

Morphometric Studies on the Genus *Septoria* in Korea (I)

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The mycoflora of Korea was rather poorly studied in the past and the fungi belonging to the genus *Septoria* are no exception. For this reason, taxonomic studies on *Septoria* have been initiated, with the eventual aim of producing a monograph of the *Septoria* species present in Korea. The present study circumscribes 10 species; viz., *Septoria artemisiae*, *S. callistephi*, *S. chrysanthemella*, *S. erigerontis*, *S. lycopersici*, *S. lysimachiae*, *S. oenotherae*, *S. phlogis*, *S. rohlenae*, and *S. sonchi*. Distinguishing morphological characters are described and illustrated for each species.

KEYWORDS: Mycoflora, Monograph, *Septoria*, Taxonomy

The genus *Septoria* Sacc. belongs to sympodial Blastopycnidiales of Coelomycetes, Fungi Imperfecti (Sutton, 1980). All species of this genus are plant pathogens causing leaf spots and blight in field crops, vegetables, ornamentals and wild plants. Saccardo (1884) included 581 species in *Septoria* and this genus presently contains about 1,000 taxa (Hawksworth *et al.*, 1995). Though taxonomic studies on species parasitic on various hosts or present in a particular geographical area have been made, this genus is still in need for world-wide monographic compilation.

Jørstad (1965, 1967) emphasized the significance of the size, shape, and septation of conidia in the taxonomy of the genus *Septoria*. Nevertheless, the shape and size of conidia are variable. The characters mostly used in the modern taxonomy of *Septoria* spp. are the conidiomatal type, conidiogenesis, conidiogenous cells, and the conidial shape, length, width, and septation (Constantinescu, 1984; Farr, 1991; Verkley and Priest, 2000).

In Korea, the fungi belonging to the genus *Septoria* have been insufficiently studied, above all with regard to their taxonomy. Some plant pathologists reported 36 species with short phytopathological notes (cf. The Korean Society of Plant Pathology, 1998). Recently, Shin and Sameva (1999) listed 30 species of *Septoria* collected from Korea with short descriptions. This paper is intended as a first step towards a monograph of *Septoria* species present in Korea.

Materials and Methods

The specimens studied in this paper and the next series of contributions have been collected by the senior author in various locations of Korea since 1989 and are maintained at the mycological herbarium (SMK) at the Division of

Environmental Science and Ecological Engineering, Korea University.

A small piece of the leaf fragments bearing conidiomata was rehydrated in 3% KOH for microscopy. For examination of the conidiogenous cells, the specimens were stained with lactofuchsin by heating over a small flame. The width of both the conidia and conidiogenous cells were measured at their widest part. Measurements of conidia and other fungal structures were made from 30 replicates for each fungus under 400× magnification with the aid of an eyepiece micrometer.

The mycological characteristics of conidia, conidiomata, and conidiogenous cells, viz., shape, size, color, number of septa, etc. were examined and illustrated with the aid of a microscope, provided with Olympus DA drawing tube under 1000× and 200× magnifications.

Description of the Species

1. *Septoria artemisiae* Pass., Atti Soc. Crittog. Ital. 2: 32 (1879) Fig. 1

Leaf spots on the upper surface, scattered to confluent, distinct, circular to irregular, small to large, 0.5–5 mm diam., up to 10 mm when coalesced, brown to blackish brown, sometimes grayish brown with dark brown margins, center becoming pale gray, finally turning white; on the lower surface, obscure or slightly discolored due to compact trichoma of the leaf. **Conidiomata** pycnidial, scattered, epiphyllous, dark brown, globose, immersed, unilocular, 55–95 µm diam.; ostioles circular, 12–20 µm wide. **Conidiogenous cells** discrete, sympodial, subhyaline to hyaline, cylindrical, lageniform or ampulliform, irregular in width, not branched, subobtuse to obconic at the apex, 4.5–10×3–4 µm, formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, substraight

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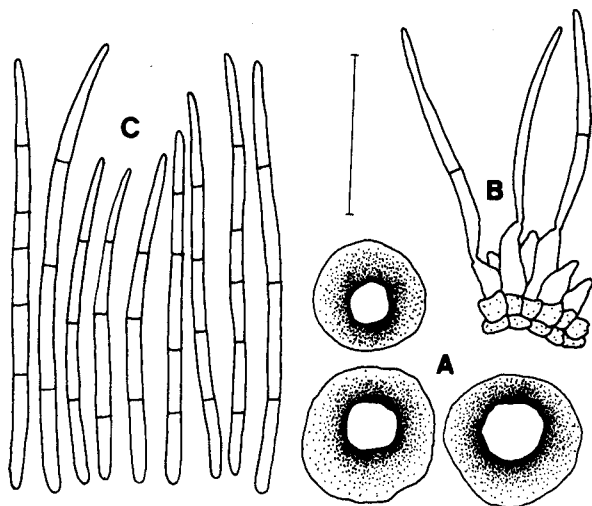


Fig. 1. *Septoria artemisiae* Pass.: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents 100 μm for A and 20 μm for B & C.

to occasionally slightly curved, subtruncate at the base, subacute to acute at the apex, slightly attenuated towards the apical portion, eguttulate, hyaline, 32~56 \times 1.5~2.5 μm , 2-5-septate, septa indistinct.

Habitat: On living leaves of *Artemisia argyi* Lév. & Vnt., *A. japonica* Thunb., *A. keiskeana* Miq., *A. lavandulaefolia* DC., *A. princeps* var. *orientalis* (Pampan.) Hara, *A. selengensis* Turcz., and *A. sylvatica* Max. [Asteraceae].

Specimens examined: On *Artemisia argyi*, SMK 15821 (20 V 1999, Pochon); on *A. japonica*, SMK 15967 (5 VI 1999, Pochon); on *A. keiskeana*, SMK 15198 (24 IX 1998, Pochon), 15970 (5 VI 1999, Pochon); on *A. lavandulaefolia*, SMK 12442 (2 VII 1993, Kangnung), 13369 (8 XI 1994, Kangnung), 13518 (6 VI 1995, Pyongchang); on *A. princeps* var. *orientalis*, SMK 15757 (5 V 1999, Samchok); on *A. selengensis*, SMK 15977 (5 VI 1999, Pochon); on *A. sylvatica*, SMK 13295 (31 X 1994, Kangnung).

Notes: More than 10 different species of *Septoria* have been recorded on *Artemisia* spp. and their taxonomy is complicated. Lu (1992) treated *S. fusca* Peck, *S. globosa* Strasser, *S. kriegneriana* Bres., *S. tabacina* Died., *S. artemisiae* Unamuno, and *S. artemisiana* Garbowski as synonyms to the oldest name *S. artemisiae* Pass. Sameva (1991) distinguished two species on *Artemisia*; *S. artemisiae* Pass. and *S. tabacina* Died. She mentioned that the conidia of the former are longer, narrower (27~48 \times 1.7~2.0 μm) than those of the latter (20~36 \times 2.5~3.0 μm). *S. moeszii* Smarods has large conidiomata (120~165 diam.) and long conidia (70~135 \times 2~3 μm). Brandenburger (1985) indicated *S. artemisiae* Pass., *S. artemisiae-maritimae* Lob., as well as *S. globosa* Strasser with probable synonyms *S. artemisiana* Garb., *S. kriegneriana* Bres. and *S. moeszii* Smarods, which conidia strongly vary in length:

45~80(~135) \times 2~3 μm . Terevnikova-Babayana (1987) accepted *S. artemisiana* Garbowski, *S. kriegneriana* Bres. and *S. globosa* Strasser as separate species and indicated also *S. artemisiae-maritimae* Lob. (1928) from European part and East Siberia of Russia with thick-cylindrical conidia with rounded ends, 20~26 \times 3~4 μm . The Korean materials examined agree well with the phenetic characters of *S. artemisiae* provided by Rádulescu et al. (1973), Terevnikova-Babayana (1987), and Vanev et al. (1997). This species was first recorded in Korea by Shin and Sameva (1999). The present work adds *Artemisia argyi*, *A. japonica*, *A. princeps* var. *orientalis* and *A. selengensis* as new host records to Korea.

2. *Septoria callistephi* Gloyer, Phytopathology 11(1): 50 (1921)

Fig. 2

Leaf spots on the upper surface, scattered to confluent, distinct, angular, vein-limited, small to large, 1~5 μm diam., or covering the whole leaf surface when coalesced, brown to reddish brown, sometimes grayish brown with dark brown margins, center becoming blackish gray; on the lower surface, obscure or slightly discolored with greenish brown border lines. **Conidiomata** pycnidial, scattered, amphigenous, but mostly epiphyllous, dark brown, globose, immersed, unilocular, 30~80 μm diam.; ostioles circular to subcircular, 18~32 μm wide. **Conidiogenous cells** discrete, sympodial, subhyaline to hyaline, cylindrical, lageniform or ampulliform, irregular in width, not branched, subobtuse to obconic at the apex, 4.5~12.5 \times 2.5~4.5 μm , formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, substraight to somewhat falcate, subtruncate at the base, narrowly obtuse to subacute at the apex, eguttulate, hyaline, 35~65 \times 1.5~2.0 μm , (2-)3-5(-6)-septate, septa distinct.

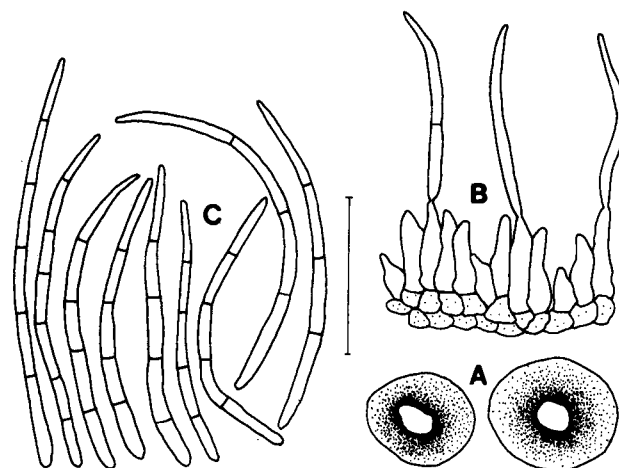


Fig. 2. *Septoria callistephi* Gloyer: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents 100 μm for A and 20 μm for B & C.

Habitat: On living leaves of *Callistephus chinensis* (L.) Nees [Asteraceae].

Specimens examined: SMK 11776 (17 VII 1992, Yangku), 13700 (5 X 1996, Kangnung), 14022 (25 VIII 1997, Pyongchang), 14865 (21 VIII 1998, Hongchon), 16083 (21 VI 1999, Dongduchon), 16776 (17 IX 1999, Wonju).

Notes: Lee *et al.* (1989) and Shin and Sameva (1999) recorded this species in Korea providing short mycological notes. The size of conidiomata and conidia for this species given by various authors vary, having larger or smaller conidiomata and narrower or wider conidia: 60~120 μm and 25~48 \times 1.5~2.5 μm (Lu, 1992); 80~110 μm and 27~50 \times 2~3 μm (Teterevnikova-Babayan, 1987); 60~95 μm and 28~42 \times 1~1.5 μm (Rádulescu *et al.*, 1973; Brandenburger, 1985). The Korean materials differ with some smaller conidiomata and longer conidia, but these features may not deviate from the range of this variable species.

3. *Septoria chrysanthemella* Sacc., Syll. Fung. 11: 542 (1895) Fig. 3

= *Septoria chrysanthemi* Cavara, Atti Ist. Bot. Pavia, ser. II, p. 266, 1892; non Allesch., 1891

= *Septoria chrysanthemi* Rostr., Bot. Tidsskr. 21: 48, 1897

= *Septoria rostrupii* Sacc. & Syd., Syll. Fung. 14: 973, 1899

= *Septoria varians* Joffrin, Compt. Rend. Hedb. Séances Acad. Sci. 133: 957, 1901

= *Septoria chrysanthemi-indici* Bubák & Kabát, Hedwigia 46: 294, 1907

Leaf spots on the upper surface, scattered to confluent,

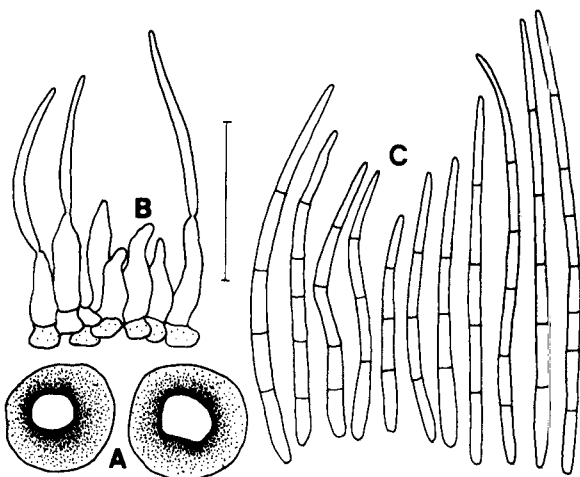


Fig. 3. *Septoria chrysanthemella* Sacc.: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents 100 μm for A and 20 μm for B & C.

distinct, circular to irregular, sometimes vein-limited, small to large, 1~5 mm diam., up to 15 mm when coalesced, brown to dark brown, sometimes purplish brown with dark brown margins, center appearing pale gray, later becoming grayish white, in advanced stages the leaves turning completely yellow and fall off or remain attached to the stem. **Conidiomata** pycnidial, scattered, amphigenous, but mostly epiphyllous, dark brown, globose, more or less immersed, unilocular, 55~95 μm diam.; ostioles circular, 15~35 μm wide. **Conidiogenous cells** discrete, sympodial, hyaline, cylindrical, lageniform or ampulliform, irregular in width, not branched, subobtuse to obconic at the apex, 5~15 \times 3~5 μm , formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, substraight to occasionally slightly curved, subtruncate at the base, subacute to acute at the apex, generally attenuated towards the apical portion, eguttulate, hyaline, 40~65 \times 1.2~2 μm , 3-6-septate, septa distinct.

Habitat: On living leaves of *Chrysanthemum boreale* Makino, *C. indicum* L., *C. morifolium* Ram., *C. zawadskii* var. *latilobum* Kitamura, and *C. zawadskii* ssp. *naktongense* (Nakai) Y. Lee [Asteraceae].

Specimens examined: On *Chrysanthemum boreale*, SMK 17152 (22 X 1999, Namyangju), 17721 (2 X 2000, Samchok), 17750 (3 X 2000, Kangnung), 17879 (16 X 2000, Jungsun); on *C. indicum*, SMK 16365 (20 VII 1997, Pochon), 17145 (21 X 1999, Pochon); on *C. morifolium*, SMK 13804 (25 V 1997, Namyangju), 14906 (25 VIII 1998, Kyongju), 16055 (21 VI 1999, Dongduchon), 16872 (28 IX 1999, Kanghwa), 17061 (13 X 1999, Seoul); on *C. zawadskii* var. *latilobum*, SMK 14099 (27 VIII 1997, Pyongchang), 16197 (6 VII 1999, Pyongchang); on *C. zawadskii* ssp. *naktongense*, SMK 17582 (23 IX 2000, Chonju).

Notes: By morphometric and cross inoculation studies, Punithalingam and Wheeler (1965) recognized 5 different species of *Septoria* occurring on species of *Chrysanthemum*. The Korean materials examined are most close to *S. chrysanthemella*. According to Grove (1935), Marland (1948), and Teterevnikova-Babayan (1987), *S. chrysanthemella* Sacc. is a synonym to the older species *S. chrysanthemi* Allesch. (1891). However Punithalingam and Wheeler (1965) accepted *S. chrysanthemella* Sacc. as a legitimate name for this taxon and considered *S. chrysanthemi* Allesch. as a dubious species. In Korea, Park (1958) first recorded this species under *S. chrysanthemi* on *Chrysanthemum morifolium*. Shin and Sameva (1999) added *C. zawadskii* var. *latilobum* as a new host record to Korea. The present work adds *Chrysanthemum boreale*, *C. indicum*, and *C. zawadskii* ssp. *naktongense* as new host records to Korea.

4. *Septoria erigerontis* Peck, Ann. Rep. N.Y. State. Mus. Nat. Hist. 24: 67 (1872) Fig. 4

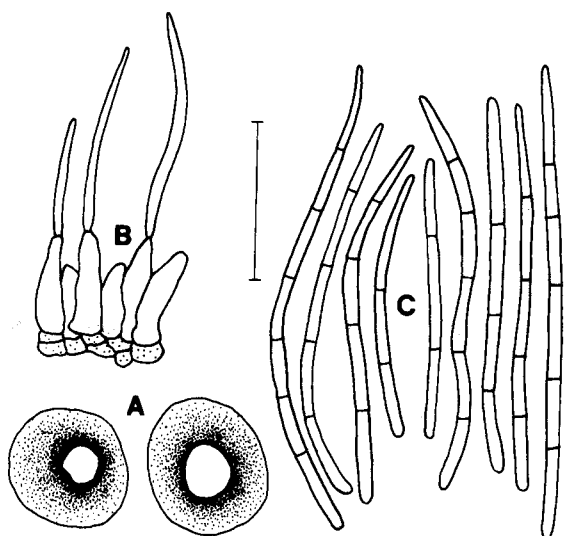


Fig. 4. *Septoria erigerontis* Peck: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents 100 μm for A and 20 μm for B & C.

= *Septoria erigerontis* Berk. & Curtis, North Am. Fungi, p. 437, 1874

= *Septoria erigeronata* Thüm., Bull. Soc. Imp. Nat. Moscou 56: 132, 1881

= *Septoria erigeronaea* Sacc., Syll. Fung. 3: 547, 1884

= *Septoria chanousii* Ferraris, Malpighia, p. 27, 1902

= *Septoria stenactis* Vill. ex Syd., Ann. Mycol. 8: 493, 1910

= *Septoria erigerontis* Hollós, Math. Termész. Közlém. Magy. Tudom. Akad. 35: 57, 1926

Leaf spots on the upper surface, scattered to confluent, distinct, circular to irregular, small to large, 2~10 mm diam., sometimes coalesced, brown to reddish brown, sometimes grayish brown with dark brown margins, center becoming dark gray with blackish dots; on the lower surface, olivaceous brown to very pale brown with indistinct border lines. **Conidiomata** pycnidial, scattered, amphigenous, but mostly epiphyllous, brown to dark brown, more or less globose, at first immersed, later erumpent, unilocular, 80~145 μm diam.; ostioles circular, 10~22 μm wide. **Conidiogenous cell** discrete, sympodial, hyaline, cylindric, lageniform or ampulliform, irregular in width, not branched, subobtuse to obconic at the apex, 4.5~15 \times 3.5~5 μm , formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, substraight to occasionally slightly curved, subtruncate at the base, subacute to acute at the apex, generally attenuated towards the apical portion, eguttulate, hyaline, 32~65 \times 1.5~2.5 μm , 2-6-septate, septa indistinct.

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

Specimens examined: On *Erigeron annuus*, SMK 10239

(3 X 1989, Kangnung), 10388 (7 IX 1990, Kangnung), 10900 (18 VII 1991, Kangnung), 11237 (5 X 1991, Kangnung), 11415 (30 X 1991, Kangnung), 11513 (16 XI 1991, Kangnung), 12014 (22 IX 1992, Kangnung), 12030 (1 X 1992, Kangnung), 12182 (14 X 1992, Kangnung), 12217 (20 X 1992, Kangnung), 12298 (27 X 1992, Kangnung), 12318 (28 X 1992, Kangnung), 12409 (24 VI 1993, Kangnung), 12688 (10 X 1993, Kangnung), 13234 (26 X 1994, Kangnung), 13290 (31 X 1994, Kangnung), 13440 (24 XI 1994, Kangnung), 13443 (27 XI 1994, Kangnung), 13454 (7 XII 1994, Kangnung), 13461 (1 V 1995, Kangnung), 13505 (23 V 1995, Kangnung), 13537 (15 VI 1995, Kangnung), 13653 (10 IX 1996, Kangnung), 13748 (2 V 1997, Seoul), 13755 (6 V 1997, Seoul), 13765 (11 V 1997, Namyangju), 13928 (4 VI 1997, Suwon), 14008 (25 VIII 1997, Pyongchang), 14379 (4 X 1997, Seoul), 14484 (27 IV 1998, Seoul), 14552 (29 V 1998, Seoul), 15031 (4 IX 1998, Seoul), 15185 (24 IX 1999, Pochon), 15315 (4 X 1998, Yonchon), 15615 (28 X 1998, Namyangju), 15639 (4 XI 1998, Pochon), 15662 (15 XI 1998, Yongin), 15678 (7 IV 1999, Seoul), 15780 (8 V 1999, Suwon), 15878 (28 V 1999, Seoul), 16032 (17 VI 1999, Seoul), 16080 (21 VI 1999, Dongduchon), 16586 (3 IX 1999, Seoul), 17341 (19 V 2000, Seoul); on *E. canadensis*, SMK 15316 (4 X 1998, Yonchon).

Notes: Park (1967) recorded this fungus for the first time in Korea and provided a short description as follows: Pycnidia globose, blackish brown, 60~125 μm ; conidia filiform, 0-4-septate, hyaline, 18~51 \times 1.2~2.0 μm . Shin and Sameva (1999) made additional description for the Korean collections. In SMK 15316, on *E. canadensis*, the conidia are usually slightly curved and conidiogenous cells are subhyaline to very pale olivaceous brown in the basal part.

5. *Septoria lycopersici* Speg., Anales Soc. Ci. Argent. 12: 115 (1882) Fig. 5

Leaf spots on the upper surface, scattered to confluent, distinct, circular, angular to irregular, pinpoint to small, 0.5~2 mm diam., often surrounded with yellow haloes, lacking concentric rings, initially gray to dark gray with blackish border lines, center becoming brownish gray to grayish white with thin and blackish margins, later turning dark gray with heavy fungal fructification, finally visible as tiny black specks in the center of the spots; on the lower surface, brown to dark brown with gray or dark brown margins. **Conidiomata** pycnidial, scattered to confluent, amphigenous, but mostly epiphyllous, dark brown, more or less globose, initially immersed, later slightly erumpent, unilocular, 95~160 μm diam.; ostioles circular to subcircular, up to 60 wide. **Conidiogenous cells** discrete, sympodial, hyaline, cylindric, lageniform or ampulliform, irregular in width, not branched, subobtuse to obconic at the apex, pale olivaceous at the basal portion,

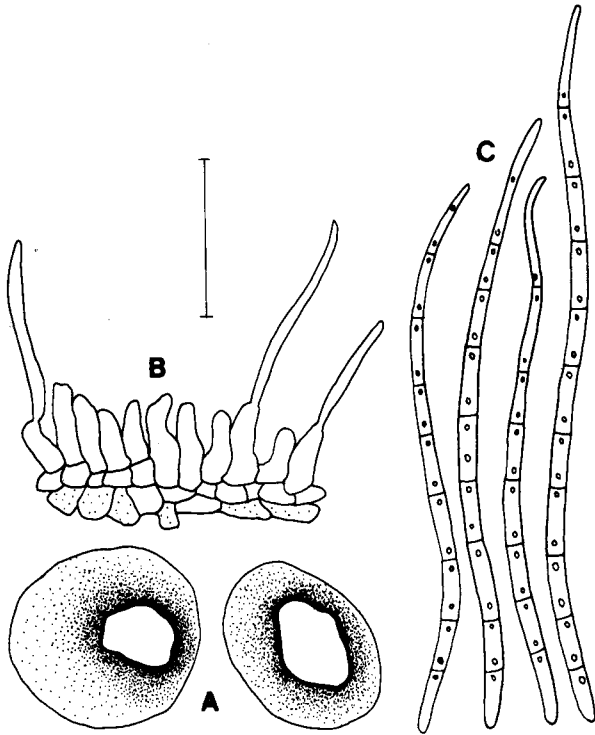


Fig. 5. *Septoria lycopersici* Speg.: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents 100 μm for A and 20 μm for B & C.

5~15 \times 2.5~5.5 μm , formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, slightly curved to sigmoid, subtruncate at the base, subacute to acute at the apex, slightly attenuated towards the apical portion, guttulate, subhyaline, 40~160 \times 2~3 μm , 5-10-septate, septa distinct.

Habitat: On living leaves of *Lycopersicon esculentum* Mill. [Solanaceae].

Specimens examined: SMK 13273 (29 X 1994, Chunchon), 14113 (4 IX 1997, Kwachon), 14184 (15 IX 1997, Yangku), 14769 (13 VIII 1998, Yangku), 15432 (9 X 1998, Chunchon), 15924 (29 V 1999, Seoul), 16410 (18 VIII 1999, Yangku), 16459 (24 VIII 1999, Chunchon), 16835 (28 IX 1999, Kanghwa), 17037 (13 X 1999, Seoul).

Notes: Nakata and Takimoto (1928) recorded this species for the first time in Korea and described the conidia as septate, 70~110 \times 3.3 μm . Recently, Cho *et al.* (1997) recorded and described this fungus as follows: Pycnidia dark brown, subglobose, 190~320 \times 90~210 μm ; conidia hyaline, filiform, 2-9-septate, 32~103 \times 2~3 μm . Though the size of conidiomata is deviating from the previous records (100~199 μm in Rádulescu *et al.*, 1973; 75~160 μm in Brandenburger, 1985; 90~206 μm in Teterevnikova-Babayana, 1987; 75~160 μm in Lu, 1992; 80~200 μm in Vanev *et al.*, 1997), the other characters of taxonomic value are in good agreement with those presented in the mentioned

papers. Our collections match the previous records. Another species described from the same host, *S. tomatoes* Speg. differs in having shorter and narrower conidia (30~50 \times 1 μm in Saccardo, 1913; 36.3~59.4 \times 1 μm in Rádulescu *et al.*, 1973; 30~50 \times 1 μm in Brandenburger, 1985).

6. *Septoria lysimachiae* (Lib.) Westend., Bull. Acad. Roy. Sci. Belgique, ser. III, 19: 120 (1852) Fig. 6

\equiv *Ascochyta lysimachiae* Lib., Pl. Crypt. Ard. 252, 1834

= *Septoria barystachyiae* Miura, Fl. Manch. East. Mong. III. p. 460, 1928

Leaf spots on the upper surface, scattered to confluent, distinct, circular to irregular, sometimes vein-limited, small to large, 1~5 mm diam., up to 10 mm when coalesced, brown to reddish brown with greenish yellow border lines, sometimes center becoming pale gray, later turning grayish brown; on the lower surface, pale brown to olivaceous brown with dark brown margins or slightly discolored without distinct border lines. **Conidiomata** pycnidial, scattered, amphigenous, sometimes only epiphyllous, dark brown, globose to cupulate, immersed, unilocular, 35~90 μm diam.; ostioles angular to subcircular, variable in shape and size, 12~45 μm wide. **Conidiogenous cells** discrete, sympodial, subhyaline to hyaline, cylindrical, lageniform or ampulliform, irregular in width, not branched, subobtuse to obconic at the apex, 5~15 \times 3~6 μm , formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, substraight to occasionally slightly curved, sometimes sigmoid, obtuse to subtruncate at the base, sub-

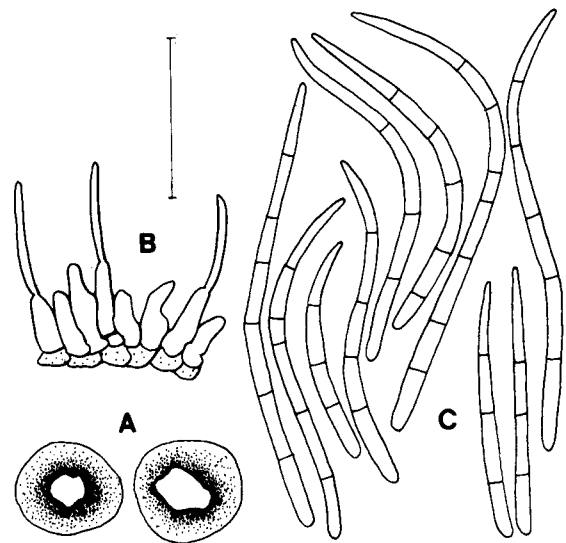


Fig. 6. *Septoria lysimachiae* (Lib.) Westend.: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents 100 μm for A and 20 μm for B & C.

acute to acute at the apex, generally attenuated towards the apical portion, eguttulate, hyaline, $35\text{--}80 \times 1.5\text{--}2.5 \mu\text{m}$, 3-7-septate, septa indistinct.

Habitat: On living leaves of *Lysimachia barystachys* Bunge and *L. clethroides* Duby [Primulaceae].

Specimens examined: On *Lysimachia barystachys*, SMK 15359 (5 X 1998, Chunchon), 16499 (25 VIII 1999, Suwon), 16614 (4 IX 1999, Seoul), 16622 (5 IX 1999, Seoul), 17495 (5 IX 2000, Suwon); on *L. clethroides*, SMK 10997 (6 IX 1991, Kangnung), 11059 (15 IX 1991, Kangnung), 11387 (23 X 1991, Kangnung), 11993 (20 IX 1992, Hongchon), 12620 (10 IX 1993, Pyongchang), 12660 (30 IX 1993, Chunchon), 12683 (9 X 1993, Kangnung), 14090 (27 VIII 1997, Pyongchang), 14129 (4 IX 1997, Seoul), 14179 (15 IX 1997, Chunchon), 15009 (4 IX 1998, Seoul), 16173 (16 VII 1999, Pyongchang), 16905 (30 IX 1999, Seoul), 17208 (7 XI 1999, Seoul), 17919 (17 X 2000, Kangnung).

Notes: Shin and Sameva (1999) first recorded this species in Korea. Saccardo (1902) recorded a form in Italy on *L. nummularia*, viz. f. *raphidospora* Tassi, with $20\text{--}22 \times 0.33\text{--}0.5 \mu\text{m}$ conidia. According to Grove (1935), this form is only a young state. We agree with him. Very immature, narrow (less than $1 \mu\text{m}$ wide) conidia were commonly encountered during microscopic preparation of this materials. According to our field observation, the conidiomata of this species were formed at the later stage of disease development, in old leaf lesion. Another three species of *Septoria* have been recorded on *Lysimachia* spp., differing in the shape and size of their conidia (Teterevnikova-Babayana, 1987): *S. saccardoii* Ferraris. (1902) - conidia $38\text{--}40 \times 3.5 \mu\text{m}$, cylindrical, curved, with blunt ends, 3-septate; *S. nambuana* P. Henn. (1904) - conidia $20\text{--}35 \times 2 \mu\text{m}$, narrow cylindrical with blunt ends, aseptate; *S. bresadoleana* Krieger (1931) - conidia $24\text{--}40 \times 4$ (~ 6) μm , cylindrical or clavate.

7. *Septoria oenotherae* Westend., Bull. Acad. Roy. Sci. Belgique, ser. III, 12: 7 (1845) Fig. 7

Leaf spots on the upper surface, scattered to confluent, distinct, circular or angular to irregular, small to large, 1-4 mm diam., up to 15 mm when coalesced, at first reddish pink without distinct margins, later grayish brown with indistinct pink brown border lines, finally turning dark gray with grayish brown border lines or reddish brown areas, sometimes grayish brown with dark brown margins, center appearing brown, later becoming grayish brown with heavy fungal fructification; on the lower surface, initially obscure or slightly discolored, later dark brown without distinct margins. **Conidiomata** pycnidial, scattered, amphigenous, dark brown to brown, more or less globose, at first immersed, later erumpent, unilocular, $80\text{--}115 \mu\text{m}$ diam.; ostioles circular to subcircular, $25\text{--}35$

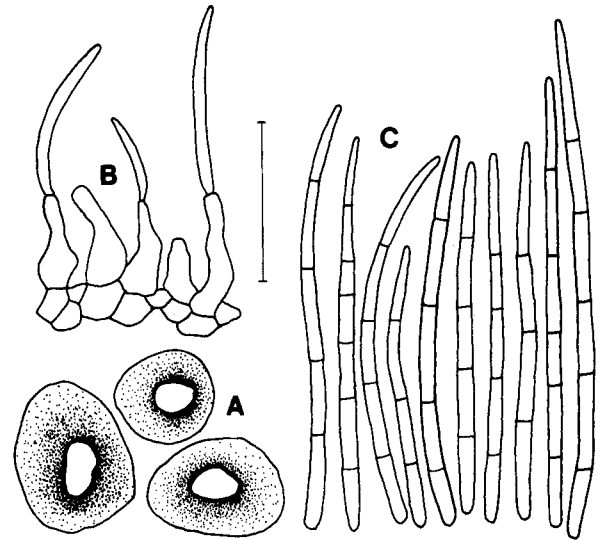


Fig. 7. *Septoria oenotherae* Westend.: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents $100 \mu\text{m}$ for A and $20 \mu\text{m}$ for B & C.

μm wide. **Conidiogenous cells** discrete, sympodial, hyaline, cylindrical, lageniform or ampulliform, irregular in width, not branched, subobtuse to obtuse at the apex, $5\text{--}20 \times 3\text{--}5.5 \mu\text{m}$, formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, straight to substraight or slightly curved, obtuse to subobtuse at the base, subacute to obtuse at the apex, generally attenuated towards the apical portion, eguttulate or guttulate, sometimes with small granules, hyaline, $35\text{--}70 \times 1.5\text{--}2.5 \mu\text{m}$, 3-6-septate, septa distinct.

Habitat: On living leaves of *Oenothera odorata* Jacq. [Onagraceae].

Specimens examined: SMK 11979 (19 IX 1992, Hongchon), 12511 (9 VIII 1993, Kangnung), 12655 (30 IX 1993, Chunchon), 12969 (5 IX 1994, Chunchon), 13929 (4 VI 1997, Suwon), 14016 (25 VIII 1997, Pyongchang).

Notes: This species was first recorded in Korea by Shin (1998) and Shin and Sameva (1999) described its morphological features.

8. *Septoria phlogis* Sacc. & Speg., in Sacc., Michelia 1: 184 (1878) Fig. 8

= *Septoria divaricatae* Ellis & Everh., J. Mycol. 5: 151, 1889

= *Septoria drummondii* Ellis & Everh., J. Mycol. 7: 133, 1892

= *Septoria phlogina* Bondartsev, Materialy Mikol. Obsled. Rossii 5(2): 7, 1921

Leaf spots on the upper surface, scattered to confluent, distinct, angular to irregular, small to large, 2-10 mm

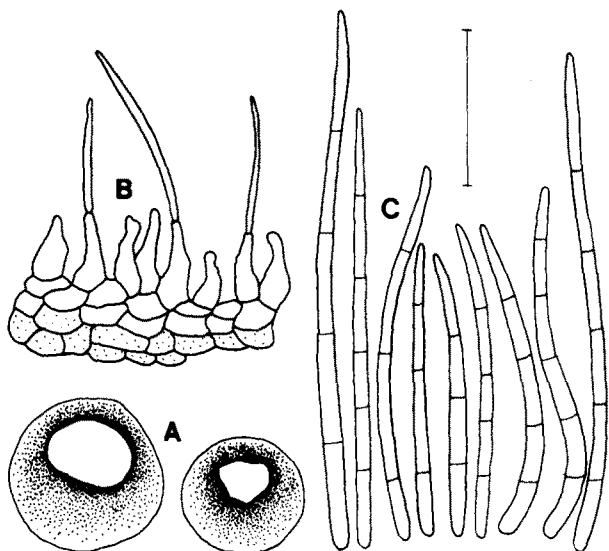


Fig. 8. *Septoria phlogis* Sacc. & Spég.: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents 100 μm for A and 20 μm for B & C.

diam., up to 25 mm when coalesced, initially pale brown to brown with indistinct yellowish brown margins, later grayish brown to dark gray with distinct or indistinct dark brown border lines, finally center becoming white or grayish white with narrow pale brown border lines; on the lower surface, obscure or slightly discolored with distinct margins. **Conidiomata** pycnidial, scattered, amphigenous, but mostly epiphyllous, dark brown to brown, globose to cupulate, at first immersed, later erumpent, unilocular, 70–110 μm diam.; ostioles subcircular to irregular, 15–25 μm wide. **Conidiogenous cells** discrete, sympodial, hyaline, obclavate, lageniform or ampulliform, irregular in width, not branched, obtuse to subobtuse at the apex, 4–15 \times 2.5–7 μm , formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, substraight to slightly curved, subtruncate at the base, subacute to acute at the apex, generally attenuated towards the apical portion, eguttulate, hyaline, 40–75 \times 1.5–2.0 μm , 3–6-septate, septa more or less distinct.

Habitat: On living leaves of *Phlox drummondii* Hooker [Polemoniaceae].

Specimens examined: SMK 13339 (5 XI 1994, Suwon), 13811 (25 V 1997, Namyangju).

Notes: This species was first recorded by Shin and Sameva (1999). Rádulescu *et al.* (1973) treated *S. drummondii* as a distinct species due to acicular and somewhat short conidia (20–50 μm long), but this is within the morphological variability. According to Lu (1992), *S. divaricatae* is a distinct species by having shorter and narrower conidia (15–35 \times 1 μm). Teterevnikova-Babayana (1987) indicated also this fungus as a separate species (conidia 18–30 \times 0.7–1 μm). *Septoria vogliniana* Sacc. & Trott. on *P.*

drummondii has large conidiomata (100–150 μm diam.) and somewhat longer conidia (70–120 μm) with 5–9 septa.

9. *Septoria rohlena* Bubák, Bull. Herb. Boissier, ser. II, 6: 479 (1908) Fig. 9

= *Septoria scrophulariae* Westend., Bull. Acad. Roy. Sci. Belgique, ser. II, 7: 93, 1854 (nomen nudum)

= *Septoria scrophulariae* Peck, Ann. Rep. N.Y. State Mus. 28: 57, 1876

Leaf spots on the upper surface, scattered to occasionally confluent, distinct, circular, angular to irregular, small to large, 0.5–6 mm diam.; up to 10 mm when coalesced, dark brown to blackish brown, sometimes blackish gray with dark brown margins, center initially appearing pale gray with dark brown margins, later becoming grayish white with blackish brown border lines; on the lower surface, obscure or pale brown with indistinct margins. **Conidiomata** pycnidial, scattered, epiphyllous, rarely also hypophyllous, dark brown to blackish brown, globose or cupulate, immersed, unilocular, 70–120 μm diam.; ostioles circular, 15–25 μm wide. **Conidiogenous cells** discrete, sympodial, hyaline, cylindrical, lageniform or ampulliform, irregular in width, not branched, subobtuse to obconic at the apex, 4.5–10 \times 3–4 μm , formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, mildly curved to falcate, subtruncate to obconically truncate at the base, subobtuse to subacute at the apex, slightly attenuated towards the apical portion, guttulate, hyaline, 15–50 \times 2–2.5 μm , 2–6-septate, septa distinct.

Habitat: On living leaves of *Scrophularia buergeriana* Miq. [Scrophulariaceae].

Specimens examined: SMK 11106 (21 IX 1991, Chunchon), 12994 (13 IX 1994, Chonju), 13262 (29 X 1994,

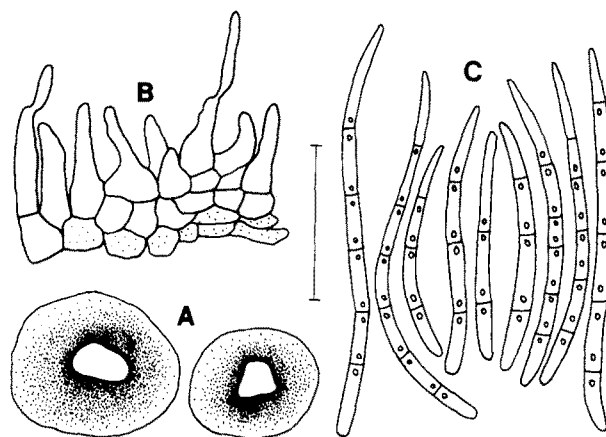


Fig. 9. *Septoria rohlena* Bubák: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents 100 μm for A and 20 μm for B & C.

Chunchon), 14813 (19 VIII 1998, Chunchon), 16372 (20 VII 1999, Pochon).

Notes: This species was first recorded in Korea by Shin and Sameva (1999). Teterevnikova-Babayana (1987) accepted *S. scrophulariae* Peck as a name of this species, but it is illegitimate (Jørstad, 1965). *S. scrophulariicola* Lob. differs in having longer, aseptate conidia (30~70×1~2 μm).

10. *Septoria sonchi* Sacc., *Michelia* 1: 183 (1878) Fig. 10

Leaf spots on the upper surface, scattered to confluent, distinct, angular to irregular, usually large, 4~8 mm diam., up to 25 mm when coalesced, pale brown to brown, sometimes grayish brown with dark brown margins, center becoming pale gray, later turning greenish gray with gray dots; on the lower surface, at first faintly discolored, later obscure or greenish brown with indistinct grayish green margins. **Conidiomata** pycnidial, scattered, amphigenous, but mostly epiphyllous, dark brown, globose, more or less immersed, relatively large, unilocular, 70~130 μm diam.; ostioles circular, rather small, 5~15 μm wide. **Conidiogenous cells** discrete, sympodial, hyaline, cylindrical, lageniform or ampulliform, irregular in width, not branched, subobtuse to obconic at the apex, 10~20×3~5.5 μm, formed from the inner cells of conidiomatal wall. **Conidia** holoblastic, filiform, straight to substraight, subobtuse to obtuse at the base, subacute to subobtuse at the apex, eguttulate, subhyaline to hyaline, 15~35×1.5~2.0 μm, (0-) 1-2-septate, septa distinct.

Habitat: On living leaves of *Sonchus asper* (L.) Hill and *S. oleraceus* L. [Asteraceae].

Specimens examined: On *Sonchus asper*, SMK 15538 (23 X 1998, Koyang), 15663 (5 XI 1998, Koyang), 17236 (10 XI 1999, Suwon); on *S. oleraceus*, SMK 12527 (16 VIII 1993, Kangnung), 14724 (30 VII 1998, Seoul), 14793 (18 VIII 1998, Seoul).

Notes: Shin and Sameva (1999) first recorded this spe-

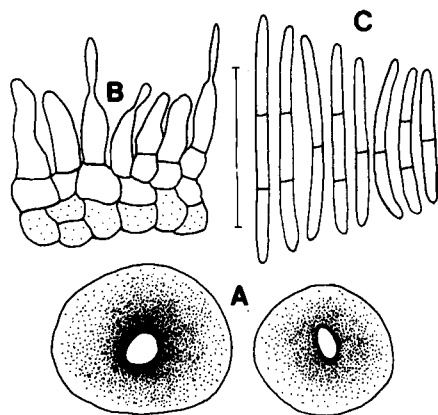


Fig. 10. *Septoria sonchi* Sacc.: (A) Conidiomata. (B) Conidiogenous cells and developing conidia. (C) Conidia. Scale bar represents 100 μm for A and 20 μm for B & C.

cies in Korea with mycological notes. About 10 species of *Septoria* have been described on *Sonchus* spp. *S. sonchi* is a variable species, particularly regarding the size of conidia and conidiomata, and number of septa. It was distinguished from *S. sonchifolia* Cook due to somewhat large conidiomata and shorter conidia (Jørstad, 1965; Rădulescu *et al.*, 1973; Vanev *et al.*, 1997). These characteristics could not be correlated with the host range, and collections from different hosts form an overlapping series. Therefore, Lu (1992) considered *S. sonchifolia* as a synonym of *S. sonchi*. *Septoria modonia* Sacc., *S. modonia* var. *brevispora* Sawada, *S. ixeridis-chinensis* Sawada, and *S. ixeridis-dentatae* Sawada were also recorded on *Sonchus* spp., but the descriptions of the four species are not detailed and the type specimens of these taxa have to be reexamined in order to elucidate their taxonomy. For the time being, we prefer to maintain the Korean fungus in *Septoria sonchi*.

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