. 9. *Ramularia inaequalis*: A, Leaf spots on the lower leaf surface of *Picris hieracioides* var. *glabrescens* (0.3×); B, Conidiophores; C, Conidia. Bar=30 μm.

=*Ramularia hamburgensis* Lindau (l.c.: 528)

=*Ramularia montenegrina* Bubák, Bull. Herb. Boiss., 2. Sér., 6: 486 (1906)

=*Ramularia scorzonerae* Jaap, Annls Mycol. 6: 216 (1908)

=*Ramularia hieracii-umbellati* A.G. Eliasson, Sv. Bot. Tidskr. 9: 412 (1915)

=*Ramularia cichorii* Dearn. & House, N.Y. state Mus. Bull. 188: 39 (1916)

=*Ramularia filarszkyana* Moesz, Bot. Közlem. 22: 47 (1924)

=*Ramularia achyrophori-uniflori* Baudyš & Picb., Práce Morav. Přir. Spol., III, 2, Sign. F, 22: 35 (1926)

=*Ramularia leontodontis* Moesz, Bot. Közlem. 23: 121 (1926)

=*Ramularia helminthiae* Bremer & Petr., Sydowia 1: 259 (1947)

=*Ramularia parva* H.C. Greene, Trans. Wis. Acad. Sci. Art. Lett. 47: 115 (1959)

=*Ramularia helminthiae* Achundov, Nov. Sist. niz. Rast. 20: 59 (1983)

=*Ramularia lampsanae* f. *sonchi-arvensis* Roum., F. gall. exs. 3388 (1885), nom. nud.!

=*Ramularia sonchi* Sacc., in herb.

Leaf spots scattered to confluent, circular to subcircular, indistinct, 2~6 mm diam., grayish brown to dirty gray with definite border line, center white to tan with narrow brown margin. **Caespituli** hypophyllous, appearing as fluccose white fungal patches similar signs of downy mildews. **Mycelium** internal, hyphae septate, branched. **Stromata** moderately to well-developed, globular, large, 30~50 μm diam., pale olivaceous brown, composed of swollen brown hyphal cells. **Conidiophores** 6~20 in a dense fascicle from arising through stomata, hyaline throughout, 0~2-septate, usually uniseptate, not branched, substraight to sinuous, 0~2 times mildly geniculate in the upper portion, 16~56×3.0~4.0 μm, conidial scars very small, but conspicuous, apical or on small shoulders caused by geniculation. **Conidia** solitary or in short chains, cylindric to long ellipsoidal, hyaline, 0~3-septate, ends subobtuse to obconically tapered, 18~48×2.0~4.5 (~5.5) μm; hilum very slightly thickened on both ends.

Habitat: On living leaves of *Picris hieracioides* var. *glabrescens* Ohwi (Compositae).

Specimens examined: SMK 11852 (10 VIII 1992, Pyongchang), 11900 (6 IX 1992, Pyongchang), 15342 (4 X 1998, Yangku).

Distribution: Cuba, Chile, Cyprus, Greeks, Portugal, Australia, China and Korea.

Notes: Shin and Braun (1993) first listed this fungus as *R. picridis* from Korea, and Shin (1997) added a brief morphological description based on Korean material. Braun (1998) reported *Ramularia* collections on numerous hosts belonging to the Asteraceae subfam. Cichorioideae are morphologically very uniform and reduced *R. picridis* to synonymy with *R. inaequalis*. He described the following characters of the species: Caespituli are amphigenous; conidiophores are in small to moderately rich fascicle and 5~50×1.5~7 μm; conidia are smooth to verruculose and usually 0~3-septate, rarely up to 7-septate. The Korean collection is within the variability of this species, and most taxonomic characters agree well with Braun's description (1998).

10. *Ramularia rubella* (Bonord.) Nannf. (Fig. 10)

in Lundell and Nannf., Fungi exs. Suec. fasc. XXXIXXL, Sched., p. 33 (1950)

≡*Crocysporium rebellum* Bonord., Bot. Z. 19: 201 (1861)

≡*Ovularia rubella* (Bonord.) Sacc., Syll. Fung. IV: 145 (1886)

=*Oidium monosporium* Westend., Bull. Soc. Roy. Bot. Belg. 2: 252 (1863)

≡*Torula monosporia* (Westend.) J.J. Kickx, Fl. Cryptog. Fland. II: 301 (1867)

≡*Ovularia monosporia* (Westend.) Ponud & Clem., Minn. Bot. Stud. 1 (bull. 9): 653 (1896)

≡*Ovularia monosporia* (Westend.) Sacc., Syll. Fung. XXII: 1296 (1913)

=*Peronospora obliqua* Cooke, Rust, Smut, Mildew and Mold, Ed. 1: 160 (1865)

=*Ramularia obliqua* (Cooke) Oudem., Nederl. Kruitk. Arch. 2, Ser. I: 262 (1872)

=*Ovularia obliqua* (Cooke) Oudem., Hedwigia 22: 85 (1883)

=*Ramularia obovata* Fuckel, Fungi rhen., Suppl., Fasc. II, No. 1635 (1866) and Jahrb. Nass. Ver. Naturk. 23/24: 103 (1870)

=*Ovularia obovata* (Fuckel) Sacc., Fungi Ital. del., Tab. 972 (1881)

=*Ramularia circumfusa* Ellis & Everh., Proc. Acad. Nat. Sci. Phil. 1895: 437 (1895)

=*Ovularia obliqua* var. *canaegricola* Henn., Notizbl. königl. Bot. Garten 1: 238 (1897)

=*Ovularia canaegricola* Henn., in Sacc., Syll. Fung. XIV: 105 (1899)

=*Ovularia monosporia* Keissl., in Zahlbr., Ann. k. k. Naturhist. Hofmus. Wien 29: 462 (1916)

Leaf spots scattered, often confluent, cir-

cular to subcircular, distinct, fairly large, 1~15 mm diam., when confluent up to 20 mm diam., center appearing brown to reddish brown with dark purplish red margin, later turning whitish brown with dark purplish brown border line. **Caespituli** hypophyllous. **Mycelium** internal, hyphae septate, branched. **Stromata** small, slightly developed, composed of swollen hyphal cells emerging through stomata. **Conidiophores** up to 20 in a divergent fascicle, hyaline throughout, usually aseptate, occasionally uniseptate, not branched, substraight to sinuous, characteristically sinuous or spiral near the upper portion, usually not geniculate but sometimes slightly geniculate at the apex, 40~140×3.0~4.5 μm, conidial scars minute, slightly conspicuous, apical or on small shoulders caused by geniculation. **Conidia** solitary, obclavate to ellipsoidal or obovoid, hyaline, aseptate or very rarely uniseptate, constricted at the septum in uniseptate spores, ends rounded, sometimes obconically attenuated, 16~40×6.5~10.5 μm; hilum slightly thickened, darkened, and nonprotuberant.

Habitat: On living leaves of *Rumex longifolius* DC. and *R. crispus* L. (Polygonaceae).

Specimens examined: On *R. longifolius*, SMK 11567 (23 XI 1991, Kangnung), 11607 (27 V 1992, Kangnung), 12490 (4 VIII 1993, Kangnung); On *R. crispus*, SMK 12843 (5 VI 1994, Samchok), 13304 (1 XI 1994, Samchok), 14470 (26 IV 1998, Nonsan), 14608 (6 VI 1998, Taejon).

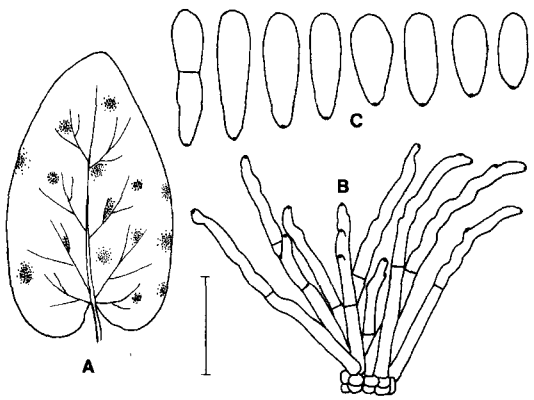

Fig. 10. *Ramularia rubella*: A, Leaf spots on the lower leaf surface of *Rumex longifolius* (0.2×); B, Conidiophores; C, Conidia. Bar =30 μm.

Distribution: Brazil, Mexico, USA, Europe, Africa, Australia, New Zealand, China, India, Iraq, Japan, Korea and Libya.

Notes: Shin and Braun (1993, 1996) first recorded this fungus from Korea, and Shin (1997) added a brief morphological description of this species as *Ramularia circumfusa* based on Korean materials. *R. rubella* and *R. circumfusa* were discussed by Braun (1992). Although the narrow, catenate conidia mentioned in the original description are not present in our collection, the conidiophores and conidia agree perfectly with *R. rubella*. *R. pseudorubella* from *Rumex crispus* is close to our fungus, but distinguished by much shorter, aseptate conidiophores and narrower (2~6 μm) conidia. Therefore, some specimens on *R. crispus* are placed a separate species (Braun, 1994).

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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 세 번째 보고이다. 이번에는 *Cercospora* 4종, *Cercosporella* 1종 *Pseudocercospora* 2종 및 *Ramularia* 3종에 대한 균학적 특징을 기재, 묘사하였다. 쇠무릎에서 *Cercospora achyranthis*, 팥에서 *C. canescens*, 봉선

화에서 *C. fukushiana*, 고마리와 봄여뀌 및 개여뀌에서 *Cercospora polygonacea*, 개망초와 망초에서 *Cercosporella virgaureae*, 때죽나무에서 *Pseudocercospora fukuokaensis*, 칡에서 *P. pueraricola*, 조뱅이에서 *Ramularia cynarae*, 쇠서나물에서 *R. inaequalis*, 그리고 개대황과 소리쟁이에서 *R. rubella*를 각각 동정하였다.

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