THE GENUS PHAEOSEPTORIA ON GRASSES IN THE WESTERN HEMISPHERE [1]

RODERICK SPRAGUE [2]

(WITH 2 FIGURES)

Phaeoseptoria Speg. was described by Spegazzini (**6**, p. 39) in 1908 as follows: "*Char.* Est Septoria sporulis olivaceis distincta." In this new genus Spegazzini described one species, namely, *P. Papayae*. In 1909, Miyake (**3**, p. 136) described *P. Oryzae* on rice (in Japanese), and in 1910, he (**4**, p. 260) republished the description in German and added illustrations (**4**, *pl. 14, figs. 61–63*). In 1913, Saccardo and Trotter (**5**) recognized the genus and listed the two species, *P. Papayae* Speg. and *P. Oryzae* Miyake. In this connection, Saccardo and Trotter (**5**) amended the description of the genus *Phaeoseptoria* Speg. as follows: "Pycnidia subcutaneo-erumpentia, nigricantia, minuta. Sporulae bacillares v. anguste fusoideae, coloratae.—Est quasi Septoria sporulis olivaceis distincta." In 1925, Tehon and Daniels (**11**, p. 245) described and illustrated *P. Caricis* on *Carex* sp. from Illinois. The writer agrees with Saccardo's emendation and gives the following key to segregate *Phaeoseptoria* from certain other genera of the Sphaeropsidales:

A. Spores lengthened, at least 10 times as long as broad, usually at least 15 times as long..... (Scolecosporae)
  B. Spores hyaline or chlorinous..... *Septoria* Sacc.
  BB. Spores yellowish to light brown, usually stout, multiseptate..... *Phaeoseptoria* Speg.

[1] Coöperative investigations between the Divisions of Cereal Crops and Diseases, Forage Crops and Diseases, Dry Land Agriculture, Bureau of Plant Industry, Agricultural Research Administration, Division of Nurseries, Soil Conservation Service, U. S. Department of Agriculture, and the Oregon Agricultural Experiment Station. Published with the approval of the Director as Technical Paper No. 410. Contribution from the Department of Botany.

[2] Pathologist, Division of Cereal Crops and Diseases, Bureau of Plant Industry.

AA. Spores broadened, usually less than 10 times as long as broad, cylindrical to fusoid
B. Spores 1-septate ..... (Didymosporae)
C. Spores hyaline or yellow ..... *Ascochyta* Lib.
CC. Spores brown ..... *Diplodia* Fries
BB. Spores 2- or more septate ..... (Phragmosporae)
C. Spores hyaline ..... *Stagonospora* Sacc.
CC. Spores colored ..... *Hendersonia* Berk.

Phaeoseptoria, therefore, has longer and usually paler spores than *Hendersonia,* which is an affinity of *Stagonospora. Phaeoseptoria* is readily distinguished from *Septoria* by the black, heavy walled, scattered, not so often maculicole, subcutaneous, less often strongly erumpent pycnidia and the stout, multiseptate, lightly colored spores. The species discussed are as follows:

Phaeoseptoria Elymi sp. nov.

Maculis fuscis, pycnidiis sparsis, 180 μ, globosis, erumpentibus, brunneis, ostiolatis (8 μ); pycnosporulis fasciculatis, curvulis, nec recurvulis, bacillari-filiformibus, utrinque obtusatis, 8–14 septatis, fuligineis, 50–75 $\times$ 2–2.5 μ.
Hab. in foliis languidis, *Elymi virginici.* Calloway, Nebr.

This fungus was found on *Elymus virginicus* L. in Rev. J. M. Bates' collection No. 2601 at Calloway, Nebr., September 10, 1900, and which is filed in the Mycological Collections, Bureau of Plant Industry, Washington, D. C. This fungus is readily distinguished from the other species of *Phaeoseptoria* by the uniformly bacillar-filiform spores, which are blunt at each end and which scarcely taper and are not swollen at the ends as in some species (FIG. 2, *D*).

Phaeoseptoria Airae (Grove) and **P. Phalaridis** (Trail)

In a contemporary article (**9**) we have discussed *Septoria Bromi* var. *Alopecuri* Karst. The description by Karsten (**2**) led Trail (**12**) to believe that certain fungi he had seen were related to *S. Bromi* var. *Alopecuri.* Grove (**1**), followed Sydow (**10**) and used the name *S. Alopecuri* Syd., but otherwise followed Trail's (**12**) description. Grove listed *S. Alopecuri* as having hyaline to faintly yellowish spores 45–75 $\times$ 2.5 μ. *Septoria Alopecuri* var. *Airae* Grove was described as having fusoid, cylindrical, pale yellowish spores, 60–75 $\times$ 2.5 μ. *Septoria Alopecuri* var. *Phalaridis* (Trail) Grove (**1**) (*S. Bromi* var. *Phalaridis* Trail (**12**)) was described

as having spores 53–65 × 3.5–4 μ, 8–15 septate, and *S. Alopecuri* var. *Calamagrostidis* Grove as having yellowish spores, 40–100 × 3–4 μ, 3–13 septate.

The variety *Airae* has been seen (FIG. 1, *G*). The pycnidia are 130–192 μ in diameter and contain stout clavulate spores with pointed apices and rounded blunted bases. They are obscurely 9 to 10 septate, 51–56 × 3.0–3.5 μ and are the same as material on *Deschampsia caespitosa* (L.) Beauv. from Oregon (O.S.C. 809). This fungus is very clearly a species of *Phaeoseptoria* and should be known as **Phaeoseptoria Airae** (Grove) comb. nov.

W. B. Cooke collected material of a *Phaeoseptoria* on *Phalaris arundinacea* L. at Corvallis, Oreg. (O.S.C. *17*), which has stout sphaerical pycnidia composed of light golden brown, large celled mycelia from which cuspidate pycnophores arise from creeping hyphae (FIG. 1, *F*). The spores are 8 to 13-septate (FIG. 1, *A*), filiform, 70–90 × 2.5–4.4 μ, somewhat constricted at the septa. This fungus differs, therefore, in several respects from *P. Airae* and from any concept of *S. Bromi* var. *Alopecuri* Karst. It is similar to Trail's *S. Bromi* var. *Phalaridis* (**12**) although the Oregon material has longer spores. We are considering them the same species and propose **Phaeoseptoria Phalaridis** (Trail) comb. nov.

In connection with *P. Phalaridis,* we examined material of *Stagonospora arenaria* Sacc. on *Phalaris arundinacea* collected by Grove on the banks of the Usk River, England, August 20, 1929. This is not our concept of *Stagonospora,* but is closer to *Hendersonia crastophila* Sacc. The spores (FIG. 2, *F*) are brown, fusoid, elongate to clavulate, 40–50 × 2.9–4.2 μ, 6 to 7-septate. However, these spores are about 12 times as long as broad and technically this would place the fungus in *Phaeoseptoria.* This case simply emphasizes the complexity of the group and the need for flexible classification. The very large pycnidia (250 μ) are diffecent also from those in some collection of *H. crastophila.* Therefore, the spores are close to *Septoria Alopecuri* as interpreted by P. Sydow (**8, 10**), but the pycnidia are not. On the basis of present knowledge, we place these fungi with spores 40–50 μ long in *H. crastophila* and not in *Phaeoseptoria.*

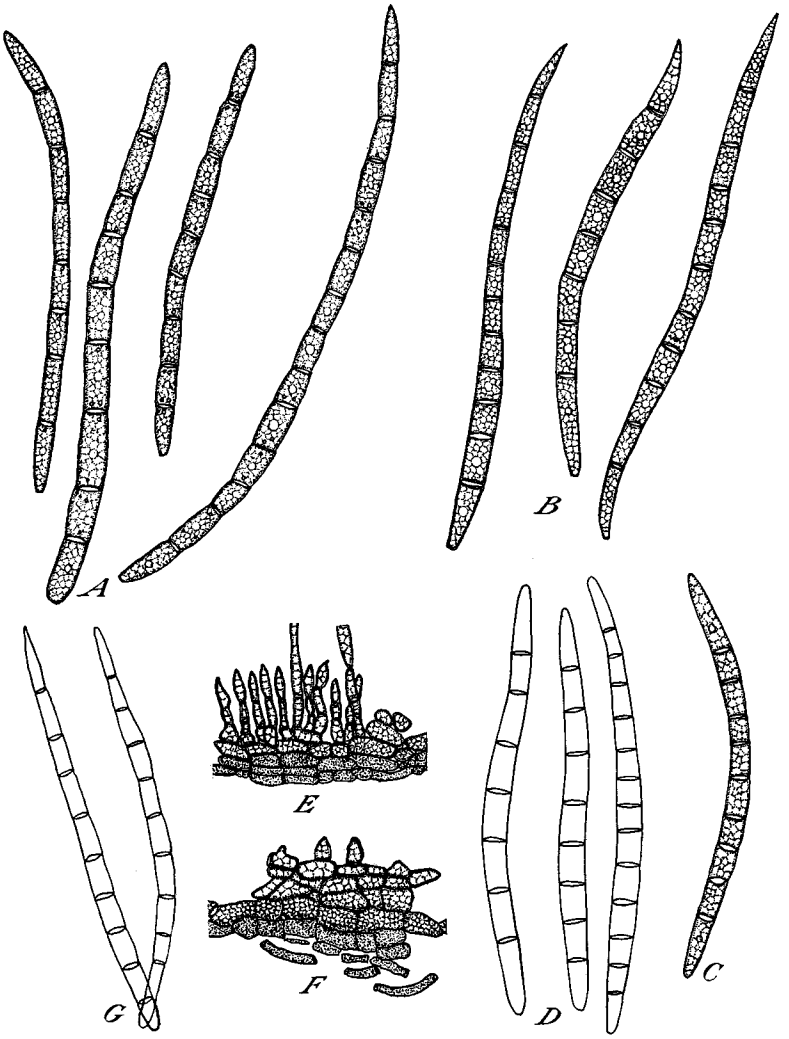

FIG. 1. *A,* pycnospores of *Phaeoseptoria Phalaridis* (Trail) Spr. on *Phalaris arundinacea* L., Corvallis, Oreg., O.S.C. *17; B,* pycnospores of *P. Festucae* Spr. on *Festuca rubra* L., Garibaldi, Oreg., O.S.C. *8376* (Type); *C,* pycnospores of *P. Festucae* on *F. rubra,* King's Valley, Oreg., O.S.C. *202; D,* pycnospores of *P. Festucae* var. *Muhlenbergiae* Spr., Lansing, Mich., H. H. Hicks No. *1211* (Type); *E,* segment of a cross section of the pycnidial wall of *P. Festucae* on *Festuca rubra,* Garibaldi, Ore., O.S.C. *8376* (Type); *F,* segment of a cross section of the pycnidial wall of *P. Phalaridis* on *Phalaris arundinacea* L., Corvallis, Oreg., O.S.C. *17; G,* pycnospores of *P. Airae* (Grove) Spr. on *Deschampsia caespitosa,* Sneyd's Coppice, Worcestershire, England, W. B. Grove, March 7, 1928. [All × 1000.]

Phaeoseptoria Calamagrostidis sp. nov.

Maculis stramineis v. nullis, pycnidiis rariis, nigris, 200 μ diam., erumpentibus, globosis, ostiolatis; pycnosporulis clavulato-filiformibus, aureo-brunneis, subvermiformibus, 5–11-septatis, 55–71 $\times$ 4.3–5.0 μ.

Hab. in foliis dejectis *Calamagrostidis nutkaensis* et *Agrostidis palustris* prope maris Pacifici Waldport et Newport, Oregon.

Spots few, scattered, straw colored or none, pycnidia few, scattered, black, heavy walled, subcutaneous, ostiolate, 200 μ diameter, pycnospores clavulate-filiform, somewhat vermiform with softly blunted ends, scarcely constricted at the septa, light yellow brown, 5 to 11-septate, 55–71 $\times$ 4.3–5.0 μ (FIG. 2, *C*).

In necrotic overwintered leaves of *Calamagrostis nutkaensis* associated with a multiseptate species of *Leptosphaeria* along the seashore at Waldport, Oreg. (Type, O.S.C. *354*) and on *Agrostis palustris* Huds., Newport, Oreg.

Efforts to locate *Septoria Alopecuri* var. *Calamagrostidis* Grove have been without success as reported earlier (**8, 9**). It appears that proof of the existence of this fungus is lacking and that Grove's description (**1**) possibly may be based on a compilation. His drawing of this fungus is closer to *P. Phalaridis* (Trail) Spr. than the vermisporous *P. Calamagrostidis* which we have described above. It must be emphasized that Grove was probably dealing with a fragment just as our material of *P. Calamagrostidis* is such a fragment. This saprophytic, probably widely scattered but never abundant fungus is evidently of no economic importance and will be encountered only by students critically studying diseases of Gramineae.

Phaeoseptoria Festucae sp. nov.

Pycnidiis globosis v. subglobosis, nigris, subcutaneis, tarde ostiolatis, 55–100 μ lat. $\times$ 50–90 alt. (140–160 μ hab. *Danthonia*), contextu brunneo- parenchymatico, 13 μ crasso; pycnophoris pyriformibus, 3–4 $\times$ 1.4–1.7 μ; pycnosporulis 50–85 $\times$ 2.8–4.8 μ, 8–11-septatis, flavidis, clavato-filiformibus.

Hab. in foliis dejectis *Festucae rubrae* L. (typus) et *Danthoniae Parryi* Scribn.

Pycnidia globose to subglobose, black, suberumpent, sunken, tardily ostiolate, 55–100 μ wide $\times$ 50–90 μ high (140–160 μ diameter on Danthonia), walls 13 μ thick with an outer brown portion of closely woven elongated cells totalling 5–6 μ thick, inner hyaline layer (FIG. 1, *E*) radiating towards the pycnophores, which are 3–4 $\times$ 1.4–1.7 μ, pyriform, sometimes constricted at the base and

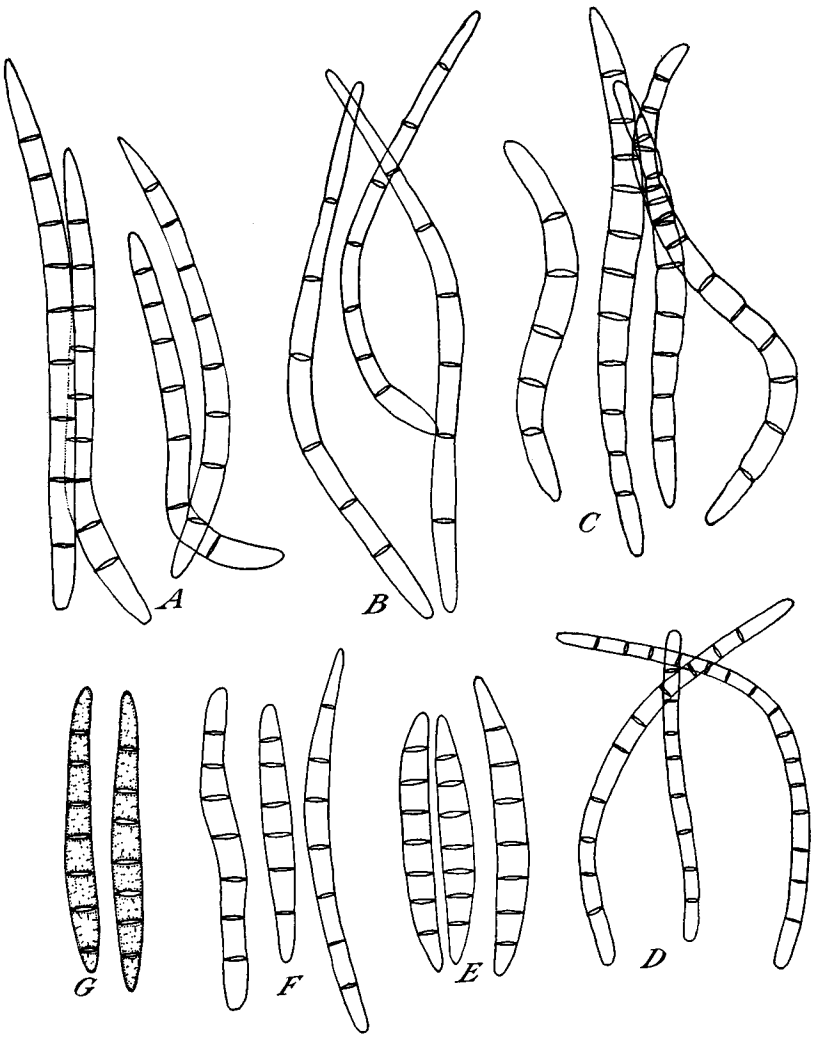

FIG. 2. *A*, pycnospores of *Phaeoseptoria Festucae* on *Danthonia Parryi*, Tolland, Colo., E. Bethel, Sept. 3, 1910; *B*, pycnospores of *P. Urvilleana* (Speg.) Spr. on *Panicum urvilleanum*, Argentina, from type of *Septoria urvilleanum* Speg.; *C*, pycnospores of *P. Calamagrostidis* Spr. on *Calamagrostis nutkaensis* Presl, Waldport, Oreg., O.S.C. *364* (Type); *D*, pycnospores of *P. Elymi* Spr. on *Elymus virginicus* L., Calloway, Nebr., J. M. Bates No. *2601*, Sept. 10, 1900; *E*, pycnospores of *Hendersonia crastophila* Sacc. on *Deschampsia caespitosa* Baxterley Common, England, W. B. Grove, Oct. 15, 1927; *F*, pycnospores of *H. crastophila* on *Phalaris arundinacea*, banks of Usk River, Brecon, England, W. B. Grove, Aug. 20, 1929; *G*, pycnospores of *H. crastophila* on *Festuca rubra*, Garibaldi, Oreg., O.S.C. *748*. [All × 1000.]

blunt at the apex; spores formed by elongation and later abscissing leaving a blunt base on the spore, spores 50–85 × 2.8–4.8 μ, 8 to 11-septate, flavid, clavulate-filiform with tapering finally blunt (narrowly truncate) base and tapering, pointed to slightly blunt apex (FIGS. 1, *B, C*; 2, *A*).

On languishing leaves of *Festuca rubra* L. at Garibaldi, Oreg. (type) (O.S.C. *8376*), facing the open sea, and at King's Valley, Oreg. (O.S.C. *202*); and on *Danthonia Parryi* Scribn., Tolland, Colo. (Bethel).

This is another obscure and economically unimportant semi-saprophyte. It has larger spores than *P. Airae* while the blunt base and sharpened apex of the spores distinguish it from *P. Calamagrostidis*. The method of spore formation and the lack of constriction at the septa distinguish it from *P. Phalaridis*.

At Garibaldi it is associated with the shorter spored *H. crastophila* (FIG. 2, *G*) (O.S.C. *748*).

Phaeoseptoria Festucae var. **Muhlenbergiae** var. nov.

Pycnidia associated with black lesions, scattered to subgregarious, prominent, suberumpent, black, subglobose, ostiolate, parenchymatous, 150–190 μ; pycnospores flavid, obclavate, 7–13-septate, bases obtuse, apices subacute, 47–64 × 3.7–4.5 μ.

Hab. in foilage of *Muhlenbergia mexicana* (L.) Trin., East Lansing, Mich., G. H. Hicks, No. *1211*. No date but old material in the undetermined files of the Mycological Collections, Bureau of Plant Industry, Washington, D. C.

This fungus is very close to *P. Festucae,* but differs in having larger pycnidia and lighter colored spores. The spores are yellow, not far removed from true *Septoria,* but the scattered stout structured pycnidia, and relatively stiff, coarse, if only yellow, spores place this fungus in our concept of *Phaeoseptoria* (FIG. 1, *D*).

The association of this fungus with the tar-spot lesions is confusing. C. R. Orton, in 1940 notations on the packet of Hicks No. *1211,* rejected this from *Phyllachora.* It is not quite clear whether our *Phaeoseptoria* is associated with the tar-spot lesions or is the cause of them. As mentioned, the pycnidia lie just outside of the tar-spot lesions. This variety appears to be more parasitic than the species proper.

Phaeoseptoria Festucae var. *Muhlenbergiae* is readily distinguished from *Septoria mississippiensis* Spr. by its multiseptate

spores but is less clearly distinct from the *S. Bromi* var. *Alopecuri* complex (**2, 8, 9, 10**). The spores of the *Phaeoseptoria* are considerably stouter, however.

Phaeoseptoria Urvilleana (Speg.) comb. nov.

Among material very kindly finished to us by Juan Lindquist, Inst. Spegazzini, was a specimen of *Septoria Urvilleana* Speg. (**7**, p. 387), which now on aging has brown spores, clavulate-filiform, 20–90 × 4.5–6 μ. This fungus, on *Panicum Urvilleanum* from Argentina was described originally as having hyaline to faintly sub-chlorinous spores, but now appears to belong in Spegazzini's genus *Phaeoseptoria* to which we transfer it, as above recorded. This fungus differs from *P. Festucae* in having wider spores, but is more readily distinguished by the less stiff, more gracefully curved spores with only 5- to 7-septa.

The following key will aid in segregating the collections of *Phaeoseptoria* discussed in this article:

A. Spores filiform-bacillar.....*Phaeoseptoria Elymi* Spr.
AA. Spores clavulate-filiform
B. Spores yellow to light brown
C. Spores 60–75 × 2.5–3 μ.....*P. Airae* (Grove) Spr.
CC. Spores wider, 55–64 × 3.7–4.5 μ.....*P. Festucae* var. *Muhlenbergiae* Spr.
BB. Spores light brown, coarser
C. Spores 5- to 7-septate, 20–90 × 4.5–6.0 μ.....*P. Urvilleana* (Speg.) Spr.
CC. Spores 8- to 13-septate, narrower
D. Spores vermiform, obtuse, 55–71 × 4.3–5.0 μ.....*P. Calamagrostidis* Spr.
DD. Spores obclavate-filiform, scarcely vermiform, acute at one end or at least acuminate
E. Spores stiffly obclavate-filiform, apices acute, bases truncated, scarcely constricted at septa, pycnophores elongate.....*P. Festucae* Spr.
EE. Spores similar to above but somewhat constricted at septa, pycnophores broadened or obscure.....*P. Phalaridis* (Trail) Spr.

The aid of A. G. Johnson and Edith Cash in the final preparation of the manuscript is gratefully acknowledged.

NORTHERN GREAT PLAINS FIELD STATION,
MANDAN, N. DAK.

LITERATURE CITED

1. **Grove, W. B.** British stem- and leaf-fungi (Coelomycetes) Sphaeropsidales. 1, 488 pp. *illus.*, Cambridge. 1935.
2. **Karsten, P. A.** Symbolae ad mycologiam fennicam XVI. Medd. Soc. Faun. Fl. Fenn. **11**: 148–161. 1884.
3. **Miyake, I.** [Studies of fungi on rice in Japan.] Bot. Mag. (Tokio) **23**: 85–97; 127–145. 1909. (In Japanese.)
4. ——. Studien über die Pilze der Reispflanze in Japan. Jour. Coll. Agric. Imp. Univ. Tokio **2**: 237–276. 1910.
5. **Saccardo, P. A. & Trotter, A.** Sylloge Fungorum **22**: 1121. 1913.
6. **Spegazzini, Carlos.** Fungi Aliquot Paulistani. Rev. Mus. La Plata **15**: 7–48. 1908.
7. ——. Mycetes Argentinensis V. Anal. Mus. Nac. Buenos Aires II. **13**: 329–467. 1911.
8. **Sprague, R.** *Septoria* diseases of Gramineae in the western United States. (In ms.)
9. ——. The status of *Septoria Alopecuri* (Karst.) P. Sydow and some related species. Mycologia **35**: (in press).
10. **Sydow, P.** Beiträge zur kenntniss der Pilzflora der Mark Brandenburg II. Hedwegia (Beiblatt) **38**: 134–140. 1899.
11. **Tehon, L. R. & Daniels, E.** Notes on the parasitic fungi of Illinois II. Mycologia **17**: 240–249. 1925.
12. **Trail, J. W. H.** Revision of Scotch Sphaeropsideae and Melanconieae. Scot. Nat. (N.S. v. 3) **9**: 219–236. 1888.