Species of Selenophoma on North American Grasses

By

Roderick Sprague

and

A. G. Johnson

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(Continued on inside back cover)

Species of Selenophoma on North American Grasses

By

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Species of Selenophoma on North American Grasses[1]

INTRODUCTION

In the course of investigations of septoria diseases of Gramineae in the western United States (40), it seemed desirable to exclude from the genus *Septoria* the group with non-septate, falcate spores and to place them in the genus *Selenophoma* as defined by Maire (22).

Selenophoma Maire (22) has non-septate, falcate spores formed in small globose to somewhat elongate, innate or erumpent, ostiolate, parenchymatous pycnidia. The pycnidia are 40-170μ diameter, most often 60-100μ. The pycnidial walls are composed of large, globose to polyhedral, golden brown cells and the pycnophores are comparatively few and coarsely cuspidate. In contrast, *Septoria* has filiform to narrowly obclavate, septate spores borne in pycnidia that are usually larger than those of *Selenophoma* and whose pycnidial walls are composed, in the main, of smaller, darker, more compacted cells.

In their actively parasitic phase, the several species of *Selenophoma* on grasses cause "frog-eye" spots on living leaves. On some grasses, however, the spots soon fade, leaving the very obscure, minute pycnidia scattered in lines over the straw-colored tissues of the leaves, sheaths, culms, and heads. This type of material is very common in the arid portions of the Columbia basin, the northern great plains, and in the mountains of North America, and also in the subarctic regions of North America, Europe, and Asia. The occurrence of these fungi in the United States has gone practically unnoticed.

In a previous note (42), the writers quoted the original description of the genus *Selenophoma* and emended the genus to include species with somewhat obtusely pointed spores as well as the typical acutely pointed ones. On

[1]Cooperative investigations carried on by the United States Department of Agriculture Divisions of Cereal Crops and Diseases, Forage Crops and Diseases, Mycology and Disease Survey, and Soil Management and Irrigation; Bureau of Plant Industry, Soils and Agricultural Engineering; and Nursery Division, Soil Conservation Service; and the Oregon, Washington, and North Dakota Agricultural Experiment Stations. Published with the approval of the Director of the Oregon Agricultural Experiment Station as Technical Paper No. 646, contribution of the Department of Plant Pathology, Oregon State College, and as Scientific Paper No. 875, Institute of Agricultural Science, Washington Agricultural Experiment Station.

the basis of the emended description, *Sel. obtusa* Sprague and A. G. Johnson was described. In the same note, the writers also proposed *Sel. donacis* var. *stomaticola* (Bäuml.) Sprague and A. G. Johnson and *Sel everhartii* (Sacc. and Syd.) Sprague and A. G. Johnson for *Phyllosticta stomaticola* Bäuml. and *Septoria everhartii* Sacc. and Syd., respectively. In another note, they (41) proposed *Sel. bromigena* (Sacc.) Sprague and A. G. Johnson and *Sel. donacis* (Pass.) Sprague and A. G. Johnson for *Sept. bromigena* Sacc. and *Sept. donacis* Pass., respectively. In another article, the writers (43) referred to synonymy certain new names and combinations proposed by Frandsen (12). It is the purpose of the present paper to give the details of these various studies.

METHOD OF PROCEDURE

This paper is a companion study to the septoria disease investigations (40). As in that work, detailed histological studies were made with the assistance of the Works Progress Administration, and host range studies likewise followed the technique previously reported (40). The collections made before the summer of 1940 are filed in the Mycological Herbarium of the Department of Botany, Oregon State College, Corvallis, Oregon, while subsequent ones are filed in the Mycological Collections, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture, Beltsville, Maryland. Those since 1946 are contained in the Herbarium, Department of Plant Pathology, State College of Washington, Pullman, Washington. There are two series in this Herbarium, one designated Collection (all numbers below 17,000) and the other designated Accession (all numbers above 17,000). One specimen of *Sel. donacis* on *Stipa comata* Trin. and Rupr. sent to W. B. Cooke was distributed as No. 112 in his Mycobiota of North America. Several hundred collections of *Selenophoma* on Gramineae were made and identified.

In attempting to classify this extremely heterogeneous group, difficulties have been met that are somewhat comparable to those encountered by workers on certain smuts of grasses (11) and by others (38) working with the polymorphic genus *Fusarium*. Rather than accept all of the existing species and then add several others, we have preferred to group the forms we have seen into four species and two varieties, one of these varieties having been previously undescribed. Each species and variety will be discussed separately starting with the large spored *Sel. donacis*.

1. SELENOPHOMA DONACIS (PASS.) SPRAGUE AND A. G. JOHNSON

Septoria donacis Pass. (26) was originally described on *Donax arundinaceus* Beauv. (*Arundo donax* L.) from Italy. In the United States it occurs on this same species of grass and on a number of other species of grass including species of *Agropyron, Elymus, Panicum, Phalaris,* and *Poa.*

On *Arundo donax* the fungus causes abundant, straw-colored spots (2-6 x 0.6-1.8 mm) with narrow fuscous or tawny borders. On *Phalaris arundinacea* L. and *Elymus* spp. the spots are chiefly fuscous, smaller, frequently with minute straw-colored or almost white centers. On *Panicum virgatum L.* the spots are more or less circular to elongate and may be as large as 15 x 1.5 mm. with conspicuous, nearly white centers and purple borders, with numerous, minute, black pycnidia in the light-colored centers.

PURE CULTURE STUDIES

Pure culture of *Sel. donacis* from *Arundo donax* collected in California produced leathery colonies with dentate margins. They were bright congo pink to testaceous or rose on the margin, shading to Road's brown in the mounded, older centers. The very bright rose shades differentiated this culture somewhat from those isolated from most other hosts. Spores, except in the old cultures, were comparable to those on the host.

A pure culture from *Panicum virgatum* from Coburn, North Dakota, isolated September 1, 1940, was similar to *Sel. donacis* from *Arundo donax.* The mounded, leathery colony had a bright rose border, while the older mounded portion was very dark brown and thinly covered with a gray weft of mycelium.

An isolate from *Stipa viridula* Trin. from near Langdon, North Dakota, (culture 923) produced a leathery, sub-crustose, gray to olivaceous colony with only faint rosaceous tints in the substratum. An isolate from *Elymus flavescens* Scribn. and Smith from the sandy desert south of Hanford, Washington, produced an isabelline, soon ivory growth with a dentate margin. After several weeks in culture it continued sterile. Its growth in culture, therefore, differed somewhat from the other cultures of *Sel. donacis.* Isolates from *Poa ampla* Merr. (Pullman, Washington) and *P. epilis* Scribn. (Big Horn Mountains, Wyoming) produced mucous, cream-colored colonies, which soon became tan, then creosote-brown, finally gray-black to creosote-black and with less lavender or rosy coloration than many isolates of *Selenophoma.*

Figure 1. *Selenophoma donacis:* A-L, pycnospores from the following grasses: *A, Arundo donax,* Parma, Italy, August 1877 (G. Passerini) (Part of type collection of *Septoria donacis* Pass.); *B, Arundo donax,* Davis, California, May 17, 1939; *C, Phalaris arundinacea,* Lower Souris Wild Life Reserve, North Dakota, June, 1940; *D, P. arundinacea,* Lake d'Puddle, Pullman, Washington (Heald and George) 1915; *E, Elymus condensatus,* High Prairie, Washington (Oregon State College 8380); *F, E. condensatus,* Blalock, Oregon (Oregon State College 268); *G, E. glaucus,* Crater Lake, Oregon (Oregon State College 10,392) (See Figure 1, *O*) (Near *Sel. obtusa*); *H, Poa juncifolia,* Underwood, Washington (Oregon State College 10,981) (See Figure 2, *G*); *I, Panicum virgatum,* Rockport, Kansas, August 1894, E. Bartholomew (Part of type collection of *Sept. donacis* f. *panici* Ell. and Barth., (*Nom. Nud.*), Ellis, J. B. and Everhart, B. M., North American Fungi 3271 (1895); *J, P. virgatum,* Coburn, North Dakota, July 10, 1940; *K, Agropyron spicatum,* Plumbago Canyon, Wyoming, May 13, 1932. Solheim, W. G. Mycofl. Saximont. Exs. 85); *L, Agropyron dasystachum,* Celilo Falls, Oregon (Oregon State College 673). *M-O,* cross sections of walls of pycnidia from the following grasses: *M, Phalaris arundinacea,* Lake d'Puddle, Pullman, Washington (Heald and George) 1915 (See Figure 1, *D*); *N, Elymus condensatus,* Biggs, Oregon (Oregon State College 8451); *O, E. glaucus,* Crater Lake, Oregon (Oregon State College 10,392) (See Figure 1, *G*). (All x 1,000.)

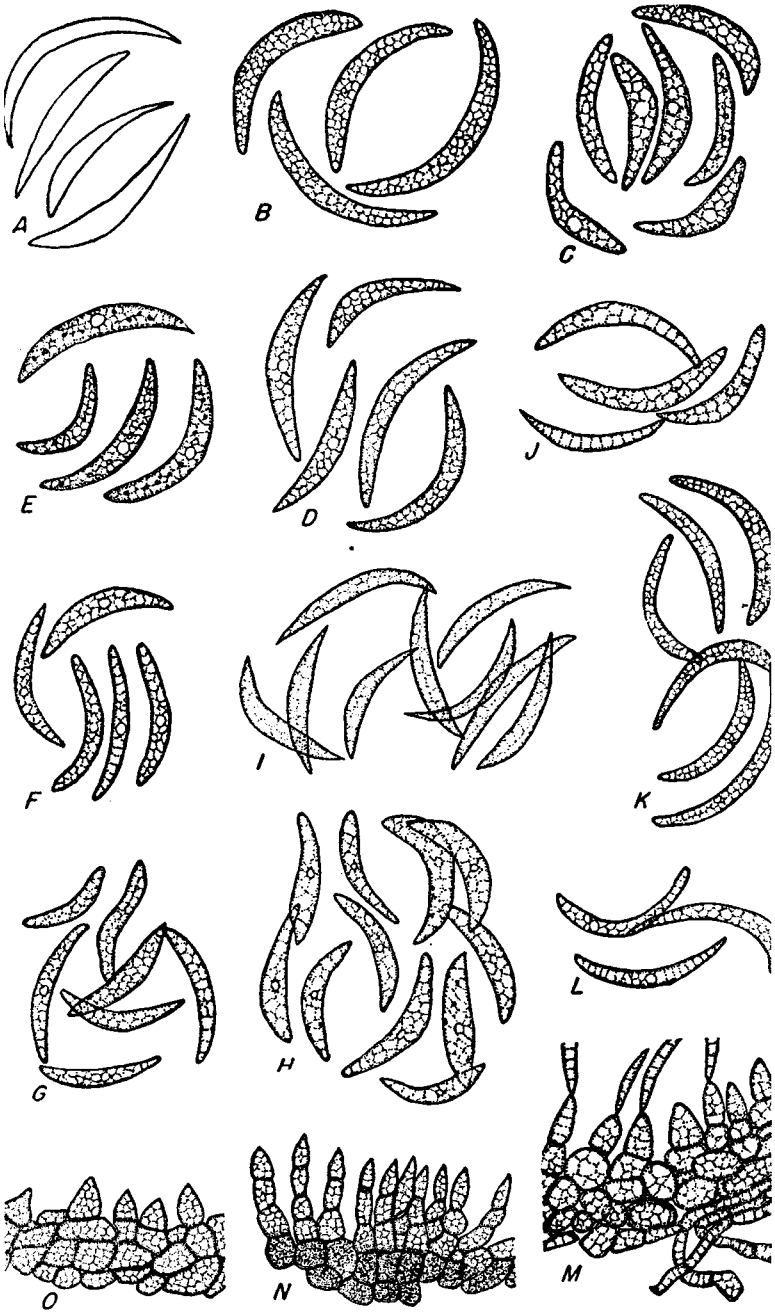
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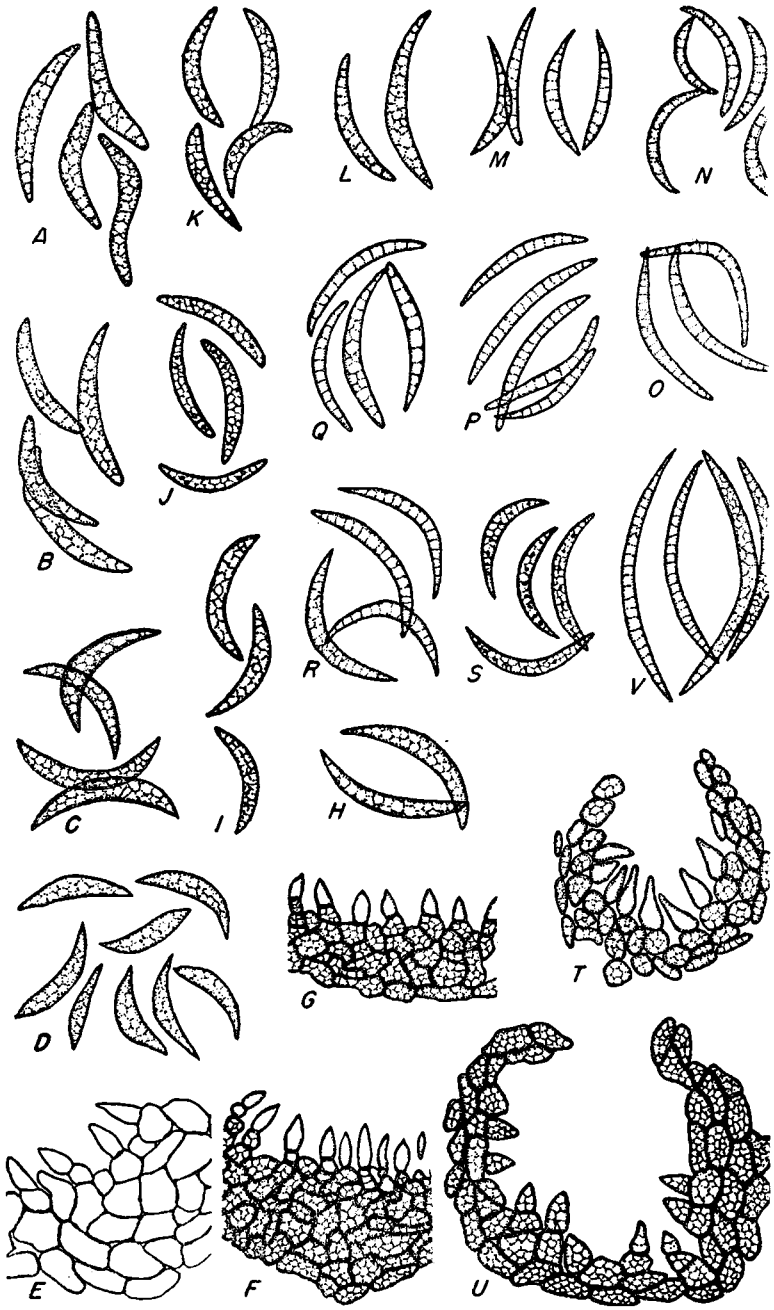
Figure 2. *A-D, Selenophoma donacis,* pycnospores from the following grasses: *A, Stipa comata,* 28 miles north of Beach, North Dakota, July 15, 1940; *B, Poa juncifolia,* Friend, Oregon (Oregon State College 10,769); *C, P. compressa,* Nekoma, North Dakota; *D, P. glauca,* Greenland (Type collection of *Septoria nebulosa* Rostr.). *E-G, Sel. donacis,* cross sections of walls of pycnidia from: *E, Poa glauca,* Greenland (Type collection of *Sept. nebulosa* Rostr.); *F, P. juncifolia,* 3 miles east of Rufus, Oregon (Oregon State College 10,951); *G, P. juncifolia,* Underwood, Washington (Oregon State College 10,981) (See Figure 1, *H*). *H-S, Sel. donacis* var. *stomaticola,* pycnospores on the following grasses: *H, Calamovilfa longifolia,* Mandan, North Dakota, May 16, 1940; *I, Phleum pratense,* Ketchikan, Alaska (Anderson); *J, Dactylis glomerata,* Moscow, Idaho, 1919; *K, D. glomerata,* Viking Park, Oregon (Oregon State College 10,379) (See Figure 2, *U*); *L, Oryzopsis hymenoides,* South Roosevelt Park, North Dakota, August 8, 1940; *M, Koeleria cristata,* 4 miles north of Gardner, North Dakota; *N, Sitanion hystrix,* Mt. Hood, Oregon (Oregon State College 10,770) (Dick Adlard); *O, Festuca idahoensis,* Lyle, Washington. (Pure culture isolation on potato dextrose agar); *P, Sporobolus asper,* Leonard, North Dakota, August 21, 1940 (Bureau of Plant Industry 80,041); *Q, Arrhenatherum elatius,* Bozeman, Montana, July 18, 1941 (Bureau of Plant Industry 80,080); *R, Poa pratensis,* Quad Creek, Montana. (Pure culture isolation); *S, Danthonia californica,* Linn County, Oregon; *T* and *U, Sel. donacis* var. *stomaticola,* cross sections of walls of pycnidia from: *T, Danthonia californica,* Peoria, Oregon (Oregon State College 10,048); *U, Dactylis glomerata,* Viking Park, Oregon (Oregon State College 10,379) (See Figure 2, *K*). *V, Sel. donacis* var. *linearis,* pycnospores from *Agropyron spicatum,* 8 miles northeast of Lyle, Washington, October 24, 1937 (Oregon State College 8,426). (All x 1,000.)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MORPHOLOGY

PYCNIDIA. The pycnidia are small to sub-prominent, brown, globose, erumpent, ostiolate, 50-100μ, sometimes 145μ in diameter. The peridia usually are composed of rather coarse, compacted, polyhedral cells, which produce cuspidate pycnophores on the inner pycnidial wall from hyaline bulbous initials (Figure 1, *M, N, O*). The walls are 5-12.5μ thick, the pycnophores 2.5-5 x 2-3μ. Sometimes the pycnophores are borne on a chain of pycnophore initials, sometimes they arise from creeping hyphae growing from the pycnidial walls. In one collection on *Elymus condensatus* Presl from near Biggs, Oregon (Oregon State College 8451) (Figure 1, *N*), the peridial cells were found to be somewhat smaller than usual, only 2.5-5μ in diameter. In this collection, strongly pointed, subulate pycnophores were arranged in palisade-like series and the hyphal initials and secondary as well as tertiary cells were direct outgrowths in seried lines from the fourth or fifth outer cell layers. Another collection on *E. condensatus,* Mandan, North Dakota, July 10, 1940, was somewhat similar to the ones from Oregon. The pycnidia were 90-120μ in diameter, globose, golden with darker color about the ostioles, and the walls were composed of smaller cells than most of the collections of *Sel. donacis.*

On *Poa juncifolia* Scribn. collected near Rufus, Oregon, (Oregon State College 10,951), the pycnidia are small, sub-globose, dark brown with relatively thick walls composed of polygonal cells averaging 2-3.5μ in diameter and as much as 10μ long. The pycnophores are poorly preserved, but are apparently 4-5 x 2.5μ, ovate to subulate (Figure 2, *F*). They are intermingled with developing pycnospores and undeveloped pycnophores. Another collection made at Underwood, Washington (Oregon State College 10,981) also shows sub-globose pycnidia with walls about 10-11μ thick at the base of the pycnidium and with pycnophores 3.0-4.5 x 2.5μ, ovate in outline (Figure 2, *G*). Material on *Poa compressa* L. from Nekoma, North Dakota has small black pycnidia 35-70 x 50-85μ with coarse cell structure. The pycnidia were scattered along the pedicels of the panicles.

Cross sections of the pycnidia from the type of *Septoria nebulosa* Rostr. on *Poa glauca* Vahl from Greenland (cfr. *Rhabdospora groenlandica* Lind) show small sunken globose pycnidia with the peridia composed of coarse, globose cells and subulate pycnophores (Figure 2, *E*).

PYCNOSPORES. The pycnospores are hyaline, non-septate, falcate to lunate, frequently with one end more slender than the other, i.e. so-called "boomerang shape," 15-35 x 2.0-4.0μ, somewhat smaller on some hosts.

The type collection of *Septoria donacis* Pass. on *Arundo donax* has spores falcate to mostly 20-27 x 2.5μ, some with ends of unequal diameter, the larger end being up to 3.5μ diameter, while some are small (18 x 1.5μ) (Figure 1, *A*). The spores were all plasmolyzed, and no doubt measured at least up to 3μ diameter when fresh. On *Arundo* from California the spores are mostly 22-27 x 2.9-4.0μ (Figure 1, *B*), while some are as small as 15 x 2.3μ and strongly curved, usually somewhat large at one end (boomerang shape), non-septate, with clear-hyaline contents or with one or two guttulae near the larger end. Sometimes the tips are faintly stiffened or bent, giving the spore a false "heeled" appearance. Another collection on *A. donax* by Unamuno (45), referred to *Septoria oxyspora,* from Spain, has spores very similar to the California material. Also, the fungus described and illustrated by Penzig (28) as *Septoria oxyspora* Penz. and Sacc. on *Arundo donax* is clearly this same fungus.

On *Panicum virgatum,* the spores are boomerang shape, 15-31 x 1.7-3.0μ, but average somewhat narrower than *Sel. donacis* on the above-mentioned hosts (Figure 1, *I, J*).

The collections of *Sel. donacis* on *Phalaris arundinacea* have sub-lunate to boomerang-shape spores (Figure 1, *C, D*), which resemble very closely those from the type collection of *Sel. donacis* (Figure 1, *A*). Similar material on *Stipa* spp. (Figure 2, *A*) has boomerang-shape spores somewhat shorter than those on *Phalaris.*

On *Elymus condensatus* the spores range from 15-26 x 1.5-4.0μ but the mature ones were 17-26 x 2.6-4.0μ (Figure 1, *E, F*). Those on smaller species of *Elymus* are not so large but comparable (Figure 1, *G*). In general, the spores on *Elymus* and *Agropyron* (Figure 1, *K, L,*) average narrower than those on *Arundo* and *Phalaris,* while those on *Poa,* which are frequently referable to *Sel. donacis* proper, usually are shorter and proportionately thicker with more or less pointed ends (Figure 1, *H*; 2, *B, C, D*).

TAXONOMY

According to Petrak (30, p. 393), *Selenophoma drabae* (Fckl.) Petr. is the common, falcate-spored sphaeropsidaceous fungus, not only on the arctic crucifers, such as *Draba,* but also on various other plants including sedges and grasses, which he did not list, in northern Europe and Asia. This species has small pycnidia and falcate, non-septate spores 12-20 x 1.5-2.5μ. It is apparent from the present studies that the species of *Selenophoma* on Gramineae constitute a polymorphic group. The writers, however, consider it undesirable at present to include too vast a complex under one species.

They therefore prefer to limit their species to Gramineae, recognizing that future study is needed to disclose the relative desirability of Petrak's suggestion. There are a number of references, incidentally, to literature antedating Petrak's that refer to non-graminicolous, falcate-spored, pycnidial forms on grasses. Rostrup (34) gave *Septoria semilunaris* Johans. (16) on *Poa glauca* from Greenland. *Sept. semilunaris*, however, was originally described on *Dryas octipetala* L. (Rosaceae) with spores 10-15 x 3-5μ and therefore different from the species on grasses. The above fungus on *Poa glauca* is, no doubt, the same as that on the same species of grass from Greenland that Rostrup (33) previously had included in *Sept. nebulosa* Rostr. This portion of *Sept. nebulosa* is referred to *Selenophoma donacis*.

Of the sphaeropsidaceous species with non-septate, falcate spores on grasses, *Septoria donacis* Pass. was the first to be described. It was named by Passerini (26) in 1878 in Thuemen, Mycotheca Universalis No. 1184, as follows:

"1184 *Septoria Donacis Pass. nov. spec. S. peritheciis punctiformibus, atris* in *macula parvula, exarida, albicante, sparsis vel seriatis; spermatiis fusiformibus, integris, rectis vel saepius curvis hyalinis.*

"Parma: Vigheffio ad folia languida Donacis arundinacea Beauv. Aug. 1877. Leg. Prof. G. Passerini."

This species was distributed also in Rabenhorst, Fungi Europei No. 2452 (1879) and in Baglietto, de Cesati, and de Notaris, Erbar. Crittog. Ital. No. 814 (1879). In 1879, Passerini (27, p. 44) amplified the earlier description slightly and gave the spore measurements as 30-35 x 2.5μ. Additional notes by Saccardo (35) gave spores also 25-30 x 2.0-2.5μ, rarely 20 x 2.0μ. Spores from the type collection (Figure 1, *A*) are similar to those from *Arundo donax* (Figure 1, *B*), collected near Davis, California, May 17, 1939.

Grove (14) assigned most of the British falcate spored sphaeropsidaceous fungi on grasses to *Septoria oxyspora* Penz. and Sacc. and to its variety *culmorum*. *Sept. oxyspora* differs from *Sel. donacis* only in spore width and is said to have spores 20-30 x 3.5-4.0μ. Reference to Penzig's illustrations (28), however, shows the spores to be very close to those of the type of *Sel. donacis*. Assuming that Penzig is correct in the spore lengths that he portrays, he apparently drew the spores as 20-33 x 2.6-3.5μ as given in the text. The collection from California, however, have spores that are commonly 3-4μ wide. *Sept. oxyspora* is produced in pycnidia and in lesions that do not differ appreciably from those of *Sel. donacis*. And since, in addition, both were found on the same host, *Arundo donax*, the giant reed, and in the same general region, they are undoubtedly only two collections of the same species.

Sel. donacis is believed to be only a narrow-spored collection of the possibly more common condition portrayed by *Sept. oxyspora.*

The name *Septoria oxyspora* has been given preference by most writers over *Septoria donacis* although the latter was published in Thuemen's Mycotheca Universalis, No. 1184, in 1878, six years before the former. It is noted that Jaap (15, p. 37), over 30 years ago, listed a collection on *Arundo donax* from Dalmatia as *Septoria donacis* Pass. with the statement that *Sept. oxyspora* was essentially the same fungus. He distributed it in his Fungi Sel. Exs. No. 592, 1912.

A study of Maire's original description of the genus *Selenophoma* (22) indicates that it can be satisfactorily used for assigning the falcate, non-septate spored species of *Septoria.* In the key to the Sphaeropsidales by Bender (5), *Selenophoma* is portrayed as a genus without a definite ostiole, but Maire's description states that the pycnidia have small ostioles. Petrak (29, p. 182) also described a similar genus, *Selenophomopsis,* which he compared critically with *Selenophoma* Maire, *Phlyctaena* Mont. and Desm., and *Ludwigiella* Petr. Later Petrak (30, p. 393; 31, p. 447) assigned the falcate-spored species on arctic plants, as mentioned, to *Selenophoma drabae,* including *Sept. suboxyspora* Lobik. On the basis of Maire's original description as amplified by Petrak (30, p. 393), the writers are satisfied that the genus *Selenophoma* is the logical place for the species included in the present study.

Some years after decribing the genus *Selenophoma,* Maire (23, p. 354) described *Selenophoma septorioides* on *Arundo donax.* From the description, it is not possible to determine if this fungus is the same as *Sel. donacis.* Since Maire gives the spores as 9-11 x 2μ and states that their association indicated that probably they were the spermogonial stage of a pyrenomycete. it is doubted that they are the same. Moesz (25) considers *Sel. septorioides* distinct from *Sel. calamagrostidis* Moesz and Smarods. On the other hand, *Sel. calamagrostidis,* which was described on *Calamagrostis epigeios* (L.) Roth as having spores 15-25 x 2.5-4 μ, is clearly the same as *Sel. donacis.*

In 1910, Spegazzini (39, p. 388) created the new genus *Pseudoseptoria* as follows:

"Pseudoseptoria Speg. (n. gen.)

Char. Perithecia superficialia astoma, sporulis fusoideis continuis v. pauciseptatis hyalinis"

In this genus, he described the single species as follows:

"Pseudoseptoria donacicola Speg. (n. f.)

Diag. Maculae parvae obsoletae albae subareolatae; perithecis pusilla

atra tenuiter membranacea laciniatim dehiscentia; sporulae selenomorphae mediocres.

"Hab. Ad folia languida *Arundinis donacis* in insula Santiago, prope La Plata, Apr. 1906.

Obs. Maculae ellipticae (1-2 mm diam.) areola angusta purpurascente obsoleta cinctae; perithecia pauca globosa (80-90 μ diam.) glabra, contextu exime parenchymatico olivaceo; sporulae utrinque acutissimae (25 $\mu = 4$ μ) plus minusve arcuatae continuae v. 1-3 septatae hyalinae."

Through the kindness of Dr. Juan C. Lindquist, director, Instituto de Botanica "Spegazzini," La Plata, Argentina, a part of the type collection (No. 2093) of the above species has been examined, as has also a subsequent collection on the same host (No. 3347), also from near La Plata, collected and determined as the same species by Dr. Lindquist. The former specimen, unfortunately, has but very few pycnidia, but the latter one (No. 3347) has numerous pycnidia and abundant spores. A few spores were found on the former specimen (No. 2093).

In comparing the above material with *Selenophoma donacis* on *Arundo donax* from the United States, we find essential agreement between the two lots of material. The pycnidia are sub-epidermal and become erumpent as they develop. The oldest ones become rather prominently erumpent. Apparently it was these that Spegazzini called superficial. A few spores were found that might be considered septate, but when stained with cotton blue, practically all the spores are clearly seen to be non-septate. The size and shape of the spores from various sources also are in essential agreement. Likewise, the leaf spots are all very similar. *Pseudoseptoria donacicola* Speg., therefore, is considered a synonym of *Selenophoma donacis*.

The writers prefer to use the combination previously given (41), with the following revised synonomy:

SELENOPHOMA DONACIS (Pass.) Sprague and A. G. Johnson, 1940 (41)

Syn.: *Septoria donacis* Pass., 1878 (26)
Septoria oxyspora Penz. and Sacc., 1884 (28, p. 652)
Septoria curva Karst. 1887 (17)
Septoria nebulosa Rostr. (*pro parte*), 1888 (33) (*non* Desm.)
Rhabdospora curva Allesch., 1901 (1)
Rhabdospora groenlandica Lind., 1910 (20)
Pseudoseptoria donacicola Speg., 1910 (39)
Septoria suboxyspora Lobik, 1928 (21)

Lunospora curva Frandsen, 1943 (12)
Selenophoma curva Petrak, 1940 (32, p. 239)
Selenophoma calamagrostidis Moesz and Smarods, 1941 (25)
Lunospora baldingerae Frandsen, 1943 (12)
Lunospora oxyspora Frandsen, 1943 (12)
Lunospora suboxyspora Frandsen, 1943 (12)

Spots pale straw with purple or reddish to discolored narrow border, elliptical to circular; pycnidia erumpent, globose, golden brown to darker, ostiolate, 40-150 μ, peridia with few layers, pycnophores prominent, cuspidate to truncate, hyaline; spores aseptate, falcate, lunate to more typically thicker at one end, chiefly 18-35 x 2.0-4.5 μ, when immature as small as 13 x 1.7 μ. Producing a more or less crustose, variously pigmented, slow-growing colony on potato dextrose agar with true pycnidia and pycnospores and, in early stages, smaller quantities of conidia.

On above-ground parts of *Arundo donax* and other hosts in Europe and on the following hosts in North America: *Agropyron albicans* Scribn. and Sm., Hebron, North Dakota (Bureau of Plant Industry 80,417), May 18, 1940; *A. cristatum* (L.) Gaertn., Libby Creek, Wyoming, August 11, 1948; *A. dasystachyum* (Hook.) Scribn., Celilo Falls, Oregon (Oregon State College 673) (16.5-20 x 1.9-2.5 μ)[4]; Celilo Falls, Oregon (Oregon State College 736) (19-24 x 2.0-3.3 μ); *A. inerme* (Scribn. and Sm.) Rydb., Carey, Idaho (Washington State College 17,058), July 30, 1948; Diamond Peak, Colorado, 1948; Pullman, Washington; *A. pendulinum* (Nevski) Swallen, Mandan, North Dakota (Bureau of Plant Industry 80,449), August 5, 1942; *A. repens* (L.) Beauv., Bingen, Washington (winter material, spores 13-18 x 1.7-2.5 μ); Mandan, North Dakota; *A. riparium* Scribn. and Sm., Mandan, North Dakota (Bureau of Plant Industry 80,463); Four Corners, Wyoming (Washington State College 3,325); *A. smithii* Rydb., Show Low, Arizona (Washington State College 3,560), June 12, 1947; U. S. Highway 10, just west of Montana-North Dakota line, July 15, 1940 (16-22 x 1.7-3.0 μ); northern Nebraska; Mandan, North Dakota (Bureau of Plant Industry 80,095), September 1, 1941; north of Beach, North Dakota, July 15, 1940 (17-23 x 1.8-3.3 μ); central South Dakota; Tensleep, Wyoming, June, 1946; Glenrock, Wyoming (16-22 x 1.7-2.6 μ); Muddy Gap, Wyoming, August 12, 1948; *A. spicatum* (Pursh) Scribn. and Sm., Chimney Rock, Colorado (Washington State College 17,031), August 10, 1948; Sentinel Butte, North Dakota (16-20 x 1.6-2.2 μ); Denio, Nevada, Washington State College

[4]Figures in microns refer to dimensions of pycnospores.

3,499), June 24, 1947; City Creek, Utah, (Washington State College 3,686), June 18, 1947; Muddy Gap, Wyoming (Washington State College 21,593), August 12, 1948; Wyoming, Myc. Sax. Mont. 85 (Solheim) (17-20 x 1.5-2.4 μ); *A. subsecundum* (Lk.) Hitchc., 8,000-foot elevation, Beaverhead National Forest, Montana (14-17 x 1.7-2.3 μ); Filmore, Wyoming, August, 1948; *A. trachycaulum* (Lk.) Malte, Columbus, Montana (Washington State College 3,317), September 27, 1946; west of Drummond, Montana, on Clark's Fork, August 26, 1941; 8,000-foot elevation, Beaverhead National Forest, Montana (pycnidia 90-115 μ, semi prominent in lesions on living leaves, pale fawn, very pale fuscous borders in early stages; spores 17-21 x 1.6-2.3 μ); Judson, North Dakota (Washington State College 3,327, 3,382), July 17, 1946; near Togwatee Pass, Wyoming (Washington State College 20,522) (pycnidia numerous, gregarious; spores 14-20 x 2.9-4.0 μ) August 12, 1948; Uinta National Forest, Utah (Washington State College 21,736), August 4, 1948; Belfield, North Dakota (Bureau of Plant Industry 81,110); 10 miles north of Harvey, North Dakota (Bureau of Plant Industry 81,011), September 21, 1946; Columbus, Montana (Washington State College 3,317), September 27, 1946; 3 miles west of Togwotee Pass, Wyoming (Washington State College 20,522), 10 miles east of Togwotee Pass, Wyoming (Washington State College 21,692), August 12, 1948; Medicine Bow National Forest, Wyoming (Washington State College 17,011); Dundwin, Saskatchewan (Bureau of Plant Industry 81,119); *Arundo donax,* Alameda, California, May, 1920 (15-25 x 2.5-3.0 μ); Davis, California, May 17, 1939 (15-27 x 2.9-4.0 μ) (Washington State College 10,686); Fall Brook, California (Washington State College 3,625), June 19, 1947; *Avena sativa L.,* Dickinson, North Dakota (Washington State College 3,322) (14-20 x 2.3 μ), July 17, 1946; *Elymus aristatus* Merr., Rainier National Park, Washington (Washington State College 3,559), September 21, 1946; *E. canadensis* L., New Salem, North Dakota (Bureau of Plant Industry 81,126); *E. condensatus,* Mt. Whitney, California; 14 miles west of Livingston, Montana, August, 1941; Mandan, North Dakota, July 10, 1940 (Bureau of Plant Industry 80,320) (15-27 x 1.8-4.0 μ); Quinn River Crossing, Nevada (Washington State College 3,812), June 24, 1947; Ryepatch, Nevada (Washington State College 3,821), June 23, 1947; Blalock, Oregon (Oregon State College 268) (17-26 x 2.6-4.5 μ); Biggs, Oregon (Oregon State College 8,451) (17-26 x 2.7-4.0 μ); High Prairie, Washington (Oregon State College 8,380) (17-23 x 2.8-3.9 μ); near Shragg, Washington, August 21, 1941; Deadman Pass, California (Washington State College 3,496), June 22, 1947; near Sprague, Washington, July 10, 1949; *E. flavescens,* in sand south of Hanford, Washington (Bureau of Plant Industry 80,319) (14-22 x 2.5-4.2

μ); *E. giganteus* Vahl, Pullman, Washington (Bureau of Plant Industry 80,301); *E. glaucus* Buckl., Rainier National Park, Washington (Washington State College 3,297), September 17, 1946; Pullman, Washington (Bureau of Plant Industry 80,290) (near *Sel. obtusa*), July, 1941; Okanogan County, Washington; near Forest Grove, Oregon (Washington State College 21,016), July 10, 1948; Myrtle Point, Oregon (Oregon State College 41) (15-22 x 1.8-2.4 μ); Crater Lake, Oregon (near *Sel. obtusa*) (13-19 x 2.3-3.2 μ); Medicine Bow Lodge, Wyoming (Washington State College 17,015 and 17,102); *E. junceus* Fisch., Langdon, North Dakota, 1941 (Bureau of Plant Industry 80,849); Mandan, North Dakota; *E. villosus* Muhl., near Wilton, North Dakota (Bureau of Plant Industry 81,084), September 2, 1943; *E. virginicus* L., Mandan, North Dakota (Bureau of Plant Industry 81,132), August 2, 1945; *Oryzopsis hymenoides* (Roem. and Schult.) Ricker, near Buffalo, South Dakota (Washington State College 3,360), June 24, 1946; *Panicum virgatum,* Stockton, Kansas, September 11, 1894 (20-29 x 1.9-2.6 μ); Fung. Columb. 1,679 (15-21 x 1.7-3.0 μ); Rooks County, Kansas, August, 1894 (17-24 x 1.9-2.8 μ); Coburn, North Dakota (Bureau of Plant Industry 80,292), September 1, 1940 (17-25 x 1.9-2.3 μ); Mandan, North Dakota (Bureau of Plant Industry 80,435), August 4, 1915 (20-27 x 2.2-2.6 μ); Madison, Wisconsin; *Panicum wilcoxianum* Vasey, Wood Lake, Nebraska (Washington State College 3,380), June 14, 1946; *Phalaris arundinacea* L., Game Sanctuary on Lower Souris River, North Dakota (Bureau of Plant Industry 80,001), May 15, 1940 (18-24 x 2.2-3.5 μ); Pullman, Washington (Washington State College 19), 1915 (20-22 x 2.9-3.3 μ); *Phragmites communis* Trin., Fort Totten, North Dakota (Bureau of Plant Industry 81,015); *Poa alpina* L., Beartooth Pass, Montana (Bureau of Plant Industry 80,297); Skyway, Colorado (Washington State College 20,049), August 6, 1948; *P. ampla,* Montana; Rowena, Oregon (Oregon State College 115) (13-15 x 2.2-2.8 μ); Pullman, Washington, numerous collections from 1941-1949 including: (Washington State College 3,474; 3,475; 3,550; and Washington State College 20,152); Sprague, Washington (Washington State College 17,056), August 17, 1948; *P. canbyi* (Scribn.) Piper, Pullman, Washington (Washington State College 20,160), July 1948; *P. cenisia* All., Greenland; *P. compressa,* Nekoma, North Dakota (Bureau of Plant Industry 80,291) (17-19 x 1.9-2.8 μ); Skyway, Colorado (Washington State College 17,184), August 6, 1948; *P. cusickii* Vasey, Cow Creek, Oregon (Washington State College 3,901), April 6, 1948; *P. epilis,* Tioga Pass, California (Washington State College 3,500); Big Horn Mountains, Wyoming (Bureau of Plant Industry 81,121), July 1941; *P. fendleriana* (Steud.) Vasey, Bryce Canyon, Utah (Washington State College 3,530); *P. glauca* Vahl, Greenland

(type of *Septoria nebulosa* Rostr.) (12-17.2 x 1.9-3.6 μ); *P. gracillima* Vasey, Steen Mountains, Oregon (Washington State College 3,490), June 24, 1947; Logan Canyon, Utah, 1948; *P. juncifolia,* Friend, Oregon (Oregon State College 10,760) (17-24 x 2.5-3.4 μ); Roaring Springs, Oregon (Washington State College 3,831), June 24, 1947; Underwood, Washington (Oregon State College 10,981) (12-18 x 2.0-3.8 μ); Rufus, Oregon (Oregon State College 10,951) (15-19 x 2.5-3.0 μ); Logan Canyon, Utah; *P. nevadensis* Vasey, Silvies, Oregon (Washington State College 3,516), June 25, 1947; Pullman, Washington (Washington State College 3,940); *P. palustris* L., Skyway Point, Colorado (Washington State College 20,097), August 6, 1948; *P. secunda* Presl, Pullman, Washington, July, 1948 (Washington State College 20,156); *Secale cereale* L., Verndale, Minnesota (Bureau of Plant Industry 81,005), June 18, 1944; 6 miles north of Jamestown, North Dakota (Bureau of Plant Industry 80,793), June 9, 1942 (12-16 x 2.0-2.8 μ); Barlow, North Dakota (Bureau of Plant Industry 80,894), June 23, 1943 (14-18 x 2.4-3.4 μ); *Stipa columbiana* Macoun, Pullman, Washington; *S. comata,* near Capitol, Montana (Bureau of Plant Industry 81,182); north of Wibaux, Montana (Bureau of Plant Industry 80,067 and 80,071), May 22, 1941 (15-20 x 2.0-3.0 μ); Kilgore, Nebraska; 28 miles north of Beach, North Dakota (Bureau of Plant Industry 80,317—Cooke, Myc. 112), July 15, 1940 (15-20 x 2.1-3.2 μ); near Buffalo, South Dakota (Washington State College 3,315; 3,320; and 3,346), June 24, 1946; Sundance, Wyoming; Lemmon, South Dakota (Bureau of Plant Industry 80,853), June 23, 1942; Wewela, South Dakota (Washington State College 3,329), June 14, 1946; Mandan, North Dakota (Bureau of Plant Industry 80,502), July 25, 1942; Madison, Wisconsin (Bureau of Plant Industry 81,101), September 2, 1943; *S. lemmonii* (Vasey) Scribn., Umatilla National Forest, Washington (Washington State College 17,147), July 10, 1948; *S. occidentalis* Thurb., Kingsley, Oregon, July 1948 (13-17 x 3.0-3.5 μ); *S. richardsonii* Lk., Jackson, Wyoming (Bureau of Plant Industry 80,287), August 17, 1941; *S. spartea* Trin., Mandan, North Dakota (Bureau of Plant Industry 80,505), July 25, 1942; *S. viridula* Trin., 4 miles west of Livingston, Montana (Bureau of Plant Industry 80,296), August 26, 1941; 10 miles north of Capitol, Montana (Bureau of Plant Industry 81,182), June 11, 1945 (17-21 x 2.3-3.2 μ); Argusville, North Dakota (Bureau of Plant Industry 80,308), June 12, 1940 (15-23 x 2.0-3.5 μ); Amidon, North Dakota; *Triticum aestivum* L. (range for following collections: 16-21 x 2.2-3.5 μ), Pullman, Washington (Washington State College 99), June 14, 1915; Agricultural Experiment Station, Pullman, Washington (Washington State College 3,943), June 4, 1948; four miles north of Pullman, Washington, June 6, 1948 (Washington State College 20,520);

near Colfax, Washington, June 6, 1948 (Washington State College 20,512 and 20,519); near Wilcox, Washington, June 6, 1948 (Washington State College 20,513 and 20,517) and June 22, 1948 (Washington State College 17,154); near Central Ferry, Washington, June 6, 1948 (Washington State College 20,515); Dusty, Washington, June 6, 1948 (Washington State College 20,512; 20,516); west of Colfax, Washington, June 6, 1948 (Washington State College 20,518); Union Flats, Washington, March 16, 1948 (Washington State College 3,905; 4,940 and Washington State College 20,072); near Moscow Mountains, Idaho, May 4, 1948 (Washington State College 3,905, 3,910).

Selenophoma donacis differs from variety *stomaticola* in the somewhat boomerang shape of many of the spores and in the fact that well-matured collections that have not been drought inhibited or otherwise stunted are somewhat broader. Some groups, however, such as most of the collections on *Poa* spp. and on all the *Elymus* spp., except those on the coarser ones as well as those on *Agropyron,* do tend to merge with var. *stomaticola.* Most of the spores shown in Figure 1 are more or less readily assigned to *Sel. donacis.* But if we compare them with Figures 2, *B, C, D,* and then finally with var. *stomaticola* represented by Figure 2, *I, H,* we will note some transitional forms and sizes.

While the writers are satisfied that *Sel. donacis* on *Arundo, Phalaris* and some other coarse grasses are very similar, they are less certain about the material on *Panicum,* which represents a distinct race. The spores on *Panicum* average somewhat narrower than those on *A. donax.* This is attributable partly to the host, as the spores on the coarse, more luxuriant *A. donax* would be expected to be larger because of the more abundant food supply. The spores on *Panicum,* however, while narrower than those on *Arundo* are, if anything, slightly longer. They are not sufficiently distinct, however, from the type of *Sel. donacis* to warrant separate taxonomic consideration.

Material on *Stipa* spp. also represents a distinct race or group of races as the isolations appear somewhat different in pure culture and the spores are slightly smaller than those on *Arundo.* Sometimes, as on *Stipa occidentalis,* they merge with *Sel. obtusa.* On the other hand, *Septoria capillatae* Trotter (*Sept. stipae* Died., non Trabut) has spores 10-15 x 1-1.5 μ, which, if mature, probably would make it belong with *Sel. everhartii* (Sacc. and Syd.) Sprague and A. G. Johnson. *Septoria vulpiellae* Maire (24) on *Festuca incrassata* Salzm. has cylindric-sub-fusiform spores, straight or curved, 15-20 x 3 μ (specimens not available) and may be close to *Sel. donacis* group.

In the final analysis, we therefore recognize *Sel. donacis* as the dominant form not only on the coarse grasses such as *Arundo, Phragmites, Phalaris,*

and *Elymus* spp. but also on most of the collections on *Agropyron, Poa,* and *Stipa* because of the boomerang shape or slightly broader dimensions of the spores on these grasses. The worker will, of course, encounter spores from collections on *Agropyron* or *Poa* that range in size from slightly coarser than those of *Sel. everhartii* to ones almost as large as those of *Sel. donacis.* Considering the profound effect of environment on these collections, we have segregated them only after detailed consideration of all factors. Some of the alpine collections on *Poa* belong in var. *stomaticola* but most of the others were placed in *Sel. donacis.*

2. SELENOPHOMA DONACIS VAR. STOMATICOLA (BÄUML.) SPRAGUE AND A. G. JOHNSON

This group, in general, has spores 3-5 μ shorter and distinctly narrower than the species proper and the spores tend to be less boomerang shape. Some groups, however, such as those on *Sporobolus,* particularly at the smaller extremes, are close to *Sel. everhartii,* while material on *Danthonia* has evenly lunate spores with softly tipped ends. It is nevertheless difficult to segregate this group into species on any satisfactory basis. Because of our present incomplete knowledge, it appears more practical to assign all of them to the earliest available name as a variety under *Sel. donacis.*

SYMPTOMATOLOGY

On *Arrhenatherum elatius* (L.) Presl, the spots are irregular to round, light colored with red borders. On such hosts as *Dactylis glomerata* L. and *Koeleria cristata* (L.) Pers., elliptical spots may occur on any above-ground parts. They have purple to lavender borders. In older faded material there are no definite lesions and the pycnidia occur in straw-colored areas. In the Willamette Valley of Oregon, frog-eye spots with prominent red or maroon borders are very abundant on *Danthonia californica* Boland during most of the year.

PURE CULTURE STUDIES

Isolates from *Dactylis glomerata* (Pullman, Washington), *Koeleria cristata* (Pullman, Washington), *Festuca idahoensis* Elmer (Lyle, Washington), all produced lavender, mucose, soon wet-leathery, lavender, finally gray to black, leathery, carbonaceous colonies with vinaceous, amethyst to lavender tints in the medium or in the depths of the colony. One isolate from *Poa pratensis* L. (Quad Creek, Montana) produced burnt-orange colonies changing to flesh pink and burnt orange, then gradually becoming mottled with

gray and black mycelia. An isolate from *Arrhenatherum* produced mucose, cream-colored, later tan, colonies with dirty-tan conidial masses.

Isolations from *Danthonia californica* produced light gray crustose colonies with scanty mycelium and opalescent grayish white spore droplets. The medium was tinted rosy-vinaceous. This fungus is different in culture from any other of the group.

This group shows wide variability in cultures. The original isolation usually has the brightest pigmentation with the greatest tendency towards conidial formation. After its initial growth, spores are produced in pycnidia to a large extent, although after repeated and frequent transfers, conidia are produced in limited mucose pseudopionnotes. The colonies from tissue transfers soon lose much of their individual appearance and become sub-cottony, variously gray, black, or creosote, with lighter or rosy margins. These fungi apparently do not thrive in pure culture.

HOST RANGE STUDIES

Cultures from *Danthonia californica* caused typical leaf spots on this host during April-May 1939 under a mist spray at Corvallis, Oregon, but were completely negative on *Avena sativa* L., *Dactylis glomerata, Elymus condensatus, E. glaucus, Hordeum vulgare* L., *Phleum pratense* L., *Poa juncifolia, Secale cereale* L., and *Triticum aestivum* L. In a second series in May-June 1939, naturally infected plants of *Danthonia californica* were closely interplanted with healthy plants of this species and with *Agropyron repens, Arrhenatherum elatius, Agrostis tenuis* Sibth., *A. alba, A. palustris* Huds., *Bromus inermis* Leyss., *Dactylis glomerata, Elymus glaucus, Poa juncifolia, Hordeum vulgare, Phleum pratense, Avena sativa,* and *Triticum aestivum.* Under a mist spray, the fungus spread quickly to the previously clean plants of *D. californica* but failed to develop on any of the other Gramineae.

MORPHOLOGY

PYCNIDIA: The pycnidia are like those of the species proper except that they are, in general, smaller.

The type of *Phyllosticta stomaticola* Bäuml., which was collected on *Arrhenatherum elatius* in Hungary in winter, has elongate pycnidia 100-130 x 60-80 μ. In summer material the pycnidia are typically globose and relatively obscure in some material.

On *Danthonia californica,* the small black pycnidia are 50-80 μ, less often up to 145 μ diam. and as much as 140 μ high. They are typically globose, light brown or golden brown with the peridium composed of large

cells, which appear globose to polyhedral. The pycnophores are prominent and are produced from hyphae but little differentiated from those of the outer cells, except that the pycnophore initials are hyaline (Figure 2, *T*).

On *Dactylis glomerata* from Viking Park, Oregon, the small globose pycnidia are 50-60 μ diameter, 35-40 μ high. The walls are composed of 3 layers of large, closely-knit golden-brown cells producing broadly cuspidate pycnophores from hyaline initials (Figure 2 *U*). The pycnophores measure 5-6 x 2.5-4.0 μ. The collection from Moscow, Idaho, has larger pycnidia than the one from Viking Park, 60-100 μ, and they are distinctly erumpent, golden brown, with coarse cellular structure.

The pycnidia on *Oryzopsis hymenoides* (Roem. and Schult.) Ricker from Victorville, California (Rel. Bethel) are densely grouped on the sheaths and culms, black, carbonaceous, strongly erumpent, globose to elongate or coalesced, 50-100 x 40-80 μ, and the peridium is composed of creosote-brown, relatively coarse, globulate cells.

Material on *Phleum pratense* from Alaska has small, brown, globose, ostiolate pycnidia with walls 6 μ thick composed of globose, packed, brown cells. The pycnophores are short cuspidate and are approximately 2.2-3.0 x 1.9-2.0 μ, but they are plasmolyzed and are unquestionably smaller than they were when fresh.

PYCNOSPORES: As mentioned, the spores are distinctly smaller than those of *Scl. donacis* and have less tendency to be boomerang shape (Figure 2, *H-S*). Spore measurements of representative collections are listed following the technical description.

TAXONOMY

Phyllosticta stomaticola Bäuml.[5] originally described on *Arrhenatherum elatius* from Hungary (3) appears to be the earliest tenable name to which the fungus with intermediate-size spores can be assigned. As pointed out previously (42), the following combination was proposed and the following revised synonymy is suggested:

SELENOPHOMA DONACIS var. STOMATICOLA (Bäuml.) Sprague and A. G. Johnson, 1945 (42)

Syn.: *Phyllosticta stomaticola* Bäuml., 1890 (3)
Septoria culmifida Lind, 1907 (19)
Septoria trapezuntica Bubak, 1919 (7)
Septoria oxyspora var. *penniseti* Trotter 1916 (44)

[5]Bäumler (3) spelled this species epithet "stomacola" but the name was corrected to "stomaticola" by Saccardo (35, v. 10, p. 137).

Septoria oxyspora var. *culmorum* Grove, 1916 (13)
Septoria lunata Grove, 1935 (14)
Lunospora culmifida Frandsen, 1943 (12)
L. culmorum Frandsen, 1943 (12)
L. lunata Frandsen, 1943 (12)
L. penniseti Frandsen, 1943 (12)
L. avenae Frandsen, 1943 (12)

Spots white to tawny or purple with red or vinaceous margins, later fading to straw color, or commonly occurring on leaves, stems, and sheaths without spots of any kind when collected in late season. Pycnidia small, 40-150 x 40-110 μ, golden brown to nearly black, globose (summer) or elongate (winter), ostiolate, erumpent, composed of coarse, polyhedral cells and cuspidate prominent pycnophores; spores falcate, aseptate, variable, 10-20 x 1.5-3.0 μ, less often up to 25 μ long.

The following collections have been made, almost entirely from western America: *Arrhenatherum elatius,* Bozeman, Montana (Bureau of Plant Industry 80,080) (17-20 x 1.5-2.3 μ); Grangeville, Idaho (Washington State College 3,611), July 4, 1947; Kendrick, Idaho (Washington State College 17,008), July 22, 1948; *Calamovilfa longifolia* (Hook.) Scribn., Mandan, North Dakota (15-22 x 1.5-2.4 μ); James River, South Dakota, May 13, 1940 (13-22 x 2.0-3.3 μ); *Dactylis glomerata,* Viking Park, Oregon (Oregon State College 10,379) (12-18 x 2.3-3.0 μ); Puyallup, Washington (Washington State College 3,928), June 7, 1948, (common in 1949, Washington State College 21,483), June 7, 1948; Pullman, Washington, common during most years from 1941-1949 (Bureau of Plant Industry 80,098-80,100, Washington State College 20,040; 20,045; Washington State College 3,886); Moscow, Idaho, 1921 (13.3-16 x 1.8-2.3 μ); Mt. Spokane, Washington (Washington State College 3,961), June 26, 1948; *Danthonia californica,* Tangent, Linn County, Oregon, and vicinity (Oregon State College 10,375), and several others (very abundant) (12-17 x 1.8-2.3 μ); Alsea Valley, Oregon (Oregon State College 8,302 and Bureau of Plant Industry 80,416), May 25, 1937 (14-16 x 1.8-2.5 μ); Peoria, Oregon (Oregon State College 10,048) (14-17 x 1.7-2.4 μ); Dayton, Oregon (Oregon State College 8,255 and Bureau of Plant Industry 80,415), (14-18 x 1.7-2.2 μ); near Helmick Park, Polk County, Oregon (Oregon State College 746) (13-18 x 1.6-2-4 μ); Isodora, Oregon (Oregon State College 629) (14-17 x 1.7-2.3 μ); *Danthonia spicata* (L.) Beauv., Six Mile Creek, Ithaca, New York (Bureau of Plant Industry 80,499 Dudley), July, 1890; *Deschampsia elongata* (Hook.) Munro, Rainier National Park, Washington (Bureau of Plant Industry 81,190), September

21, 1946; *Elymus caput-medusae* L., near Goldendale, Washington (Washington State College 3,665), August 2, 1947; (Washington State College 17,165), June 24, 1948; *Festuca elatior* L., Rockport, California (Bureau of Plant Industry 80,462), July 5, 1942; Craig, Colorado (Washington State College 20,530) (14-18 x 1.5-2.2 μ); *F. idahoensis* Elmer, Dyer Hill, Washington (Washington State College 17,057), September 15, 1948; Lyle, Washington (19-22 x 1.9-2.2 μ) (resembles *Sel. lunata* Grove); *F. octoflora* Walt., Long Pine, Nebraska (Washington State College 3,336), June 14, 1946; *F. ovina* L., central Washington; *Hesperochloa kingii* (S. Wats.) Rydb., Teton Pass, Wyoming (Washington State College 21,659); Logan Canyon, Utah (Washington State College 3,690, Washington State College 17,131) (14-20 x 1.7-2.3 μ); *Hordeum brevisubulatum* (Trin.) Lk., Mandan, North Dakota (Bureau of Plant Industry 81,057), August 17, 1944; *H. vulgare,* Oregon; Dodsland, Saskatchewan (Bureau of Plant Industry 80,897), 1943; *Koeleria cristata,* Montana, near Langdon, North Dakota; Mandan, North Dakota (Bureau of Plant Industry 81,061) August 1941; 4 miles north of Gardner, North Dakota (Bureau of Plant Industry 80,409) (13-17 x 1.4-2.0 μ) (approaches *Sel. everhartii*); Ferdinand, Idaho (Washington State College 17,065), June 27, 1945; Pullman, Washington (Washington State College 3,666), July 8, 1947; 4 miles north of Jackson, Wyoming, August 17, 1941; Pullman, Washington (Bureau of Plant Industry 80,096) (13-16 x 1.9-2.6 μ), *Melica harfordii* Boland., Mendocino County, California; *Oryzopsis hymenoides,* S. Roosevelt Park, North Dakota (Bureau of Plant Industry 80,312 and 80,326) (15-22 x 1.5-2.7 μ); 8 miles west of Terry, Montana (Bureau of Plant Industry 80,486), August 17, 1941; Buffalo, South Dakota (Washington State College 3,360), June 24, 1946; City Creek, Utah, (Washington State College 3,555), June 10, 1947; Adelento, California (Washington State College 3,637), June 19, 1947; Victorville, California (Rel. Bethel) (13-17 x 2.3-3.0 μ); Arlington, Oregon; Muddy Gap, Wyoming (Washington State College 17,041), August 12, 1948; Yellowstone National Park, Wyoming (Bureau of Plant Industry 81,082), August 16, 1941; *Phleum alpinum* L., Logan Pass, Montana (Washington State College 21,078), August 8, 1949 (Fischer); *Phleum pratense,* Ketchikan, Alaska (13.8-16.4 x 1.7-2.3 μ); Melville, North Dakota (Bureau of Plant Industry 81,053), June 18, 1944; Naicam, Saskatchewan (Bureau of Plant Industry 80,405), April 8, 1939; Snoqualmie Falls, Washington (Washington State College 3,514), June 29, 1947; 5 miles south of Craig, Colorado (Washington State College 17,182), August 5, 1948; Pullman, Washington (Washington State College 29), June 23, 1916 (Dana); *Poa compressa,* Skyway, Colorado (Washington State College 17,184) (11-17 x 1.6-2.2 μ), August 6, 1948; *P. interior* Rydb., 2 col-

lections in an alpine meadow at Beartooth Pass, Montana, elevation 10,000 feet, August 14, 1941; St. Marys, Glacier County, Montana (Bureau of Plant Industry 80,306) (11-14 x 1.5-2.0 μ); *P. pratensis* L., Quad Creek, Montana (Bureau of Plant Industry 80,309), August 14, 1941; 4 miles west of Livingston, Montana (Bureau of Plant Industry 80,327), August 26, 1941; Fargo, North Dakota, October 1, 1940 (13-16 x 1.5-2.4 μ); north of Harwood, North Dakota (Bureau of Plant Industry 80,288) (15-20 x 2.0-2.4 μ), September, 1940; *Poa secunda* Presl, Alzada, Montana; Denio, Nevada (Washington State College 3,848), June 24, 1947; Steens Mountain, Oregon (Washington State College 3,495), June 24, 1947; Maryhill, Washington (Oregon State College 8,087) (13-17 x 1.8-2.8 μ); Big Horn Mountains, Wyoming; Colony, Wyoming, (Bureau of Plant Industry 80,517), June 24, 1942; South Roosevelt Park, North Dakota (Bureau of Plant Industry 80,065), May 22, 1941; Mason, South Dakota; *Sitanion hansenii* (Scribn.) J. G. Sm. (hybrid), near Goldendale, Washington (Washington State College 3,654), August 2, 1947; *S. hystrix* (Nutt.) J. G. Sm., Mt. Hood, Oregon (Oregon State College 10,770); Quemado, New Mexico (Washington State College 3,607), June 12, 1947; *Sporobolus asper*, (Michx.) Kunth, west of Wolcott, North Dakota (Bureau of Plant Industry 80,325 and 80,381) (17-19 x 1.5-2.2 μ), September 1940; Ames, Iowa (Bureau of Plant Industry 80,011), September 9, 1940 (15-21 x 1.4-2.1 μ); Leonard, North Dakota (Bureau of Plant Industry 80,041), August 31, 1940 (18-21 x 1.6-2.0 μ); Glendive, Montana; *S. cryptandrus* (Torr.) A. Gray, Riggins, Idaho (Washington State College 3,509), June 4, 1947; Mandan, North Dakota (Bureau of Plant Industry 80,864), June 7, 1943; Buffalo, South Dakota (Washington State College 3,383), June 23, 1946; 10 miles south of Buffalo, South Dakota (Washington State College 3,345); Carlile, Newcastle, Wyoming; *S. giganteus* Nash, Hartt, Arizona (Washington State College 3,507), June 14, 1947; *S. heterolepis* (A. Gray) A. Gray, Sauk City, Wisconsin (H. C. Greene), September 18, 1946; *Trisetum spicatum* (L.) Richt., near summit Highway 130, Medicine Bow National Forest, Wyoming (Washington State College 17,110), August 11, 1948 (differs from most of material on this host because the spores are too large for *S. everhartii*).

At present we are able to recognize a number of subdivisions of this group which show only small morphological differences, and are best considered simply as groups.

1. GROUP on *Danthonia californica* appears to be restricted to this one host genus. It shows slight but recognizable differences in the spores, which

are regularly lunate with softly-pointed tips (Figure 2, *S*). This fungus is probably akin to *S. lunata* Grove and under some classifications would be considered a distinct species.

2. GROUP on *Dactylis glomerata* and *Koeleria cristata* from Pullman, Washington, with identical appearance in culture and on the hosts are representative of the common race which produces lavender-tinted colonies in pure culture.

3. GROUP on *Festuca idahoensis* from Lyle, Washington, is similar to group 2 in pure culture, but the narrower spores (Figure 2, *O*) place it near the group on *Agropyron*. *Hesperochloa kingii* bears comparable material but with variable spores. Some collections were assigned to *S. everhartii*.

4. GROUP on *Poa pratensis* from Quad Creek, Montana, develops very distinct burnt orange, later brown colonies and somewhat boomerang-shape spores (Figure 2, *R*), which indicates that this collection represents at least a localized variant.

5. GROUP on *Arrhenatherum elatius* from Bozeman, Montana (Figure 2, *Q*), differs from group 2 in less tendency to form lavender color in agar and to produce dirty-tan, mucose conidial masses in early stages of growth. In culture it acts very much like *Sel. donacis* on *Poa ampla* at Pullman, Washington.

6. GROUP on *Phleum pratense* (Figure 2, *I*) is distinct from group 1 in host range, but its relation to the others awaits further study. The fungus on *P. pratense* was originally described as *Septoria culmifida* Lind (19). If this were recognized as distinct, the name would become *Sclenophoma culmifida* (Lind) *Comb. Nov.* The writers, however, prefer to include the name *Sept. culmifida* as a synonym under *Sel. donacis* var. *stomaticola* as the pycnospores are practically indistinguishable from those of many of the other groups in this variety as here interpreted. Lind repeatedly observed perithecia of *Metasphaeria culmifida* (Karst.) Sacc. on the faintly evident lesions on dead leaves of the host and suggested that the connection between the two spore forms was highly probable. *Sept. phleina* Baudys and Picb. (4), which was described on *P. pratense* from Bohemia, is distinctly different. It has straight, slender, 1-septate spores, 24-39 x 1 μ.

7. GROUP on *Sporobolus asper* (Figure 2, *P*,) shows affinity to *Sel. donacis* on *Stipa* spp., except that the spores are narrow. It and the other collections on *Sporobolus* spp. have not been cultured and little is known as to their affinities. This group often occurs in open, somewhat arid regions.

8. GROUP on *Deschampsia* spp. is somewhat similar to *Sel. everhartii* but in final analysis most of the collections were assigned to *Sel. donacis* var. *stomaticola*. It also needs further study.

9. GROUP on *Hordeum* spp. appears to represent a weakly parasitic phase of this complex. It should be studied in comparison with *Sel. donacis* on grain hosts.

The writers tentatively recognize these nine groups, realizing that the number no doubt will be increased by host range cross inoculation studies. Recent work by such workers as Snyder and Hansen (38) and Fischer (11) has shown the trend toward consolidation of species. The problem involved in this *Selenophoma* group compares in difficulty with that in *Fusarium*.

3. SELENOPHOMA DONACIS var. LINEARIS var. nov.

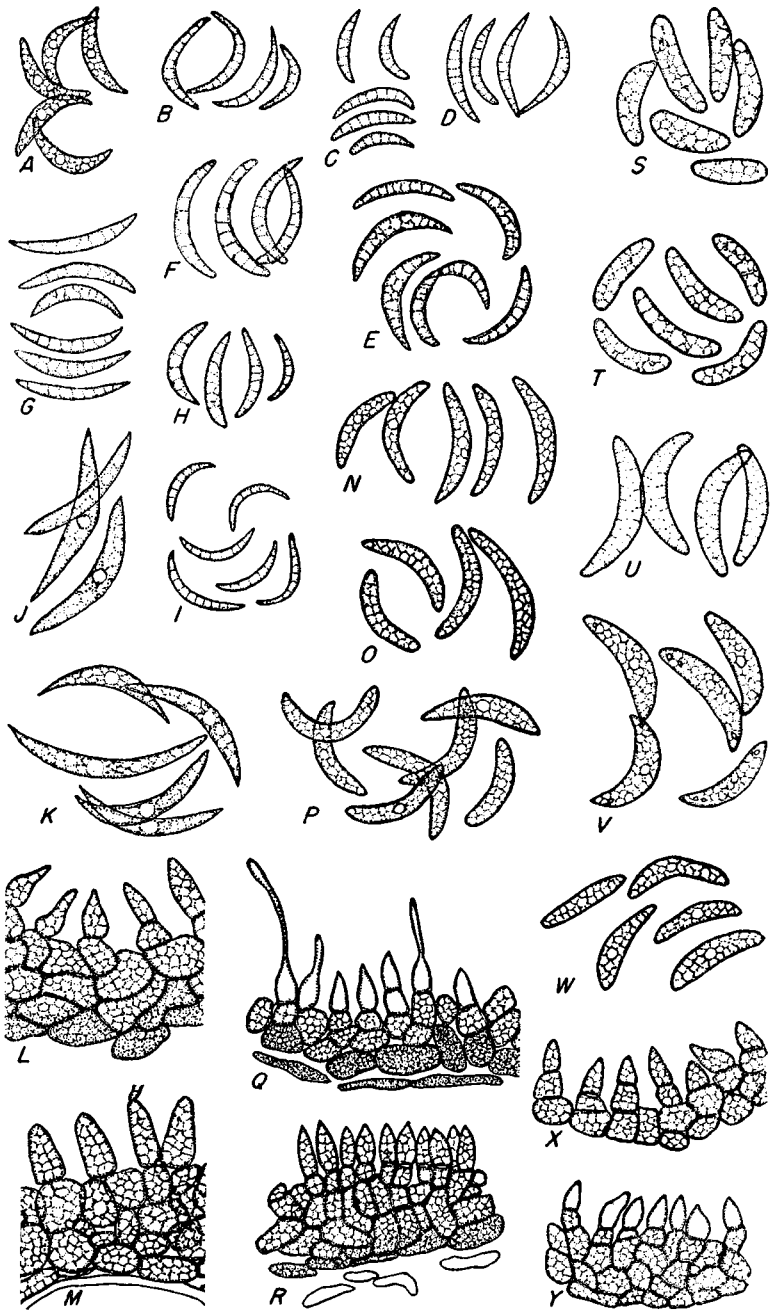
Pycnosporulis lineari-falcatis, hyalinis, 20-34 x 1.8-2.5 μ. Hab. in foliis dejectis *Agropyri spicati* prope Lyle, Washington, socia *Pini ponderosae* (Typus Oregon State College 8,426). Differs from both *Sel. donacis* and *Sel. donacis* var. *stomaticola* in having linear-falcate spores, 20-34 x 1.8-2.5 μ (Figure 2, *V*).

In 1937, a single, meager collection of this fungus was made eight miles northeast of Lyle, Washington. At first, the fungus was tentatively included with *Sel. donacis* var. *stomaticola* but on further study it became evident that it could scarcely be included in that variety, particularly because of much greater length of the spores of the new variety. It is, therefore, proposed as a new variety of *Sel. donacis*. As it was found on dead leaves of *Agropyron spicatum*, no spots were evident.

4. SELENOPHOMA EVERHARTII (SACC. AND SYD.) SPRAGUE AND A. G. JOHNSON

Selenophoma everhartii, in its range on several genera of grasses, is a complex of morphologically similar forms. The pycnospores are small, 11-15 x 1.3-2.2 μ (10-20 x 1.0-2.4 μ) (Figure 3, *A-I*) and usually are strongly arcuate. While the spores of this species are definitely smaller than those of *Sel. donacis* var. *stomaticola*, with which the species intergrades, especially on species of *Poa* and *Koeleria*, it is probable that this difference is, at least in part, due to the hosts, particularly species of *Agrostis, Calamagrostis,*

Figure 3. *A-I, Selenophoma everhartii,* pycnospores from the following grasses: *A, Agrostis diegoensis* (*A. foliosa* Vasey), Eldorado County, California (Heller, A. A., Forage Plants of California, 12, 149); *B, A. scabra,* Ft. Totten, North Dakota (Pure culture isolation); *C, Poa arctica,* northeast of Cooke City, Montana (elevation 10,500 feet), July 29, 1939 (G. L. Weber and A. E. Ferber, N 7-1020); *D, P. nervosa,* Butte, Montana, June 16, 1939 (G. L. Weber N 7-996); *E, Bouteloua curtipendula,* 55 miles north of Beach, North Dakota, July 15, 1940; *F, Calamagrostis scribneri,* Jackson Lake Forest Camp, Wyoming, August 16, 1941; *G, Puccinellia nuttalliana,* between Mott and Richardton, North Dakota, June 27, 1916; *H, Festuca rubra,* near Beartooth Pass, Montana, August 14, 1941; *I, Hesperochloa kingii,* Beaverhead Forest, Montana, August 14, 1936. *J-M, Sel. bromigena: J,* pycnospores from *Bromus inermis,* Craigmont, Idaho; *K,* pycnospores from *B. inermis,* Moccasin, Montana (Oregon State College 10,887); *L,* cross section of wall of pycnidium from *B. inermis,* Marshall, North Dakota (Oregon State College 10,814); *M,* cross section of wall of pycnidium from *B. inermis,* Pullman, Washington. *N-Y, Sel. obtusa: N,* pycnospores from *Sitanion hystrix,* Tanaway, Washington, July 27, 1898 (Kirk Whited 741); *O,* pycnospores from pure culture isolation (SIII) from *S. hystrix,* Mt. Shasta, California; *P,* pycnospores from *S. hystrix,* Mt. Shasta, California (Cooke) (Oregon State College 10,281); *Q,* cross section of wall of pycnidium from *S. hystrix,* Mt. Shasta, California (Cooke) (Oregon State College 8,341); *R,* cross section of wall of pycnidium from *S. hystrix,* Mt. Shasta, California (Cooke) (Oregon State College 8,354). *S-W,* pycnospores from: *S, Poa arida,* Mandan, North Dakota, April, 1941; *T, Stipa richardsonii,* north shore of Little Bitterroot Lake, Montana (Weber N9-541); *U, Agropyron inerme,* Washtucna, Washington, June 19, 1941; *V, Elymus condensatus,* White Bluffs, Washington, August 8, 1938 (See Figure 3, *X*); *W, E. glaucus,* near Dayton, Washington (Fischer) (Oregon State College 10,875) (See Figure 3, *Y*); *X,* cross section of wall of pycnidium from *Elymus condensatus,* White Bluffs, Washington, August 18, 1938 (See Figure 3, *V*); *Y,* cross section of wall of pycnidium from *E. glaucus,* Dayton, Washington (Fischer) (Oregon State College 10,875) (See Figure 3, *W*). (All x 1,000.)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Deschampscia, Trisetum and small, alpine species of other genera of grasses. This group of grasses has a tendency to inhibit robust growth of fungi, particularly of the Fungi Imperfecti.

SYMPTOMATOLOGY

The symptoms induced by *Sel. everhartii* depend upon the host attacked. On *Calamagrostis* the lesions are elongated, white, with vinaceous to vague borders. Much of the material on *Agrostis* and on alpine hosts in semi-arid regions is, in general, obscure, with minute pycnidia on stramineous, dead plant parts. On *Aristida* and *Bouteloua,* gray to tawny or paler eye-spot lesions, with vinaceous borders, occur, often with saprophytic material from the year previous intermingled with the fungus.

MORPHOLOGY

Pycnidia: On *Aristida longiseta* Steud., *A. oligantha* Michx., *Agrostis diegoensis* Vasey, and certain alpine fescues, the pycnidia are globose, black to creosote-brown and small, 50-80, sometimes 100 μ in diameter. On the larger hosts, such as *Calamagrostis* spp., the pycnidia range larger and some are elongate, 100-120 x 75-80 μ.

Pycnospores: Agrostis diegoensis from California carries spores that are short, stout, crescent-shape, with pointed tips, 10-13 x 1.3-1.9 μ (Figure 3, *A*). Those on *Calamagrostis canadensis* (Michx.) Beauv. were said to be arcuate (10), continuous and 12-15 x 1.5 μ while those from Canada (6) were 10-14 x 1.0-1.5 μ. Spores on *C. montanensis* Scribn. were lunate to subarcuate, mostly 11-15 x 2.0 μ, but many were smaller. The spores on *Aristida longiseta* from North Dakota were also small, crescent shape, narrow, 11-16 x 1.5-2.2 μ, as were those on *A. oligantha* from Iowa, 10-15 x 1.3-2.0 μ.

One collection on *Bouteloua curtipendula* (Michx.) Torr. had small crescent-shape to boomerang-shape spores, 11-17 x 1.6-2.5 μ (Figure 3, *E*). They were morphologically closest to the small-spored group on Agrostidae except that they averaged thicker with a tendency for one end to be larger than the other, which gave some of them a boomerang shape.

PURE CULTURE STUDIES

Selenophoma everhartii, considering the fewer number of isolates made, showed greater diversity in culture than did *Sel. donacis* var. *stomaticola.*

There were scarcely any two cultures alike. Their range of variability is indicated as follows:

Host	*Place collected*	*Mycelium texture*	*Mycelium color*	*Substratum color*
Agrostis scabra Willd.	Ft. Totten, North Dakota	Leathery	Gray or rose	Lavender
Bouteloua curtipendula	North of Beach, North Dakota	Crustose	Off-white	None
Deschampsia atropurpurea (Wahl.) Scheele	Beartooth Pass, Montana	Moist, leathery	Gray and isabelline	None
D. danthonioides (Trin.) Munro	Pullman, Washington	Leathery to mucose, to sub-cottony	Burnt orange mixed with pink and black	Orange
Trisetum spicatum (L.) Richt.	Beartooth Pass, Montana	Moist, leathery	Gray and creosote over pale lavender	Lavender to none

The isolate from *Agrostis* resembled one of *Sel. donacis* from *Panicum* while the brightly pigmented isolate from *Deschampsia danthonioides* was macroscopically identical with an isolate of *Sel. donacis stomaticola* from *Poa pratensis* from Quad Creek, Montana (see group 4). The isolate from *Deschampsia* at first was a burnt orange and finally became a black in later transfers. Its original colony after isolation consisted of a flat, sub-leathery growth with several rings of yellow-brown to creosote-brown color at the margin. The center of the growth soon became black or creosote-black-brown with many small, amethyst-tinted masses of pycnospores. The substratum was strongly-tinted pale vinaceous.

The spores in pure culture of these various isolates were small, arcuate, and 10-13 x 1.5 μ, when typical, but there were many vacuolated and distorted forms in all sizes, ranging from those typical of *Sel. everhartii* to others equalling or surpassing *Sel. donacis* in size. In some cases, these became 1-septate before germination.

TAXONOMY

Septoria nebulosa Rostr. (33, p. 575) was described on *Calamagrostis phragmitoides* Hartm., *C. stricta* Trin., *Trisetum subspicatum* (L.) Beauv. (= *T. spicatum*) and *Poa glauca* from Greenland in 1888. In 1910, Lind (20) pointed out that Desmazières (9) had used the specific epithet *Sept. nebulosa* previously for a fungus on celery. Lind, therefore, erected a new name, *Rhabdospora groenlandica,* for a fungus on *Poa cenisia* that he considered the same as the one described by Rostrup and placed *Sept. nebulosa* Rostr. as a synonym under it. In the meantime, Ellis and Everhart (10) in 1898 has described *Sept. calamagrostidis* on *Calamagrostis canadensis* from Wisconsin. But Libert (18) in 1832 had used this specific epithet for *Ascochyta calamagrostidis* on *Calamagrostis silvatica* (Probably = *C. arundinacea* Roth) which Saccardo (36, v. 2, p. 22), in 1888, transferred to the genus *Septoria as Sept. calamagrostidis* (Lib.) Sacc., a true species of *Septoria* with filiform, hyaline spores 45-55 x 1-1.5 μ. This specific epithet, therefore, was unavailable for the fungus described under that name in 1898 by Ellis and Everhart. Saccardo and Sydow (35, v. 16, p. 973), therefore, in 1902 gave it the name *Sept. everhartii,* which was transferred to the genus *Selenophoma* by the writers (42) in 1945. As pointed out earlier in this paper, the portion of *Septoria nebulosa* Rostr. that covers the fungus described by Rostrup (33) on *Poa glauca* is referred to *Sel. donacis,* as is also *Rhabdospora groenlandica Lind* (20). The rest of *Sept. nebulosa* Rostr., that is, the portion on *Calamagrostis* and *Trisetum* is tentatively referred to *Sel. everhartii.*

Selenophoma everhartii tends to have spores distinctly smaller, especially narrower, and more curved, and the pycnidia usually smaller than those of *Sel. donacis* var. *stomaticola.*

We believe that much of this material is specifically distinct from *Sel. donacis,* although as mentioned previously, the hosts do seem to encourage the formation of small pycnidia and spores. In addition, the dry season (mostly summer) in which this group occurs also tends to reduce the size of the pycnidia and spores. The arcuate condition of the spores, particularly on *Agrostis,* is due to the cramping effect of the very small, thick-walled pycnidia. We find that material of *Sel. everhartii* on the coarser grasses, such as *Calamagrostis,* is somewhat more robust and approaches the size of var. *stomaticola,* while in the reverse situation, the latter variety on small, alpine species of *Poa* is very close to *Sel. everhartii.* While further study may show the desirability of segregating the forms on *Aristida, Bouteloua,* and

Deschampsia from the others, at present they are all assigned to the one species with synonymy as follows:

SELENOPHOMA EVERHARTII (Sacc. and Syd.) Sprague and A. G. Johnson, 1945 (42).

Syn.: *Septoria nebulosa Rostr.* (p.p), 1888 (33) (non Desm.)
Septoria calamagrostidis Ell. and Ev., 1898 (10) (non (Lib.) Sacc.)
Septoria everhartii Sacc. and Syd., 1902 (35, v. 16, p. 973)

Spots white, elongate emarginate to faintly colored (*Calamagrostis*), tawny eye-spots, red bordered (*Aristida*), frequently stramineous indefinite on all above ground parts, pycnidia small, obscure, black to creosote-brown ostiolate, globose, 40-120 x 50-100 μ; pycnophores few, cuspidate; pycnospores arcuate, sharply pointed, 10-15 (rarely longer) x 1.0-1.5 (to 2.4) μ. On *Calamagrostis canadensis* and *C. inexpansa* A. Gray in North America (Alaska, Saskatchewan, Wisconsin) and on the following hosts as represented by collections; *Agrostis diegoensis* (*A. foliosa* Vasey) (Heller For. Plants of California 12, 149) Eldorado County, California (10-13 x 1.3-1.9 μ); *A. scabra,* Ft. Totten, North Dakota (Bureau of Plant Industry 80,441) (11-15 x 1.5 μ), July 29, 1941; Mandan, North Dakota (Bureau of Plant Industry 80,431), July 31, 1915 (12-15 x 1.5 μ); South Dakota; *Aristida longiseta,* 55 miles north of Beach, North Dakota (Bureau of Plant Industry 80,421), July 15, 1940 (11-17 x 1.6-2.5 μ); Albia, Iowa (Bureau of Plant Industry 80,422) (10-15 x 1.3-2.0 μ); *Bouteloua curtipendula,* 55 miles north of Beach, North Dakota (Bureau of Plant Industry 80,418), July 15, 1940; Attica, Wisconsin (H. C. Greene), August 21, 1947; *Calamagrostis inexpansa,* Greenland; *C. koelerioides* Vasey, Medicine Bow National Forest, Wyoming (Washington State College 17,105), August 11, 1948; *C. montanensis* Scribn. between Mott and Richardson, North Dakota (Bureau of Plant Industry 80,444) (11-15.5 x 1.5-2.3 μ), June 27, 1916; *C. rubescens* Buckl., Chelan National Forest, Washington (Washington State College 3,699; 3,870; and 3,882), August 9-12, 1947; *C. scribneri* Beal, Jackson Lake Forest Camp, Wyoming (Bureau of Plant Industry 80,420) (14-17 x 1.5-2.4 μ); *Deschampsia atropurpurea,* Beartooth Pass, Wyoming (Bureau of Plant Industry 80,425), August 14, 1941; Chinook Pass, Washington; *D. caespitosa* (L.) Beauv., northeast of Cooke City, Montana, at an elevation of 10,500 feet (Bureau of Plant Industry 80,426) (Weber and Ferber N 7-1,012) (11-14 x 1.4-1.8 μ), July 27, 1939; Beartooth Pass, Wyoming, August 15, 1941; *D. danthonioides,* Pullman, Washington (Bureau of Plant Industry 80,098) (15-18 x 1.4-1.8 μ); Grangeville, Idaho; *D. elongata*

(Hook.) Munro, eastern Washington, 1941; *Festuca octoflora* Walt., Buffalo, South Dakota (Washington State College 10,713); *F. ovina* L., southwest of Red Lodge, Montana (Bureau of Plant Industry 80,432) (Weber N 7-1,036) (10-13 x 1.4-1.8 μ), August, 1941; *F. ovina* var. *brachyphylla* (Schult.) Piper s. f. Cache la Poudre, r., Colorado (Washington State College 20,529), August 8, 1948; Beartooth Pass, Montana; Beartooth Pass, Wyoming (Bureau of Plant Industry 80,427), August 15, 1941; Tioga Pass, California; *F. rubra* L., Beartooth Pass, Montana (Bureau of Plant Industry 80,420), August 15, 1941 (11-15 x 1.6-2.0 μ); Rochester, Washington; Mt. Spokane, Washington; *F. rubra* var. *commutata* Gaud., Rochester, Washington; (Washington State College 21,630), July 9, 1948 (Fischer and Meiners); *Hesperochloa kingii* (S. Wats.) Rydb. (*Festuca kingii* (S. Wats.) Cassidy), Beaverhead National Forest, Montana (Bureau of Plant Industry 80,428) (10-13 x 1.4-1.6 μ), August 14, 1936 (Figure 3, *I*); Beartooth Pass, Montana, August 14, 1941; Medicine Bow National Forest, Wyoming (Washington State College 17,104), August 11, 1948; *Muhlenbergia cuspidata* (Torr.) Rydb., McClusky, North Dakota (Washington State College 3,381), August 1, 1944; *M. racemosa* (Michx.) B.S.P., Mandan, North Dakota (Bureau of Plant Industry 80,955), September 3, 1943; *Poa arctica* R. Br., northeast of Cooke City, Montana, July 29, 1939; *P. nervosa* (Hook.) Vasey, Butte, Montana; Moskee, Wyoming (Bureau of Plant Industry 80,902) (11-13 x 1.5-2.0μ), June 24, 1942; *Puccinellia nuttalliana* (Schult.) Hitchc., 10 miles west of Sulfur, South Dakota (Washington State College 3,384), June 27, 1946 (material on *Puccinellia* may in part belong to *Sel. donacis* var. *stomaticola*); Crystal Springs, North Dakota (Bureau of Plant Industry 81,074 and 81,067) (Figure 3, *G*), June 20, 1944; Buffalo, North Dakota (Bureau of Plant Industry 81,050), August 1, 1944; *Sphenopholis obtusata* (Michx.) Scribn., Mandan, North Dakota (Bureau of Plant Industry 80,433), July 31, 1915 (11-14 x 1.6-2.0 μ); *Trisetum spicatum*, Monarch Pass, Colorado (Washington State College 17,097), August 7, 1948; Loveland Pass, Colorado at 12,000 feet elevation (Washington State College 21,004); Beartooth Pass, Montana (Bureau of Plant Industry 80,430), August 15, 1941 (11-15 x 1.3-1.6 μ); *T. subspicatum* Beauv. (= *T. spicatum*), Greenland; *T. wolfii* Vasey, Medicine Bow National Forest, Wyoming (Washington State College 17,082), August 11, 1948. Bisby, et al. (6) reported *Septoria* (?) *nebulosa* Rostr. on *Calamagrostis canadensis* from Canada with spores 10-14 x 1.0-1.5 μ. This is clearly *Sel. everhartii*.

The specimen on *Bouteloua* differs from most of the others of *Sel. everhartii* in that a certain percentage of the spores are boomerang shaped.

In addition to the hosts listed, there is other material that is confusable with *Sel. everhartii*. Most of these cases have been mentioned previously.

Septoria falcispora Demidova (8, p. 152) (non Bubák) occurs on *Festuca, Briza, Poa* and *Secale*. It is a septate-spored species of *Septoria*.

5. SELENOPHOMA BROMIGENA (SACC.) SPRAGUE AND A. G. JOHNSON

Selenophoma bromigena occurs widely on Bromus inermis Leyss in the United States and Europe. It also occurs on *B. carinatus* Hook and Arn. in California, Washington, Wyoming, and North Dakota and on *B. ciliatus* L., *B. frondosus* (*Shear*) Woot. and Standl. and *B. brizaeformis* Fisch. and Mey. in Colorado. In recent years the fungus has become moderately common on *B. carinatus* at Pullman, Washington.

Allison (2) reported that of 34 species of *Bromus* inoculated in the field and greenhouse with *Septoria bromigena* (= *Sel. bromigena*) only *B. inermis* was susceptible which may indicate specialization.

On *Bromus inermis, Selenophoma bromigena* causes gray, irregular to subcircular leaf spots in the high prairies of Idaho, Washington, Utah, and south to the Grand Canyon in Arizona. It is common eastward through Montana, North Dakota, and Minnesota to Wisconsin and south into Colorado. It has been found recently also in Alaska by C. L. Lefebvre. In some places the fungus is very abundant. For instance, in the vicinity of Fargo, North Dakota, in early spring of 1940, the disease covered most of the leaf surface of the very abundant smooth brome (*B. inermis*) for several weeks. The plants eventually developed foliage that was relatively free of the disease, but the earlier heavy infection definitely reduced the vigor of the stand. This disease, together with bacterial blight (*Bacterium coronafaciens* var. *atropurpureum* Reddy and Godkin) and and rootrot (*Pythium* spp.) is, no doubt, a factor in reducing the acreage of smooth brome in the Dakotas.

PURE CULTURE STUDIES

Selenophoma bromigena produces crustose, gray to mousy mounds of mycelium with purple to lavender pigment formed in the substratum. The pycnidia produce lavender spore masses. Staling colonies produce white and sub-cottony, rosy mycelia.

MORPHOLOGY

PYCNIDIA: The pycnidia of *Sel. bromigena* are small, spherical to somewhat flattened, light golden brown, ostiolate, and subepidermal under one layer of leaf cells. They average larger than those of *Sel. donacis* and its varieties except for some collections of the latter made in mountainous regions. Material of *Sel. bromigena* has pycnidia 50-150 μ in diameter, but mostly 90-120 μ. In cross section the pycnidia have large, nearly globular peridial cells measuring 4-6 μ in diameter (Figure 3, *L, M*). The outer brown layer is from one to three cells thick with an equally thick hyaline or subhyaline inner layer of similar structure. The globular inner cells give rise to prominent, truncate or flask-shaped pycnophores, which measure 3-4 x 4.6 μ in stained material (Figure 3, *L, M*).

PYCNOSPORES: The pycnospores are regularly falcate to lunate, scarcely ever boomerang shape, acute at both ends, 17-25 x 2.0-3.2 μ, on *Bromus inermis* (Figure 3, J, K).

TAXONOMY

Septoria bromigena Sacc. (37) was originally described in 1915 on *Bromus inermis* collected near Kulm, North Dakota, June 20, 1914, by J. F. Brenckle and distributed by him as No. 319 in his Fungi Dakotensis. In 1940 the species was transferred to the genus *Selenophoma* by the writers (41).

Selenophoma bromigena (Sacc.) Sprague and A. G. Johnson differs from *Sel. donacis* somewhat vaguely in that the spores of *Sel. bromigena* are regularly falcate to lunate, with ends sharp pointed, rarely boomerang shape.

Except for scattered collections on other bromes, *Sel. bromigena* is very largely confined to *Bromus inermis* growing in plains country or open grasslands. The only collection that we have seen from Europe was made by J. A. Bäumler at Pozsony, Hungary (Krypt. Exs. Ed. Museo Palantino Vind. No. 1,465), without date but received in April, 1923. This specimen is labelled *Septoria oxyspora* but the spores are only very slightly narrower than those of *Sel. bromigena* from the United States. The pycnidia are 70-120 μ in diameter and contain lunate spores 18-25 x 2.0-2.3 μ. Bäumler, presumably from fresh material, gave spore dimensions on the label, 18-24 x 2.0-3.0 μ. It is, therefore, clearly *Sel. bromigena.*

Septoria bromivora Speg. (39, p. 380) was described in 1910 as having bacillar, slightly arcuate spores with attenuate acute tips and rounded bases, 30 x 2.0 μ. The type of this was seen through the courtesy of Dr. Juan Lindquist of the Institute Spegazzini. Although the entire type was examined, no spores were found that correspond to the description or to the sketch

made by Spegazzini on the packet. The prominent pycnidia were nearly empty or contained bacillar, hyaline, non-septate spores 5.8-9 x 0.6-0.8 μ. They were straight or curved and resembled microspores of *Septoria tritici.* The name *Sept. bromivora,* therefore, must remain a *nomen dubium,* at least for the present.

The name *Phlyctaena bromi* F. E. and E. S. Clements was used on a packet of Crypt. Form. Coloradensium with the following notation: "Saprophilus copiosus in vaginulis et culmis emortuis *Bromi ciliati* interdum Picea-Pseudotsuga-hylio." The specimen was collected at Halfway, Colorado, June 25, 1906, and distributed, without date, in the exsiccati the same year. The above notation was not intended as a description and cannot be interpreted as one. In fact, under date of February 10, 1920, Dr. F. E. Clements wrote to Miss Vera K. Charles, Bureau of Plant Industry, United States Department of Agriculture, as follows, regarding the names included without descriptions in the above exsiccati: "I am sorry not to be able to help you in the matter of the missing descriptions as these were never published. About the time the collection was finished it dawned upon me that I was making just as poor 'species' as the thousands that already made mycology all but impossible. Hence, these will probably always remain in ms., in spite of the obligation arising from having them named. I hope this the lesser evil.—" The name, therefore, must be regarded as a *nomen nudum.*

An examination of the above specimen on *B. ciliatus* discloses erumpent black pycnidia in streaks or vague lesions on the culms and sheaths. The pycnidia have coarse polyhedral to globose oblong hyphae composing the peridium. The pycnidia are 80-140, rarely 180 μ in diameter, globose, ostiolate and appear to have developed saprophytically as stated in the notation. They have coarse brown mycelia ramifying through the tissues and all stages from small non-ostiolate, undeveloped pycnidia to mature ones occur. The spores are lunate, sharp pointed, 23-29 x 2.3-3.0 μ and resemble slightly elongated spores of *Sel. bromigena.* Recently a specimen of *Sel. bromigena* was collected on *B. ciliatus* at Climax, Colorado, at an elevation of approximately 11,000 feet, in a meadow at the edge of woods. The pycnidia were prominent, clustered in gray lesions on living leaves. The spores were exceptionally large for *Sel. bromigena,* 20-32 x 2.7-4.2 μ.

The following collections are reported: On *Bromus brizaeformis* Fisch. and Mey., Broomfield, Colorado (Washington State College 20,535), August 6, 1948; *B. carinatus,* Pullman, Washington, 1942 (Bureau of Plant Industry 80,819), May 16, 1947 (Washington State College 3,472); Mandan, North Dakota, August 5, 1942 (Bureau of Plant Industry 80,450); Glenrock, Wyoming, July 27, 1937 (Bureau of Plant Industry 80,329);

Medicine Bow National Forest, Wyoming (Washington State College 17,099); Tioga Pass road, California, June, 1947 (Washington State College 3,567); *B. ciliatus,* Halfway, Colorado, June 25, 1906 (Crypt. Form. Colo. 258); Climax, Colorado (Washington State College 20,525), August 7, 1948; *B. frondosus* (Shear) Woot. and Standl., Loveland Pass, Colorado, August 7, 1948 (Washington State College 20,536); *B. inermis,* Grand Canyon National Park, Arizona (Washington State College 3,544), June 10, 1947; near Donnelly, Idaho, June 5, 1947 (Washington State College 3,792 and 3,678); near Cascade, Idaho, June 5 (Washington State College 3,675); Detroit Lake, Minnesota, June 18, 1944 (Bureau of Plant Industry 81,054); near Fergus Falls, Minnesota, June 14, 1946 (Washington State College 3,802); Roundup, Montana (Bureau of Plant Industry 80,146); Hebgen, Montana, August 27, 1941; Moccasin, Montana, July 12, 1928; Lincoln, Nebraska, September 12, 1940 (Bureau of Plant Industry 80,025), and September 11, 1940 (Bureau of Plant Industry 80,330); Bismarck, North Dakota, July 4, 1935; Dickinson, North Dakota, July 16, 1941 (Bureau of Plant Industry 80,248); Emerado, North Dakota, May 30, 1940 (Bureau of Plant Industry 80,307); Fargo, North Dakota, May 21, 1915 (Sydow, Fungi Exot. Exs. 533); Fargo, North Dakota, September 30, 1940 (Bureau of Plant Industry 80,332), Kulm, North Dakota, July 12, 1908, and June 20, 1914 (Fungi Dak. 319); Mandan, North Dakota, May 16, 1940 (Bureau of Plant Industry 80,339), April 24, 1946 (Washington State College 10,675); Mohall, North Dakota, June 18, 1925; Sanborn, North Dakota (Bureau of Plant Industry 80,172); Zahl, North Dakota, June 12, 1944 (Bureau of Plant Industry 81,012); Brookings, South Dakota, June 19, 1944 (Bureau of Plant Industry 81,043); Cleveland, North Dakota, April 29, 1941 (Bureau of Plant Industry 80,164); Hecla, South Dakota, May 15, 1940 (Bureau of Plant Industry 80,331); Webster, South Dakota, June 6, 1941 (Bureau of Plant Industry 80,243); Logan, Utah, June 6, 1947 (Washington State College 3,794, 3,594); Pullman, Washington, August 8, 1912 (Washington State College 17,143), May 12, 1925 (Washington State College 15,552), June 1, 1934 (Washington State College 2,456), August 14, 1934 (Washington State College 2,488), 1940 (Bureau of Plant Industry 80,815), July 2, 1941 (Bureau of Plant Industry 80,129), May 29, 1941 (Washington State College 4,662), 1942 (Bureau of Plant Industry 80,810 and 80,816), June 28, 1942 (Bureau of Plant Industry 81,811); June 8, 1943 (Washington State College 20,996), May 10, 1947 (Washington State College 3,468), July, 1948 (Washington State College 21,621); Sundance, Wyoming, June 25, 1946 (Washington State College 3,313); Four Corners, Wyoming, June 27, 1946 (Washington State College 3,314); and Pozsony, Hungary (Krypt. Exs. Ed. Mu. Pal. Vind. 1,465).

SELENOPHOMA OBTUSA SPRAGUE AND A. G. JOHNSON

Selenophoma obtusa is a variant of the *Sel. donacis* complex, but in most collections it is distinguishable by its short, almost reniform spores, which average 13-17 x 2.5-4.2 μ (Figure 3, *N, O, P, S-W*). In pure culture, it is distinguished from most of the isolates of other species of *Selenophoma* on Gramineae by prominent, black pycnidial aggregates scattered in "salt and pepper" pattern over a light isabelline to very pale-flesh background. While the spore exudate is pale lavender, the strong rosy tints of *Sel. donacis* and the vinaceous to lavender tints of *Sel. donacis* var. *stomaticola* are less prominent in *Sel. obtusa.* In the early stages of a culture from *Sitanion hystrix, Sel. obtusa* produced a wet-leathery, faintly flesh-colored to isabelline colony. A culture isolated from *Agropyron inerme,* collected at Washtucna, Washington, by G. W. Fischer, showed the usual flesh-colored, early wet-leathery growth, but mucose-tan, later brown conidial masses formed over it. These pseudopionnotes soon became carbonaceous and eventually leathery. They were virtually identical in appearance with those from isolates of *Sel. donacis* from *Poa ampla* from Pullman, Washington, and from *Poa epilis* from the Big Horn Mountains, Wyoming.

Selenophoma obtusa is common on *Elymus glaucus, Sitanion hystrix, S. hansenii,* and occasionally on *Elymus condensatus, Agropyron inerme,* and *Stipa* spp. in the interior of western North America and in California. Material from Mt. Shasta, California, shows prominent tawny lesions with faint fuscous margins and relatively prominent pycnidia. Similar material was obtained in 1949 on *Sitanion hansenii* at Buttermilk Pass, Chelan National Forest, Washington. The material from the Rocky Mountains and plains adjacent is similar but often scanty and obscure.

The pycnidia of *Sel. obtusa* average somewhat stouter than those of *Sel. donacis* in sub-alpine material, but desert collections, such as on *Elymus condensatus* from White Bluffs, Washington, have very small pycnidia, 40-80 μ in diameter. The walls of the pycnidia are 10 μ thick and are composed of 2-3 cell layers (Figure 3, *Q, R, X, Y*). The pycnophores are broadly subulate, 4-5 x 2.2-2.8 μ. On *Sitanion* spp. the pycnidia range from 65-144 μ in diameter, are sphaeroidal, brown, ostiolate, and composed of coarse, relatively thin-walled cells that are as much as 8 μ in diameter although mostly 3-4 μ. The pycnidial walls are 13-16 μ thick. The ostioles tend to elongate and are about 7-15 μ in diameter in large pycnidia. The pycnophores arise either from bulbous cells or from elongate rectangular cells and are subulate or

pointed, with bulbous bases. They are 2.5-3.5 x 4.0-6.5 μ (Figure 2, *Q*) and are closely packed (Figure 2, *R*).

While the pycnospores of typical material of *Sel. obtusa* (Figure 3, *S*, *T*, *V*) are readily distinguishable from those of the *Sel. donacis* complex, we have some difficulty with other material on *Sitanion hystrix* and *Elymus* spp. (Figure 3, *N*, *O*, *P*, *W*), and on *Agropyron* (Figure 3, *U*). Spores of material on *Sitanion* are particularly variable. A fragment on *S. hystrix*, collected by Kirk Whited (Figure 3, *N*) at Tanaway, Washington, many years ago, has narrow spores, 13.5-15.8 x 1.7-2.5 μ is close to *Sel. donacis* var. *stomaticola*, while still younger or smaller material on the same host, collected by Dick Adlard on Mt. Hood, Oregon (Oregon State College 10,770) has spores 11-13.4 x 1.5-2.1 μ and, because of its sharp-pointed spores, is tentatively assigned to *Sel. donacis* var. *stomaticola* (Figure 2, *N*). It is noted that collections from the higher mountains of the west are particularly variable. The fluctuating temperatures, variable moisture and intense sunlight no doubt account for some of this variability. *Selenophoma obtusa* was described earlier (42) and the English description is included here for convenience of reference.

SELENOPHOMA OBTUSA SPRAGUE AND A. G. JOHNSON

Spots tawny, rounded to elongate or irregular, margins fuscous to pale lavender; pycnidia globose, sub-prominent to obscure, black, ostiolate erumpent, sometimes in lines, more often scattered, 40-150 x 40-138 μ in diameter; walls relatively thick, composed of coarse polyhedral cells; pycnophores cuspidate, prominent 3-7 x 2.0-3.5 μ; pycnospores falcate, ends obtuse or, when young, sub-acute, 13-17 (rarely 21) x 2.5-4.2 μ, typically about 14 x 3.5 μ.

Habitat in living leaves, sheaths, and culms of *Sitanion hystrix*, Mt. Shasta, California, type locality, and from the following collections: *Agropyron spicatum*, Washington; *A. inerme*, Washtucna, Washington (13-17 x 3.2-3.6 μ); *A. subsecundum* var. *andinum* (Scribn. and Sm.) Hitch., Monarch Pass, Colorado (Washington State College 17,081); *A. trachycaulum*, Libby Creek in Medicine Bow National Forest, Wyoming (Washington State College 20,057), August 11, 1948; near Togwatee Pass, Wyoming (Washington State College 21,752) August 12, 1948; *Elymus condensatus*, Mandan, North Dakota; Oregon; Chamber's Bar near White Bluffs, Washington (13-17.6 x 2.6-4.0 μ), August 19, 1938; *Elymus glaucus*, several collections by Fischer at Pullman, Washington, in 1941 and 1943 (Washington State

College 21,100), Dayton, Washington, in 1937 (Oregon State College 10,875) (13.3-16.1 x 2.6-4.2 μ); Mud Creek Canyon, Mt. Shasta, California (Cooke 14,709) (14.3-17 (rarely 21) x 2.5-3.5 μ); at 6,000 feet in Mud Creek Canyon, Mt. Shasta, California (Cooke 13,386) (14.5-16.2 x 2.5-4.0 μ); Bear Springs, Mt. Shasta, California (Cooke, 15,688) August, 1941; Crater Lake, Oregon; Myrtle Point, Oregon; east of Blitzen, Oregon (Washington State College 3,502), June 24, 1947; Teton Pass, Wyoming (Washington State College 20,028), August 13, 1948; *Poa arida* Vasey, Mandan, North Dakota (Bureau of Plant Industry 80,488), May 4, 1941 (spores very blunt (Figure 3, *S*), 11-18 x 3.2-4.3 μ); *Poa secunda,* Malheur National Forest, Oregon (Washington State College 3,837), June 25, 1947; *Sitanion hansenii,* Mt. Shasta, California (Cooke, 9,169 and Oregon State College 8,467) (13.3-17.6 x 2.7-4.0 μ); meadow below Wagon Camp, Mt. Shasta, California (Cooke, 15,692), August 18, 1941; north of Burns, Oregon (Washington State College 3,837), June 25, 1947; Buttermilk Pass, Chelan National Forest, Washington (Washington State College 20,523) (15-18 x 3.0-3.8 μ) July 15, 1949; *S. hystrix,* several collections made by Cooke on Mt. Shasta, California, during recent years, including the type (Cooke 8,627) (12-17 x 2.4-4.1 μ); Tioga Public Camp, California (Washington State College 3,566), June 22, 1947; Lake Crowley, California (Washington State College 3,488), June 21, 1947; Pipestone Pass, near Butte, Montana (Bureau of Plant Industry 80,102); U. S. Highway 30, Montana (Fischer) (Bureau of Plant Industry 80,101), July 24, 1945; Logan Canyon, Utah; Tanaway, Washington (Kirk Whited 741), July 27, 1898; *Stipa columbiana,* High Prairie, Washington (Washington State College 17,156), June 24, 1948; *Stipa coronata* Thurb., Julian, California, (Rel. Bethel), April 17, 1918, (13-15 x 2.7-3.6 μ), (a few scattered spores seen appear to be obtuse. The closely grouped pycnidia occur in obscure, fuscous spots); Rainbow, California, June 19, 1947; *S. richardsonii,* Butte, Montana (Bureau of Plant Industry 80,108), July 1941; Jackson, Wyoming, August 17, 1941; north shore of Little Bitterroot Lake, Montana (Weber N9-541) July 4, 1936 (10-15 x 2.4-4.2 μ).

The collection on *Agropyron inerme* has spores (Figure 3, *U*) that are somewhat less blunt than in most collections of *Sel. obtusa.* In culture the fungus from *A. inerme* also shows more resemblance to *Sel. donacis* than do the other isolations of *Sel. obtusa. Sel. obtusa* is most characteristic on the sub-alpine material. Further study of this fungus is needed to determine interrelationships more accurately.

KEY TO SPECIES AND VARIETIES OF SELENOPHOMA ON GRAMINEAE

A. Spores sub-acute to acute at both ends
- a. Spores lunate to boomerang shape, chiefly 18-30 x 2.0-4.0 μ — 1. *Sel. donacis*
- b. Spores lunate to sub-arcuate, chiefly 11-20 x 1.5-2.5 μ — 2. *Sel. donacis* var. *stomaticola*
- c. Spores sub-arcuate to falcate, chiefly 20-34 x 1.8-2.5 μ — 3. *Sel. donacis* var. *linearis*
- d. Spores chiefly lunate, mostly 11-25 x 1.3-2.2 μ — 4. *Sel. everhartii*
- e. Spores falcate to lunate, chiefly 17-25 x 2.0-3.2 μ — 5. *Sel. bromigena*

B. Spores obtuse at both ends, mostly 13-17 x 2.5-4.2 μ — 6. *Sel. obtusa*

LITERATURE CITED

(1) Allescher, A.
1901. Fungi imperfecti: Hyalin-sporige Sphaeriodeen. *In* Rabenhorst, L. Kryptogamen Flora von Deut., Oesterr. und Schweiz 2, Aufl. 1 (Abt. 6): p. 916, Leipzig.

(2) Allison, J. L.
1939. Studies on Septoria bromigena. (Abs.) Phytopathology 29:1.

(3) Bäumler, J. A.
1889. Mykologische Notizen, II. Oesterr. Bot. Zeitschr. 39: [289]-291.

(4) Baudyš, E., and Picbauer, R.
1926. Fungi novi vel minus cogniti, Pars. III. Práce Morav. Přírod. Společ. (Brno, Ceskoslovensko) (Acta Soc. Sci. Nat. Morav.) 3(2): [29]-36, illus.

(5) Bender, H. B.
1934. The fungi imperfecti: Order Sphaeropsidales, with keys and references for the genera. 52 pp., North Woodbury, Conn.

(6) Bisby, G. R., Buller, A. H. R., Dearness, J., Fraser, W. P., and Russell, R. C.
1938. The fungi of Manitoba and Saskatchewan. Nat'l. Res. Council of Canada, 189 pp., illus. Ottawa.

(7) Bubák, F.
1909. *In* Handel-Mazzetti, H. von. Ergebinesse einer botanischen Reise in das Pontische Randgebirge im Sandschak Trapezunt. Ann. d. K. K. Naturhist. Hofmus. 23: 101-107, illus.

(8) Demidova, Z.
1926. Nabluideniia nod vi idami Septoria na Zlakakle. (Studies on species of *Septoria* on grasses) Material po mikol. Fitop. (Material for Mycology and Phytopathology) 5: 133-155, illus.

(9) Desmazières, J. B. H. J.
1843. Dixième notice sur quelques plantes cryptogames, la plupart inédites, récemment découvertes en France, et qui vont paraitre en nature dans la collection publiée par l'uteur. Ann. Sci. Nat. (Bot.) 2 Sér., 19: 335-373.

(10) Ellis, J. B. and Everhart, B. M.
1898. New species of fungi from various localities. Torr. Bot. Club. Bul. 25: 501-514.

(11) Fischer, George
1937. Observations on the comparative morphology and taxonomic relationships of certain grass smuts in western North America. Mycologia 29: 408-425.

(12) Frandsen, N. O.
1943. Septoria-arten des Getreides und anderer Graser in Dänemark. Meddel. f. Plantepatol. Afd. d. Kgl. Vet. og Landbrohøjsk. København No. 26, 92 pp., illus.

(13) Grove, W. B.
1916. New or noteworthy fungi, Part V. Jour. Bot. (London) 54: 185-193, illus.

(14) Grove, W. B.
1935. British stem- and leaf-fungi (Coelomycetes) Sphaeropsidales Vol. 1, 488 pp., illus. Cambridge.

(15) Jaap, Otto
1916. Beiträge zur Kenntnis der pilze Dalmatiens. Ann. Mycol. 14: 1-44.

(16) Johanson, C. J.
1885. Svampor från Island Öfvers. af Kongl. Vetensk.-Akad. Förhandl. 1884, 41(9): 157-174, illus., Stockholm.

(17) Karsten, P. A.
1887. Symbolae ad mycologiam fennicam, XXI. Meddel. Soc. Faun. Fl. Fenn. 14: 103-110.

(18) Libert, M. A.
1832. Plantae Cryptogamiae quas in Arduenna collegit. (Exsic.) Cent. 2, No. 157.

(19) Lind, J.
1907. Bemerkenswerte pilzfunde in Dänemark. Ann. Mycol. 5: 272-277.

(20) Lind, J.
1910. Fungi (Micromycetes) collected in Arctic, North America (King William Land, King Point and Herschell Isl.) by the Gjöa expedition under Captain Roald Amundsen, 1904-1906. Vidensk. Selsk. Skr. I. Math. Nat. Kl. 1909 (9): 1-25, illus. Christiana.

(21) Lobik, A. I.
1928. (Materials for the mycological flora of the Terek district.) Morbi Plantarum. Bolezni Rast. 17(3-4): 157-199, illus.

(22) Maire, R.
1906. Contributions à l'étude de la flore mycologique de l' Afrique du Nord. Bul. Soc. Bot. France 53: CLXXX-CCXV.

(23) Maire, R.
1913. Etudies Mycologiques, Fasc. I. Ann. Myc. 11: [331]-358, illus.

(24) Maire, R.
1927. Champignons nord-africains nouveaux ou peu connus. Fasc. 3. Soc. d'Hist. Nat. de l'Afrique du Nord, Bul. 18(5): 117-120.

(25) Moesz, Gustav.
1941. Uj Gombak Lettországból VII (Neue Pilze aus Lettland VII). Bot. Közlem. 38: 68-73, illus., Budapest.

(26) Passerini, G.
1878. Septoria donacis Pass. nov. spec. *In* Thueman, F. Mycotheca Universalis No. 1184.

(27) Passerini, G.
1879. Fungi parmensi enumerati (Sphaeropsideae). Atti della Soc. Crittog. Ital. (Ser. 2) 2: 20-47.

(28) Penzig, O.
1884. Note micologiche II. Funghi della Mortola. R. Ist. Venet di Sci., Let., ed Arti, Atti, 1883-1884: [639]-663, illus.

(29) Petrak, F.
1924. Mykologische Notizen VII. Ann. Myc. 22: 1-182.

(30) Petrak, F.
1929. Mykologische Notizen X. Ann. Myc. 27: [324]-410.

(31) Petrak, F.
1934. Mykologische Notizen XII. Ann. Myc. 32: [317]-447.

(32) Petrak, F.
1940. Mykologische Notizen XIII. Ann. Myc. 38: [181]-267.

(33) Rostrup, E.
1888. Fungi Grønlandiae. Oversigt over Grønlands Svampe. Meddel. om Grønland 3: [515]-590. Kjøbenhavn.

(34) Rostrup, E.
1904. Fungi Grønlandiae orientalis in expeditionibus G. Amdrup 1898-1902, a G. Amdrup (G.A.) N. Hertz (N.H.) et C. Kruuse (C.K.) Collecti. Meddel. om Grønland 30: [111]-121. Kjøbenhavn. Re-issued in 1907 as III in Part 1 of volume 30 (same pagination).

(35) Saccardo, P. A.
1882-1902. Sylloge fungorum 3: 564; 10: 391; 16: 973-974.

(36) Saccardo, P. A.
1888. Funghi delle Ardenne contenuti nelle Cryptogamae Arduennae della Signora M. A. Libert. Malpighia I, p. 211-219, 1886; I, p. 454-459, 1887; II, p. 18-25, 234-241.

(37) Saccardo, P. A.
1915. Notae mycologicae, Series XIX. Ann. Myc. 13: 115-138.

(38) Snyder, W. C. and Hansen, H. N.
1940. The species concept in Fusarium. Amer. Journ. Bot. 27: 64-67.

(39) Spegazzini, C.
1910. Mycetes Argentinensis, Ser. V. Anal. Mus. Nac. Buenos Aires 20 (Ser. 3, 13): [329]-467, illus.

(40) Sprague, R.
1944. Septoria disease of Gramineae in western United States. Oregon State Col. Monog. Bot. 6, 151 pp., illus.

(41) Sprague, R. and Johnson, A. G.
1940. Selenophoma on grasses. Mycologia 32: 415.

(42) ———— and ————
1945. Selenophoma on grasses, II. Mycologia 37: 638-639.

(43) ———— and ————
1947. Selenophoma on grasses, III. Mycologia 39: 737-742.

(44) Trotter, A.
1916. Caratteri ecologici e prospetto della flora micologicia della Libia. Nuovo Gior. Bot. Ital. (N.S.) 23: 5-33, illus.

(45) Unamuno, P. Luis M.
1930. Hongos microscopicos de los alrededores de Caudete (Albacete) Bol. R. Soc. Esp. His. Nat. 30: 384-387.

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