Species of *Septoria* on the Fabaceae, subfamily Faboideae, tribe Genisteae

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Fourteen taxa of *Septoria* that have been described on members of the Fabaceae, subfamily Faboideae, tribe Genisteae were studied. Seven taxa are accepted including the new taxa *Septoria sulphurei*, *S. cytisi* var. *alpini*, and *S. cytisi* var. *petteriae*. Conidial morphology, hosts and lesion morphology were found to be valuable in separating taxa. Illustrations and a key to the accepted taxa are included.

Keywords: taxonomy, coelomycetes, pycnidial fungi, Deuteromycotina.

The Fabaceae contains many economically important taxa, several of which have been reported to be infected with species of *Septoria*, including *S. astragali* Roberge in Desmaz. on *Astragalus*, *S. glycines* Hemi on *Glycine*, *S. fulvescens* Sacc. on *Lathyrus*, and *S. pisi* Westend. on *Pisum*. This paper covers the taxonomy of the *Septoria* species that have been reported on members of the Fabaceae, subfamily Faboideae, tribe Genisteae, as part of a larger study of the approximately 160 species of *Septoria* reported on the Fabaceae. The tribe Genisteae was chosen primarily because the type of the genus, *Septoria cytisi* Desmaz., occurs on *Cytisus*, one of the genera in this tribe.

The coelomycete genus *Septoria* is characterized as having pycnidial conidiomata, holoblastic conidial ontogeny, sympodial and/or annellidic conidiogenous cells and hyaline, generally filiform, septate conidia, provided with unthickened scars (Constantinescu, 1984). The multiseptate filiform conidia are often considered one of the distinctive features of the genus, but other conidial shapes have been included in the genus. *S. tetrathecae* Sutton & Pascoe (1989) has long clavate one-septate conidia that are 20–24 x 3.5–4.0 µm, *S. phyllodiorum* Sacc. has fusiform 1–3 septate conidia that are 17–27 x 3–3.5 µm, and *S. acaciae* Neergaard has cylindrical one-septate conidia that are 12–20 x 2 µm (Sutton & Pascoe, 1987). The diversity of conidial morphology and conidiogenesis suggests that the genus could be further subdivided (Sutton, 1980) but modern descriptions of a larger number of the described species of *Septoria* are needed before any significant restructuring of the genus can be considered.

Tab. 1. – Hosts for selected species of *Septoria*.

Septoria species	Hosts	Source
Septoria acaciae Neergaard	*Acacia armata*	Sutton & Pascoe (1987)
S. grampianensis Sutton & Pascoe	*A. myrtifolia*	
S. lamentana Sutton & Pascoe	*A. verniciflua*	
S. phyllodiorum Sacc.	*A. retinodes, Acacia* sp.	
S. aureocorona Sutton & Pascoe	*A. saligna*	
S. alni Sacc.	*Alnus* (8 species, not including the two below)	Constantinescu (1984)
S. alnifolia Ell. & Ev.	*A. rhombifolia, A. rubra*	
S. betulae Pass.	*Betula* (7 species), *Carpinus caroliniana*	
S. betulae-odoratae Bubak & Vleugel	*Betula* (3 species)	
S. ostryae	*Carpinus* (3 species), *Ostrya virginiana*	
S. weiriana Sacc.	*Alnus crispa, Alnus tenuifolia, Betula occidentalis*	
S. chrysanthemella Sacc.	*Chrysanthemum* cultivated	Punithalingham & Wheeler (1965)
S. obesa Syd.	*Chrysanthemum* cultivated	
S. adanansis Petrak	*Chrysanthemum* cultivated	
S. leucanthemi Sacc.	*C. leucanthemum, C. maximum*	
S. socia Pass.	*C. leucanthemum*	
S. canadensis Peck	*Cornus canadensis* L.	Farr (1991)
S. floridae Tehon & Daniels	*C. florida* L.	
S. cornicola (DC.:Fr.) Desmaz.	*Cornus* (4 species)	
S. cornina M. Kuhnholtz-Lordat	*Cornus* (9 species, including the four above)	

Detailed morphological studies of *Septoria* species on dicotyledonous hosts are few. Tab. 1 lists the host ranges for the species of *Septoria* covered in four previous papers. Each of the five species of *Septoria* found on *Acacia* was restricted to a different species of *Acacia* (Sutton & Pascoe, 1987). Of the *Septoria* species found on *Chrysanthemum*, three were found on the cultivated chrysanthemum, and the other two were found on two additional host species (Punithalingham & Wheeler, 1965). Of the four species of *Septoria* found on *Cornus* two are restricted to a single species and two are more omnivorous (Farr, 1991). In a study of *Septoria* on the Betulaceae, some fungal species were restricted to a single species, some to a single genus, and some to two genera (Constantinescu, 1984). From these studies it would appear that host ranges can be rather limited. Extrapolation from these few studies to other host groups is not possible. However, they do suggest that host ranges are an important character in species delimitation and support the rationale for selecting a host grouping as a basis for the subdivision of the genus *Septoria* into workable units.

In addition to host ranges, these studies have also documented the types of morphological variation to be anticipated in species of *Septoria*. The conidiophores, conidiogenesis, and shape, size and septation of conidia have provided taxonomically useful information. The combination of host ranges and morphological characters appear to incorporate enough variation to permit taxonomic differentiation based on herbarium specimens. This is in contrast to other large Coelomycete genera such as *Phoma* where a dearth of morphological features makes separation of taxa difficult (Aa &. al., 1990).

Materials and methods

Leaf fragments bearing conidiomata were rehydrated in 70% ethyl alcohol followed by 3% KOH. Conidiomata were either sectioned using a freezing microtome or gently separated by pressure on the cover slip. Material was stained with either 1% phloxine in water or cotton blue in lactic acid. For curved conidia several measurements were made along the circumference. The widths of both the conidia and conidiogenous cells were measured at their widest part. Whenever possible, conidial measurements were made using conidia from the cirrus of expelled conidia. The material was placed in a small drop of water to allow dispersion of the conidia. After the drop of water had evaporated, the preparation was completed by one of the following methods: 1) phloxine was added, a cover slip applied, and the phloxine removed with KOH, or 2) cotton blue in lactic acid was added and a cover slip applied. When a cirrus was not present,

mature conidiomata were rehydrated in water. If conidia did not emerge, then the conidiomata were gently prodded to expel the conidia. Conidia were randomly measured from these preparations. For each taxon the total number of conidia measured (N) is indicated along with the mean and standard deviation for the length, width, and number of septa. The terms used in describing the lesions are defined in Pascoe & Sutton (1986).

In listing host ranges I am dependent on the quality of the identification made by the original collector. Most material examined as fungal herbarium specimens is not adequate for verification of host identity. The distribution statements for each species are based only on the specimens examined. Host names have been changed to reflect current concepts in the taxonomy of the Fabaceae (Wiersema &. al., 1990).

Several year ago BPI began adding numbers to the herbarium specimens. At this time not all collections have been numbered and thus specimens cited from BPI may or may not have a number.

Key to species of Septoria on Fabaceae, Subfamily Faboideae, Tribe Genisteae

1. Conidia less than 25 µm long ..... *S. laburni*
1.* Conidia 25 µm or more long 2

2. On *Lupinus* 3
2.* On *Chamaecytisus*, *Cytisus*, *Genista*, *Laburnum*, *Petteria* ... 5

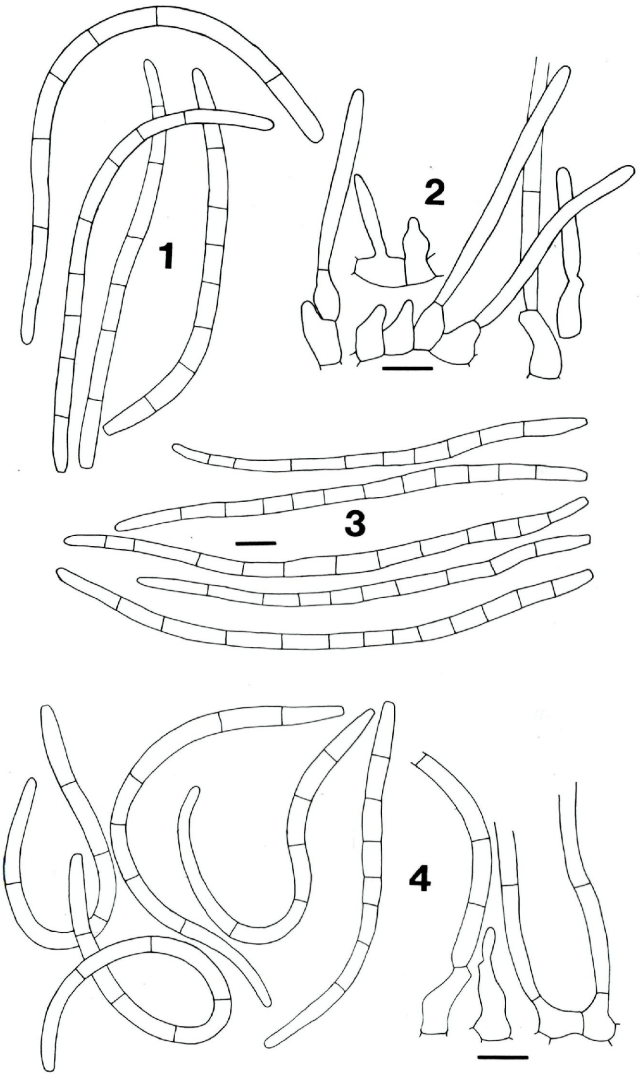
3. Conidia 3 µm or less wide ..... *S. lupini*
3.* Conidia wider than 3 µm 4

4. Conidia with 2–5 septa and an mean length of 62 µm ..... *S. sulphurei*
4.* Conidia with 4–13 septa and a mean length of 106 µm ..... *S. kaznowskii*

5. Many of the conidia strongly curved, lunate, hooked, c-shaped, on *Laburnum alpinum* ..... *S. cytisi* var. *alpini*
5.* Conidia straight, falcate, occasionally lunate, not on *Laburnum alpinum* 6

6. Conidia 90–235 µm, mean 150 µm, on *Petteria* ..... *S. cytisi* var. *petteriae*
6.* Conidia with mean less than 150 µm ..... *S. cytisi* var. *cytisi*

Figs. 1–4.– Conidiogenous cells and conidia in *Septoria*.– 1–3. *S. cytisi* var. *cytisi*. – 4. *S. citysi* var. *alpini*. – Bar = 10 µm.



Description of species

Septoria cytisi Desmaz. var. *cytisi*, Ann. Sci. Nat. Bot. ser. 3, 8: 24. 1847. – Figs. 1–3.

= *Septoria cytisi* var. *genistae* P. Syd., Mycotheca Marchica no. 2473. 1888.

= *Septoria cytisi* f. *genistae* Bäumler, Atti Soc. Venet. – Trent. Sci. Nat. Padova, ser. 2, 3: 200. 1897.

= *Septoria cytisi-hirsuti* Savul. & Sandu, Bull. Soc. Mycol. France 46: 185. 1930.

Lesions on *Laburnum* hologenous, discrete to confluent; discrete lesions to 10 mm in longest dimension, generally irregularly elongate, occasionally circular, scattered; epigenous lesions compound, composed of two to several irregularly shaped pale brown to white 'lesions' each of which is surrounded by a thin, relatively distinct, brown margin, the whole surrounded by a thin to somewhat broad brown margin; lesions on other hosts hologenous, discrete to confluent, discrete lesions to 7(-8) mm in longest dimension, generally with a small, central circular 'lesion', surrounded by 1 to 2 (occasionally more) rows of elongated 'lesions', each of which is successively surrounded by a thin to broad brown margin, and a broad brown margin; in both types, hypogenous lesions are similar to epigenous but with coloration muted. – Conidiomata pycnidial, immersed, separate, globose to cupulate, brown to black, (65-)80–160(-200) µm wide, several formed in each lesion, epigenous, occasionally hypogenous, dehiscence circular to irregular. – Conidiophores occasionally present, simple, two-celled, each cell of conidiophore may be conidiogenous, hyaline, formed from the inner cells of the conidiomatal wall. – Conidiogenous cells hyaline, discrete or integrated, determinate or indeterminate, ampulliform to lageniform, 4–12 x 2–4(-6) µm, sometimes with sympodial holoblastic proliferation, annellations present in some, formed from the inner cells of the conidiomatal wall.– Conidia holoblastic, hyaline, (1-)2–13(-14) septate, cylindric or tapering towards apex, straight, irregularly curved, sigmoid, falcate, hooked, guttulate, apex rounded, base truncate, (54-)62–160 x (2.5-)3.0–6.0(-8) µm. Length 107.37 ± 22.75; width 3.99 ± 1.46; septa 6.97 ± 2.08; N = 1222.

Hosts and distribution. – *Chamaecytisus hirsutus* (Romania); *Chamaecytisus ratisbonensis* (USSR); *Cytisus nigricans* (Czechoslovakia, Romania); *Genista tinctoria* (Czechoslovakia, Germany, USSR); *Laburnum anagyroides* (Czechoslovakia, France, Italy, Romania); *Laburnum vulgare* (Italy).

Specimens examined. – Neotype: FRANCE: on *Laburnum anagyroides* as *Cytisus laburnum*, 1847 (Desmaziéres Plantes Cryptogames de France 2190, BPI). – CZECHOSLOVAKIA: Bratislava (Pozsony), on *Laburnum anagyroides* as *Cytisus laburnum*, J. A. Bäumler, Aug 1885 (Linhart Fungi Hungarici 495, BPI); Mahren, Losch bei Brunn, on *Cytisus nigricans*, J. Hruby, Sep 1929 (Dr. F. Petrak Mycotheca

Generalis 1462, BPI); Mt. Sytno, Pocuvadlo Lake, on *Genista tinctoria*, A. Kmet, 4 Jul 1890 (Fungi Schemnitzienses, Isotype of *Septoria cytisi* f. *genistae*, BPI 379004); Muehlthal near Bratislava (Pressburg), on *Laburnum anagyroides* as *Cytisus laburnum*, J. A. Bäumler, no date (Kryptogamae Exsiccatae Vindobonensi 416, BPI 378994, 378985). – GERMANY: Lichterfelde near Berlin, on *Genista tinctoria*, P. Sydow, Sep 1888, Type of *Septoria cytisi* f. *genistae* (FH). – ITALY: Boschi near Como, on *Laburnum anagyroides* as *Cytisus laburnum*, Aut. 1893 (Briosi e Cavara i Funghi Parassiti Delle Piante Coltivate od Utili 247, BPI); Parma Prov., on *Laburnum anagyroides* as *Cytisus laburnum*, G. Passerini, Aut. (Erbario Crittogamico Italiano. Ser. II 1097, BPI); Selva near Treviso, on *Laburnum vulgare*, P. A. Saccardo, Oct 1876 (Thuemen, Herb. Mycol. Oeconomicum 537, BPI); on *Laburnum anagyroides* as *Cytisus laburnum*, P. A. Saccardo, Oct 1876 (Rabenhorst Fungi Europaei 2359, BPI 378995A); on *Laburnum anagyroides* as *Cytisus laburnum*, P. A. Saccardo, Oct 1876 (Rabenhorst Fungi Europaei 2359, BPI); Venetia, Selva Treviso, on *Laburnum anagyroides* as *Cytisus laburnum*, Sep 1874 (Saccardo Mycotheca Veneta 322, BPI). – ROMANIA: Baile Herculane (Herkulesfuerdoe) Cerna Valley, on *Cytisus nigricans*, F. Bubák, 23 Jun 1905 (Fungi Hungarici Bubák, BPI 378996); Bucharest, on *Laburnum anagyroides*, E. Docea, 27 Jul 1949 (Mycoflora Romaniae, BUCM 83.398); Oltenia, Craiova Distr., on *Laburnum anagyroides*, I. Comes & I. Ene Il., 25 Oct 1963 (Flora Olteniae Exsiccata 143, BPI); on *Laburnum anagyroides* as *Cytisus laburnum*, T. Savulescu & C. Sandu, 21 Jul 1927 (Herbarium Mycologicum Romanicum Savulescu Fasc. IV 165, BPI 378984); Oltenia, Valcea Distr., Mihaesti, on *Chamaecytisus hirsutus* as *Cytisus hirsutus*, T. Savulescu & C. Sandu, 25 Aug. 1926, (Herbarium Mycologicum Romanicum Savulescu 164, Isotype of *Septoria cytisi-hirsuti*, BPI); on *Chamaecytisus hirsutus* as *Cytisus hirsutus*, T. Savulescu & C. C. Sandu, 25 Aug 1926 (Herbarium Mycologicum Romanicum Savulescu 164, Type of *Septoria cytisi-hirsuti*, BUCM 32.910); Transilvania, Covasna Distr., Zagon, on *Laburnum anagyroides*, G. Negrean, 31 Jul 1981 (Mycoflora Romaniae, BUCM 74.583). – USSR: Kvishkheti, on *Chamaecytisus ratisbonensis* as *Cytisus biflorus*, Kuschke, 5 Jul 1914 (Herb. James R. Weir 18028, BPI 378981); Orlow Prov., Liwni Distr., Michailowskoje, on *Chamaecytisus ratisbonensis* as *Cytisus ratisbonensis*, A. Bondarzew, 14 Aug 1915 (Fungi Rossici Exsiccati ED. F. Bucholtz & A. Bondarzew Ser. 639, BPI); Tambov, on *Chamaecytisus ratisbonensis* as *Cytisus ratisbonensis*, T. Schirajewsky, 8 Jul 1911 (Tranzschel & Serebrianikow Mycotheca Rossica 332, BPI); on *Chamaecytisus ratisbonensis* as *Cytisus biflorus*, T. Schirajewsky, 12 Jul 1911 (BPI 378979); Ukraine, Stryy, near Lotatniki, on *Genista tinctoria*, F. Petrak, 24 Sep 1917 (BPI 379001).

This species is characterized by the compound lesion and long conidia which are straight to somewhat curved or occasionally lunate. Conidia measurements for this species have been reported by Sutton (1980) as 58–93 x 4–5.5 µm with 4–6 septa, Teterevnikova-Babayan (1987) as 51–130 x 3.5 µm with 3–7 septa, and Radulescu & al. (1973) as 65–108 x 3–4.5 µm with 3–7 septa. These reports point out the considerable variation in this species. A similar range in conidial dimensions was found in this study. Fig. 5 lists the means, and ranges in conidia for 22 specimens. The range in conidial size, indicated by the vertical bar is large and there is considerable overlap between collections. The horizontal bars indicate two standard errors above and below the mean. From a statistical standpoint several individual collections could be distinguished, but the continuum of conidial sizes makes a further subdivision in taxa untenable.

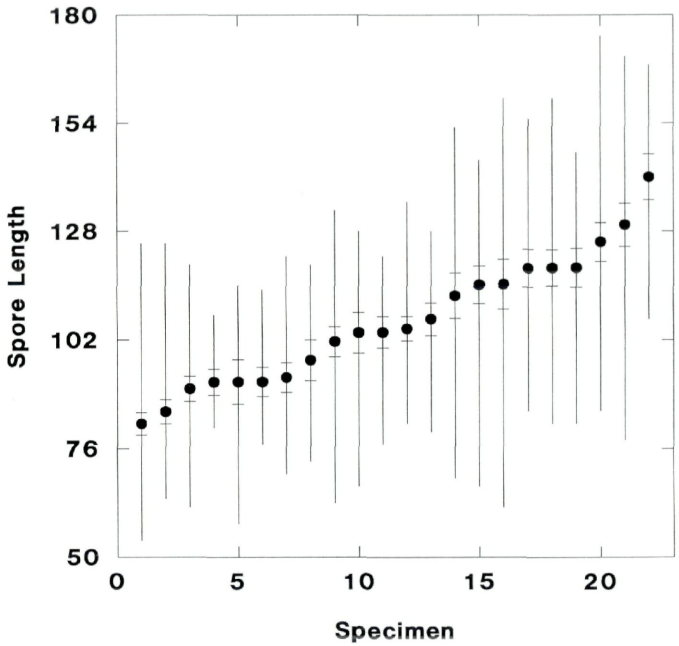


Fig. 5.– Comparisons of spore lengths in collections of *Septoria cytisi* var. *cytisi*.– For each collection the range, mean and 2 standard errors are shown.

A similar range in conidial lengths has been reported in *Septoria cornicola* M. Kuhnholtz-Lordat (Farr, 1991).

In addition to the hosts reported above, Teterevnikova-Babayan (1987) has reported *Septoria cytisi* as occurring on *Chamaecytisus borysthenicus* (Gruner) A. Klaskova, and Radulescu & al. (1973) reported *Laburnum watereri* Dopp. as a host. Grove (1935) reported *Leptosphaeria lucina* Sacc. associated with *Septoria cytisi*.

Septoria cytisi var. *alpini* D. F. Farr, var. nov.– Fig. 4.

= *Septoria cytisi* f. *laburni-alpini* Thuemen, Mycotheca Universalis, no. 1693, 1880, *nom. nud.*

= *Septoria cytisi* f. *cytisi-alpini* D. Sacc., Mycotheca Italica, no. 1701, 1913, *nom. nud.*

A *S. cytisi* var. *cytisi* conidiis 2–13 septatis, cylindricis vel angustatis apicem versus, plerumque valde curvatis sed interdum falcatis, lunatis, sigmoideis, vel irregu-

lariter curvatis,guttulatis, apicibus rotundatis basibus truncatis, (77-)88–170 x 3.5(-6) µm differt.

Typus: Austria, Tyrol, St. Michael, on *Laburnum alpinum*, Thuemen – Jul 1879, de Thuemen Mycotheca Universalis #1693, (BPI 379002).

Lesions hologenous, discrete to confluent; discrete lesions to 5.5 mm in longest dimension, generally irregularly elongate; epigenous lesions compound, composed of two to several irregularly shaped light brown to white 'lesions' each of which is surrounded by a thin, relatively distinct, brown margin; the whole surrounded by a thin to somewhat broad brown margin, hypogenous lesions similar but with coloration muted. – Conidiomata pycnidial, immersed, separate, globose to cupulate, brown to black, 70–160 µm wide, a few to several formed in each lesion, epigenous occasionally hypogenous, dehiscence circular to irregular. – Conidiophores occasionally present, simple, 2 celled, each cell of conidiophore may be conidiogenous, hyaline, formed from the inner cells of the conidiomatal wall. – Conidiogenous cells hyaline, discrete or integrated, determinate or indeterminate, ampulliform to lageniform, 8–15 x 4–7(-10) µm, sometimes with sympodial holoblastic proliferation, formed from the inner cells of the conidiomatal wall. – Conidia holoblastic, hyaline, 2–13 septate, cylindric or tapering towards apex, strongly curved in most, falcate, lunate, c-shaped, sigmoid or irregularly curved, guttulate, apex rounded, base truncate, (77-)88–170 x 3–5(-6) µm. Length 118.43 ± 18.22, ; width 4.23 ± 0.64; septa 6.99 ± 2.02; N = 114.

Host and distribution.– *Laburnum alpinum* (Austria, Italy).

Specimens examined. – Type. AUSTRIA: Tyrol, St. Michael, on *Laburnum alpinum*, Thuemen, Jul 1879 (Thuemen Mycotheca Universalis 1693, BPI 379002). – ITALY: Veralta, Verona, on *Laburnum alpinum* as *Cytisus alpinus*, C. Massalongo, Sep 1905 (D. Saccardo Mycotheca Italica 1701, Isotype of *Septoria cytisi* f. *cytisi-alpini*, BPI 379003A).

This variety is distinguished from *S. cytisi* var. *cytisi* and *S. cytisus* var. *petteriae* by its strongly curved spores.

Septoria cytisi var. *petteriae* D. F. Farr, var. nov.– Fig. 6.

A *S. cytisi* var. *cytisi* laesionibus unaquaeque cum area centrali alutacea usque ad albidam, a margine distincto generaliter tenui, elevato, atrobrunneo vel atro circumcincta, conidiomatibus 110–260 µm latibus; conidiis 7–16 septatis, cylindricis vel angustatis apicem versus, rectis, irregulariter curvatis, sigmoideis, lunatis vel falcatis, guttulatis, apicibus rotundatis basibus truncatis, (90-)105–200(-235) x 4–6(7)µm differt.

Typus:Yugoslavia: Montenegro, Simunje, Katun District, on *Petteria ramentacea* (as *Cytisus ramentaceus*; Bubák: Fungi Imperfecti Exsiccati #18, BPI 378999).

Lesions hologenous, discrete to confluent; discrete lesions to 3.5 mm in longest dimension, circular to irregular, scattered; epigenous lesions with a tan to white central area, surrounded by a distinct, generally thin, well-defined, raised, dark brown to black margin; hypogenous lesions similar but with color muted. – Conidiomata pycnidial, immersed, separate, globose to cupulate, brown to black, 110–260 µm wide, generally with one in each lesion, epigenous and hypogenous, dehiscence circular to irregular. – Conidiophores occasionally present, simple, generally with 2 cells, each cell of conidiophore may be conidiogenous, hyaline, formed from the inner cells of the conidiomatal wall. – Conidiogenous cells hyaline, discrete or integrated, determinate or indeterminate, ampulliform to lageniform, 8–15 x 4–10(-12) µm, sometimes slightly annellidic, formed from the inner cells of the conidiomatal wall. – Conidia holoblastic, hyaline, 7–16 septate, cylindrical or tapering towards apex, straight, irregularly curved, sigmoid, lunate, or falcate, guttulate, apex rounded, base truncate, (90-)105–200(-235) x 4–6(-7) µm. Length 154.07 ± 28.45; width 4.96 ± 0.48; septa 10.44 ± 2.10; N = 84.

Host and distribution.– *Petteria ramentacea* (Yugoslavia).

Specimens examined. – Type: YUGOSLAVIA: Montenegro, Simunje, Katun District, on *Petteria ramentacea* as *Cytisus ramentaceus*, F. Bubák, 20 Jul 1901 (Fungi Montenegrini Bubák, BPI 378998). – YUGOSLAVIA: Montenegro, Simunje, Katun District on *Petteria ramentacea* as *Cytisus ramentaceus*, F. Bubák, 20 Jul 1901 (Kabát & Bubák: Fungi Imperfecti Exsiccati 18, BPI 378999).

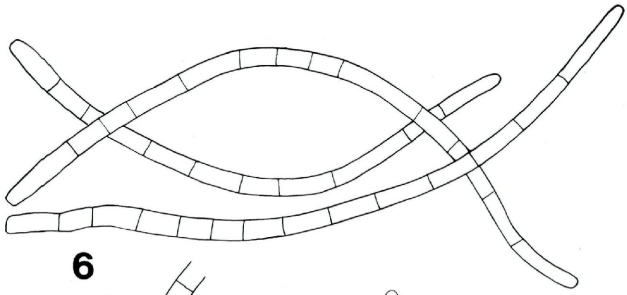
This variety is distinguished from *S. cytisi* var. *cytisi* and *S. cytisi* var. *alpini* by its conidial length with a mean of 154 µm, simpler lesion morphology and larger conidiomata.

Septoria kaznowskii M. Nikolojeva, Mikol. Fitopatol. 5: 427. 1971.– Fig. 7.

≡ *Septoria lupini* Kaznowski in Siemaszko, Acta Soc. Bot. Poloniae 2: 5. 1925; non *Septoria lupini* Harkness. 1884.

Lesions hologenous, discrete to confluent; discrete lesions 3 to 9 mm in longest dimension, circular to irregular, scattered; epigenous lesions somewhat zonate, compound from the accretion of

Figs. 6–8.– Conidiogenous cells and conidia in *Septoria*.– 6. *S. cytisi* var. *petteriae*.– 7. *S. kaznowskii*. – 8. *S. laburni*.– Bar = 10 µm.



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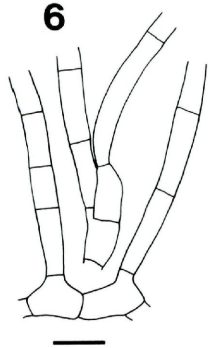

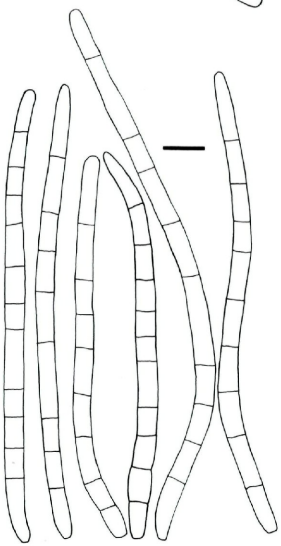

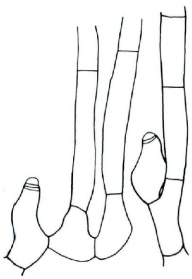

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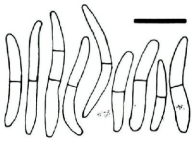

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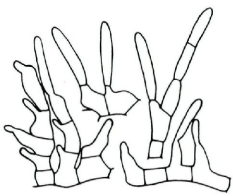


smaller brownish to whitish 'lesions' each of which is surrounded by a thin brown margin, generally with a circular, central small 'lesion', which is surrounded by 1 to 2 rows of elongated 'lesions', the whole surrounded by a broad brown margin; hypogenous lesions similar but the coloration is muted. – Conidiomata pycnidial, immersed, separate, globose to cupulate, dark brown to black, 80–180 µm wide, several formed in each lesion, epigenous, occasionally hypogenous, dehiscence circular to irregular. – Conidiophores occasionally present, simple, two celled, each cell of conidiophore may be conidiogenous, hyaline, formed from the inner cells of the conidiomatal wall. – Conidiogenous cells hyaline, discrete or integrated, determinate or indeterminate, ampulliform to lageniform, 10–16 x 4–10 µm, sometimes with obscure annellations, formed from the inner cells of the conidiomatal wall. – Conidia holoblastic, hyaline, (3-)4–13(-14) septate, cylindric or tapering towards apex, straight, irregularly curved, broadly falcate, guttulate, apex rounded, base truncate, (72-)78–136(-155) x 4–5.5 µm. Length 106.73 ± 16.98; width 4.67 ± 0.45; septa 9.07 ± 2.06; N = 153.

Host and distribution.– *Lupinus polyphyllus* (Poland, West Germany).

Specimens examined. – POLAND: Skierniewice, on *Lupinus polyphyllus*, Z. Zweigbaum, 10 Aug 1923 (Herbarium Instituti Phytopathologici Scholae Superioris Agriculturae Varsaviensis Fungi Polonici, BPI 381232). – WEST GERMANY: Bavaria, Oberpfalz, Amberg Kr., Suedlager near Vilseck, on *Lupinus polyphyllus*, K. Starcs, 12 Aug 1945 (Herbarium K. Starcs Flora Bavarica G.72, BPI 375894).

The original description lists two collections, one from Zytomierz collected by L. Kaznowski in 1915 and the other from Skierniewice collected by Z. Zweigbaum in 1923. I have only seen the latter which is located at BPI. This species is distinguished from the other species on *Lupinus* by its conidia length. It is similar to *S. cytisi* var. *cytisi* but is considered distinct because of its occurrence on *Lupinus*.

Septoria laburni Pass., Atti Soc. Crittog. Ital. 2: 26. 1879.– Fig. 8.

Lesions hologenous, discrete to confluent; discrete lesions to 4.2 mm in longest dimension, circular to irregular, scattered; epigenous lesions generally with a central light brown area, surrounded by a thin to broad, rust colored margin, some lesions lack the central light brown area; hypogenous lesions similar but lacking the reddish coloration. – Conidiomata pycnidial, immersed, separate, globose to cupulate, black, 50–100 µm wide, many formed in each lesion, dehiscence circular to irregular, epigenous and hypogenous. – Conidiophores common, simple, to 4 cells long, each cell of co-

nidiophore may be conidiogenous, hyaline, formed from the inner cells of the conidiomatal wall. – Conidiogenous cells hyaline, discrete or integrated, determinate or indeterminate, ampulliform to lageniform, (3-)7–10(-12) x 3–5(-10) µm, formed from the inner cells of the conidiomatal wall. – Conidia holoblastic, hyaline, (0-)1(-2) septate, filiform or tapering towards apex, straight, irregularly curved, guttulate, apex rounded, base truncate to obtuse, 11–24 x 1.5–2.5(-3.5) µm. Length 16.78 ± 3.63; width 2.12 ± 0.36; septa 1.05 ± 0.37; N = 42.

Host and distribution.– *Laburnum anagyroides* (Germany, Italy).

Specimens examined.– GERMANY: Unterfrankern, Gerolzhofen, Saudrachshof, on *Laburnum anagyroides* as *Cytisus laburnum*, A. Vill, Oct 1908 (Allescher & Schnabl Fungi Bavarici 978, BPI). – ITALY: Lago di Santa Croce, Belluno, on *Laburnum anagyroides* as *Cytisus laburnum*, Sep 1903 (BPI 378982A).

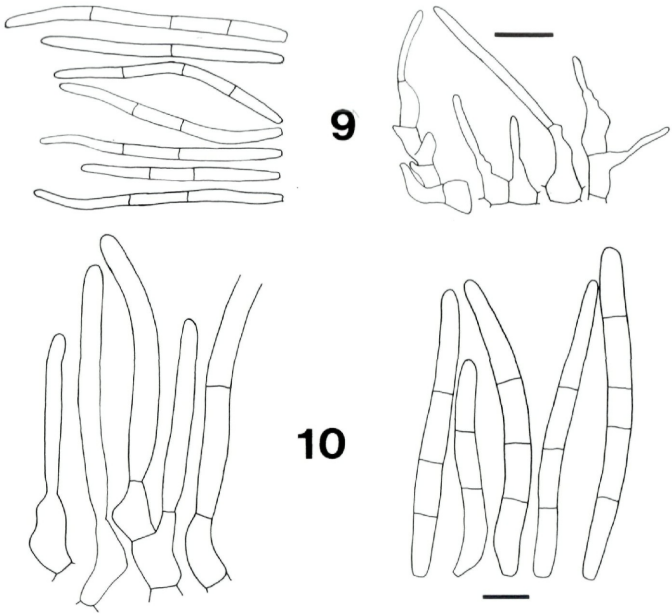
I was unable to locate the type of this taxon. The short, one septate, irregularly curved conidia are unique for this group of fungi.

Septoria lupini Harkness, Bull. Calif. Acad. Sci. 1: 31. 1884. – Fig. 9.
= *Septoria lupinicola* Dearn., Mycologia 8: 103. 1916.

Lesions hologenous, discrete; discrete lesions to 15 mm in longest dimension, circular to irregular, scattered; epigenous lesions brownish, with or without a differentiated dark brown margin; hypogenous lesions similar but with color muted. – Conidiomata pycnidial, immersed, separate, globose to cupulate, brown, 60–160 µm wide, many formed in each lesion, epigenous and sometimes hypogenous, dehiscence circular to irregular. – Conidiophores common, simple, 2–4 cells long, each cell of conidiophore may be conidiogenous, hyaline, formed from the inner cells of the conidiomatal wall. – Conidiogenous cells hyaline, discrete or integrated, determinate or indeterminate, ampulliform to lageniform, 6–12 x 3–5(-7) µm, frequently with sympodial holoblastic proliferation, formed from the inner cells of the conidiomatal wall. – Conidia holoblastic, hyaline, (0-)1–4 septate, cylindric or tapering towards apex, straight, irregularly curved, guttulate, apex rounded, base truncate, (28-)32–57(-65) x 1.5–2.5(-3) µm. Length 43.17 ± 0.55; width 2.02 ± 0.02; septa 2.52 ± 0.09; N = 426.

Hosts and distribution.– *Lupinus densiflorus* (U.S.A. – California); *Lupinus perennis* (Canada, U.S.A. – Wisconsin); *Lupinus* sp. (Canada).

Specimens examined.– Type. UNITED STATES: California, Sunnyside, Mt. Tamalpais, on *Lupinus densiflorus*, Apr 1882 (BPI 381229).



Figs. 9–10.– Conidiogenous cells and conidia in *Septoria*.– 9. *S. lupini*.– 10. *S. sulphurei*.– Bar = 10 µm.

CANADA: Ontario, Oakland, on *Lupinus* sp., Dearness 3633, 26 Jul 1911 (DAOM); on *Lupinus* sp., Dearness 3633, 22 Jul 1911, Lectotype of *Septoria lupinicola*, (DAOM); on *Lupinus* sp., Dearness 3633, 11 Jun 1911 (DAOM); on *Lupinus perennis*, Dearness, 21 Jul 1914 (DAOM). – UNITED STATES: California, Sunnyside, Mt. Tamalpais, on *Lupinus densiflorus*, Apr 1882, Type of *Septoria lupini* (BPI 381228); Wisconsin, Sauk City, Dane Co., on *Lupinus perennis*, H. C. Greene, 12 Jun 1942 (BPI 381230).

This species is distinguished from the other species on *Lupinus* by its narrow, mostly straight conidia.

Septoria sulphurei D. F. Farr, sp. nov.– Fig. 10.

Laesiones hologenae, discretae vel confluentes; discretae 1.7–4.2 mm, circulares vel irregulares, dissitae; laesiones epigenae et hypogenae juventute ochraceae maturitate alutaceae pallidae margine fuscato vel non distinguibili. Conidomata pycnidialia epigena, immersa, discreta, globosa, brunnea, 80–130 µm lata, aliquot in laesionibus omnibus formata, dehiscentia circulari vel irregulari. Conidiophora aliquando adsunt,

simplicia, cum cellulas duabus aut una aut amba conidiogena, hyalina, ex cellulis interioribus parietis conidiomatis formata. Cellulae conidiogenae hyalinae, discretae vel integratae, determinatae vel indeterminatae, ampulliformes, lageniformes vel fusiformes, 10–15(-20) x 4–6 µm, e cellulis interioribus parietis conidiomatis formata. Conidia holoblastica hyalina, (1-)2–5(-6) septata, cylindrica vel angustata apicem versus, recta, irregulariter curvata, aliquando late falcata, guttulata, apice rotundata basi truncata, (43-)45–82(-86) x 4–6µm.

Typus: United States: Washington, Bear Creek, Hunter Spring? Trail, Umatilla National Forest, Garfield Co., on *Lupinus sulphureus*, C. G. Shaw, W. M. Yerkes and R. Sprague, 11 Jul 1948 (BPI 381231).

Lesions hologenous, discrete to confluent; discrete lesions 1.7–4.2 mm, circular to irregular, scattered; epigenous lesions golden brown when young to light tan with age, margin darker to undifferentiated; hypogenous lesions similar. – Conidiomata pycnidial, immersed, separate, globose, brown, 80–130 µm wide, several formed in each lesion, dehiscence circular to irregular, epigenous. – Conidiophores occasionally present, simple composed of two cells, each cell of conidiophore may be conidiogenous, hyaline, formed from the inner cells of the conidiomatal wall. – Conidia holoblastic, hyaline, (1)2–5(6) septate, cylindrical or tapering towards apex, straight, irregularly curved, sometimes broadly falcate, guttulate, apex rounded, base truncate, (43-)45–82(-86) x 4–6 µm. Length 62.07 ± 10.92; width 5.05 ± 0.45; septa 3.14 ± 0.89; N = 90.

Host and distribution. – *Lupinus sulphureus* (U.S.A. – Washington).

Specimen examined. – Type: UNITED STATES: Washington, Bear Creek, Hunter Spring? Trail, Umatilla National Forest, Garfield Co., on *Lupinus sulphureus*, C. G. Shaw, W. Yerkes & R. Sprague, 11 Jul 1948 (BPI 381231).

This species is distinguished from *S. lupini* by its broader conidia and from *S. kaznowskii* by it shorter conidia.

Species not examined

Septoria cytisina L. Garbowski, Bull. Soc. Mycol. France 39: 250. 1923.

Garbowski did not clearly state the location of the collections examined. The identifications were done while the author was in St. Petersburg. A request to Leningrad (LE) for assistance in locating this collection was made. Unfortunately no response has been received. *S. cytisina* was found on the leaves of *Cytisus ratisbonensis* and described as having linear, straight, guttulate conidia, 35–50 x 1 µm. The width of the conidia is unique for this group of fungi. No information was provided about septation.

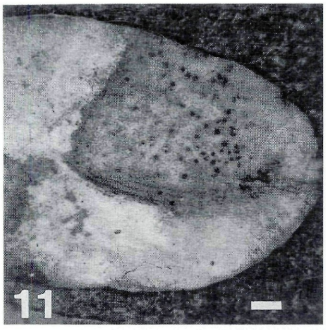
Discussion

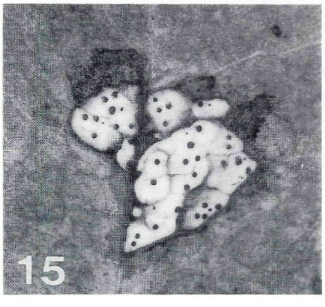
There are several types of lesions produced by the fungi covered in this study. *Septoria laburni*, *S. lupini* and *S. sulphurei* produce undifferentiated, irregular brownish spots (Fig. 11). The other *Septoria* species produce distinctive rather complex lesions. The lesions produced on *Laburnum* by *S. cytisi* var. *cytisi*, which are generally somewhat angular, seem to be subdivided into a number of smaller irregularly shaped 'lesions' (Figs. 14–16). The lesions produced on other hosts by *S. cytisi* var. *cytisi* have a more circular outline and the smaller 'lesions' are arranged in concentric circles (Figs. 12–13). The actual development of these lesions is unknown. Based on herbarium specimens it would appear that each lesion is the result of a single infection. As the lesion expands, the host tissue becomes delimited into the smaller 'lesions'. Coalescing of lesions further complicates an understanding of the development using herbarium specimens (Fig. 14). An additional type of lesion is formed by *S. cytisi* var. *petteriae* on *Petteria*. This circular lesion has a central discolored area surrounded by a distinct somewhat raised margin. Each lesion generally contains only one pycnidium. Without inoculation studies, the influence of host morphology on lesion morphology remains unknown and thus the taxonomic significance of lesion morphology remains unclear.

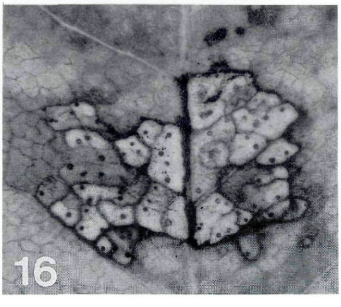
This study has demonstrated that lesion morphology, conidial morphology and host ranges provide potentially useful taxonomic information. However, this variation is not always easily expressed by taxonomic units. This is especially true for the *Septoria* spp. found on *Chamaecytisus*, *Cytisus*, *Genista*, *Laburnum* and *Petteria*. Two species have been enumerated from this group of hosts. *S. laburni* is clearly separated from *S. cytisi* by its short, irregular, one septate conidia and the presence of conidiophores. Within *S. cytisi* there are some trends that suggest additional taxonomic groups. The strongly falcate conidia in *S. cytisi* var. *alpini* are unique amongst the collections observed in this study. *S. cytisi* var. *petteriae* is recognized by its average conidial length of 154 µm, its occurrence on *Petteria*, the simple lesion and somewhat larger conidiomata.

The wide range of conidial dimensions among the collections of *S. cytisi* var. *cytisi* suggests that a further taxonomic subdivision of this taxon may be possible. Tab. 2 compares lesions, and conidial size and shape for collections on *Laburnum* with those on *Chamae-*

Figs 11–16. – Lesions in *Septoria*. – 11. *S. lupini*. – 12–13. *S. cytisi* var. *cytisi* on *Cytisus nigricans*, zonate lesion. – 14. *S. cytisi* var. *cytisi* on *Laburnum vulgare*, non-zonate lesion. – 16. *S. cytisi* var. *cytisi* on *L. anagyroides*, non-zonate lesion. – Bar = 1 mm.







cytisus, Cytisus, and *Genista*. Lesions on *Laburnum* tend to be irregular; conidia from pycnidia on those lesions average 105 µm and tend to be curved. However, these correlations are not sufficiently consistent to permit the recognition of a distinct taxon on *Laburnum*.

Tab. 2. – Comparison of collections of *S. cytisi* var. *cytisi*. Differences between means for length, width, and number septa are significant at P=0.05.

	Mean	Standard deviation	Total	Collections	Spore shape	Lesion
Laburnum						
Length	104.93	21.78	590	14	Generally curved (Fig. 1)	Irregular (Fig. 16)
Width	3.68	0.67				
Septa	6.54	1.75				
Other hosts						
Length	109.65	23.41	632	11	Generally straight (Fig. 3)	Zonate (Fig. 13)
Width	4.27	1.87				
Septa	7.37	2.28				

The Fabaceae, subfamily Faboideae, tribe Genisteae can be further subdivided into two subtribes, the Lupininae with a single genus *Lupinus* and the Genistinae with 19 genera. The Genistinae comprises an Old World complex of shrubby plants of yet contentious generic delimitation (Isely, 1990). The fungal species appear to mirror the host taxonomy. There are three distinct species on *Lupinus* in contrast to the considerable variation in *S. cytisi* over several host genera in the Genistinae. Whether this correspondence reflects evolutionary processes or is merely happenstance can not be determined. Farr (1991) has suggested that the species of *Septoria* which occur on *Cornus* may show morphologies that reflect the evolution of the host.

The results presented in this paper in conjunction with those of Constantinescu (1984), Farr (1991) and Sutton & Pascoe (1987, 1987) demonstrate that a delimitation of taxa based on the morphological features associated with herbarium specimens and host ranges is feasible. Subdivision of the genus *Septoria* by hosts represents a practical procedure for improving our taxonomic knowledge in this large genus.

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