

## THE GENUS SELENOPHOMA ON GRAMINEAE IN AUSTRALIA.

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(Plate ix.)

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*Synopsis.*

*Selenophoma donacis* on *Arundo donax* is recorded for the first time in New South Wales and Queensland.

*Selenophoma donacis* var. *stomaticola* is also recorded for the first time, in New South Wales, Australian Capital Territory, Tasmania, South Australia and the Northern Territory, on introduced and native grasses. Many of the specimens were heavily diseased. Pure cultures were established from most collections, and varied considerably in texture, colour and pigmentation of the medium. Inoculation tests carried out to date show that the isolates are specific for the host from which they were obtained.

*S. donacis* var. *stomaticola* on wheat is recorded from South Australia. Certain commercial varieties of wheat, and other varieties used as sources of resistance to other diseases, were susceptible when inoculated in the glasshouse with spores from culture. Lesions with pycnidia and spores were obtained. Only a few varieties showed some resistance. The isolate did not attack the other cereals or the grasses tested.

The economic importance of the wheat and grass diseases is discussed.

## INTRODUCTION.

Organisms now referred to the genus *Selenophoma* were at one time described as species of *Septoria*. The genus *Selenophoma* was erected by Maire (1906) and the name taken up by Sprague and Johnson (1940). The papers of these workers (1940, 1945, 1947, 1950) have clarified the position in many respects, particularly regarding the synonymy.

Information in scattered references in the literature on this genus, its distribution, morphology and hosts, is brought together in this paper.

## HISTORY OF THE GENUS ON GRAMINEAE.

*Septoria donacis* Pass. was described in 1878 and 1879 on *Arundo donax* and *Septoria oxyspora* Penz. and Sacc., with slightly different spore widths, in 1884, also on *Arundo donax* (Sprague and Johnson, 1950). Maire (1906) erected the genus *Selenophoma* to cover a pycnidial species, with hyaline, aseptate, curved spores with acute ends.

Grove is cited by McKay (1946) as being apparently the first to record *Septoria oxyspora* from the British Isles in 1910. Stapledon *et al.* (1922) recorded *Septoria culmifida* Karst. on *Alopecurus pratensis*, *Poa trivialis*, *Dactylis glomerata*, *Phleum pratense* and *Arrhenatherum avenaceum* in Britain.

Jørstad (1924, 1930) reported that in Norway *Septoria culmifida* attacked barley and caused severe infection of timothy. Grove (1935) described the symptoms of *Septoria oxyspora* on *Arundo donax* and gave *S. culmifida* Lind. as a synonym. At the same time he described *S. lunata* with smaller and narrower spores as occurring on a grass (? *Festuca*).

Allison (1939) published his studies on *Septoria bromigena* Sacc. isolated from *Bromus inermis*. *B. inermis* was the only susceptible species of 34 bromes tested. Later (Allison, 1945) he could not obtain infection of species of *Agropyron*, *Elymus*, *Hordeum*, *Sitanion*, *Avena*, *Secale* or *Triticum*.

Sprague and Johnson (1940, 1945) stated that they considered that "certain fungi with non-septate falcate spores borne in small globose pycnidia . . . were more logically assigned to *Selenophoma* Maire than to *Septoria* Fries.". Accordingly, *Septoria bromigena*, *S. donacis* and *S. everhartii* became *Selenophoma bromigena*, *S. donacis* and *S. everhartii*. These workers emended the genus to include species with somewhat

obtusely pointed spores, and described a new species, *S. obtusa*. At the same time it was proposed that *Phyllosticta stomaticola* Bäuml. be included in *Selenophoma donacis* as *S. donacis* var. *stomaticola* (Bäuml.), comb. nov.

Sampson and Western (1941) described the lesions on various grasses caused by *Septoria oxyspora* in Britain, and noted that Lind, in 1907, suggested that *Metasphaeria culmifida* Sacc., which he found on dead leaves associated with the *Septoria*, was the perfect stage. Moesz (1941) recorded *Selenophoma calamagrostidis* as causing spotting on leaves of *Calamagrostis epigies* in Latvia.

Fischer *et al.* (1942) published a host and pathogen index to the diseases observed on grasses in certain Western States. Connors and Savile (1943) reported *S. donacis* var. *stomaticola* on barley in Canada.

Frandsen (1943) proposed to separate representatives of a group of *Septoria* species parasitizing grasses with non-septate half-moon or boomerang-shaped conidia, from the genus *Septoria* under the genus *Lunospora*, with *L. oxyspora* as the type species. Petrak (1947) commented that the new genus *Lunospora* of Frandsen was identical with *Selenophoma*. Sprague and Johnson (1950) also stated that they considered that the genus *Lunospora* was founded on essentially the same characteristics as *Selenophoma*, which has priority. They then gave the complete synonymy as they understood it.

McKay (1946) published a study of *Septoria oxyspora*, isolated from diseased barley in Ireland. No infection was obtained on cocksfoot, timothy, oats, rye or wheat. Sprague (1949) recorded *Selenophoma donacis* var. *stomaticola* as occurring on wheat in Washington and Idaho. The fungus was tentatively called Race 12 of the variety *stomaticola*, but was later (Sprague and Johnson, 1950) included in the species. Weiss (1950), in an index of the diseases of Gramineae in the United States, listed those grasses reputed to be hosts of species of *Selenophoma*. Sprague and Johnson (1950) published a study of the species occurring on North American grasses, dealing particularly with the taxonomy, cultural characters and recorded hosts.

Sprague (1950) published further notes on host range studies, which are summarized below.

*S. bromigena*.—*Bromus carinatus* had been found infected, and this increase in host range, it was stated, may be associated with the development of a new race. No cross-inoculation tests, however, had been carried out on *B. inermis*.

*S. donacis*.—No cross-inoculation tests were reported other than those for the isolate from wheat. It was stated, however, that on the basis of single spore cultures there appeared to be several distinct strains, groups or races.

*S. donacis* var. *stomaticola*.—Pure culture studies and examination of collections showed that the variety is divisible into ten major groups, on *Danthonia californica*, *Dactylis glomerata* and *Koeleria cristata*, *Festuca idahoensis*, *Poa pratensis*, *Arrhenatherum elatius*, *Phleum pratense*, *Sporobolus asper*, *Festuca kingii*, *Deschampsia* spp. and *Hordeum* spp. No cross-inoculations were reported other than for the group on *Danthonia*.

*S. everhartii* and *S. obtusa*.—Some of the collections approached the other species and variety. No inoculation tests were reported.

#### AUSTRALIAN RECORDS.

No species of *Septoria* which could be assigned to *Selenophoma* have been located in any reference of Australian fungi, except for a record of *S. nebulosa* Rost. by Brittlebank\* on "Grass stems". The entry concludes with the note "N.S.W. 1895 Sci. Bull. Dept. Agr. No. 46, p. 39, 1934." and "C. C. B. [Brittlebank] Vict.". No record can be found, however, anywhere in the Science Bulletin of *S. nebulosa*.

Sprague (1950) noted that *Septoria nebulosa* Rostr. non Desm., a synonym of *Rhabdospora groenlandica* Lind, belongs to *Selenophoma*, and it is probable that Brittlebank recorded on "Grass stems" what would now be regarded as *S. donacis* var. *stomaticola*. On request, Mr. Fish, Biologist of the Victorian Department of Agriculture,

\* "Catalogue of Australian Fungi", compiled by C. C. Brittlebank between 1910 and 1937.

kindly checked through herbarium material, but no specimen of *Septoria nebulosa* has been retained.

Pollock (1945) published the results of an examination of five shiploads of Australian wheat at Plant Quarantine Station at San Pedro, California. Among the organisms listed on wheat stem and leaf fragments was *Selenophoma* sp. The report stated that wheat was apparently a new host for this fungus.

#### COLLECTIONS, CULTURAL CHARACTERISTICS AND INOCULATION TESTS.

Species of *Selenophoma* have been identified on many native and introduced grasses and one cereal, from New South Wales, Australian Capital Territory, Tasmania, South Australia, Queensland and the Northern Territory.

Collections examined were of two main types:

1. Those with spores falcate to straight, the horns usually of unequal thickness with sharp points, measuring  $16-28 \times 2-4\mu$ . These were assigned to *S. donacis*.

2. Those with falcate spores, symmetrical to slightly irregular in width of the horns, measuring  $(8)-10-16-(20) \times 2\mu$ , with slightly smaller pycnidia than in type 1. These were assigned to *S. donacis* var. *stomaticola*.

None of the collections was assigned to *S. bromigena*, *S. obtusa*, *S. everhartii* or to var. *linearis*, although individual spores in some collections were similar to the published figures of those species.

TABLE 1.  
*Selenophoma donacis* (Pass.) Sprague and A. G. Johnson.

S.U. Acc.	Date.	Collector.	Locality.	Pycnidia. $\mu$	Pycnidiospores. $\mu$
258	6.9.50	A. L. Dyce.	Wallalong, N.S.W.	50-120	(16)-20-26-(28) $\times$ 2-3
703	20.1.52	A. L. Dyce.	Texas, Queensland.	60-110	18-24 $\times$ 2-4
773	12.8.52	D.S.	Gunnedah, N.S.W.	70-110	20-23 $\times$ 3
774	12.8.52	D.S.	Mary's Mount, N.S.W.	85-120	20-24 $\times$ 2.5-3

Cultures were established from most collections, either from pycnidiospores exuded into water and streaked on agar, or from surface-sterilized eyespots, and were maintained on P.D.A. As noted by Sprague and Johnson (1950), cultures were very varied as to texture, colour and pigmentation of the medium. With all isolations the morphology of the conidia from newly established cultures was checked with the morphology of the pycnidiospores from the field. Conidia, particularly of the species, varied considerably in old cultures.

#### *Selenophoma donacis* (Pass.) Sprague and A. G. Johnson.

Collections of this species, as set out in Table 1, were from New South Wales and Queensland, and were heavily infected, showing on the leaves numerous lesions, up to 6 mm. long  $\times$  3 mm. wide, with abundant pycnidia in the centres of the spots. Lesions were less abundant on the sheaths but, when they did occur, were up to 10 mm. long  $\times$  5 mm. wide, with abundant pycnidia in the centres.

The hosts of all four accessions were called "bamboo" in their localities. Miss J. W. Vickery, of the National Herbarium, Botanic Gardens, Sydney, identified the hosts as probably *Arundo donax*, and this was reasonably confirmed when portion of an old head was subsequently found at Texas, Queensland.

Cultures on P.D.A. were slow-growing, at first mucous, pale cream, bearing masses of conidia which varied from  $18 \times 2$  to  $4\mu$ . The spores were falcate to irregular in shape, and the ends were usually pointed. Cultures later turned black with a pale pink spore exudate and a pink tinge in the medium. Cultures from the four accessions were similar in texture, colour and pigmentation of the substrate.

Mature spores from the field were uninucleate. Two nuclei were detected only in dividing spores from culture (Shaw, 1953).

Sprague (1950) has recorded this species, mainly as the small-spored form, on other grasses besides *Arundo donax*, on which it was first described. Therefore as many as possible of these hosts were included in inoculation tests. No clonal material from the four accessions was available for inoculation.

Infection could not be obtained on the following in several tests, using both spores direct from the field, and from culture: *Avena sterilis algeriensis* "Algerian"; *Digitaria sanguinalis*; *Holcus lanatus*; *Hordeum distichon* "Kinver"; *Panicum antidotale*; *Phalaris tuberosa*; *Poa compressa*; *Secale cereale*; *Setaria italica*; *Triticum vulgare* "Federation".

Species of *Avena*, *Panicum*, *Phalaris*, *Poa*, *Secale* and *Triticum* have been recorded as hosts of *S. donacis*, but from these tests it appears that the organism from *Arundo donax* represents a distinct race. Sprague (1950) noted that there appeared to be several distinct strains, groups or races of *S. donacis*, on the basis of single spore cultures. No other inoculation tests have been reported for the organism from *Arundo donax*.

*S. donacis* on Wheat.—A *Selenophoma* on wheat was first reported for the U.S.A. in a preliminary note by Sprague (1949) as the var. *stomaticola*. Later it was placed in the species proper (Sprague, 1950).

An Australian isolate has now been studied, and while it is realized that the American isolate was transferred to the species proper only after much consideration, the writer feels that the local isolate is more readily assigned to the var. *stomaticola* than to the species. The collection is therefore considered in the following section.

*Selenophoma donacis* var. *stomaticola* (Bäuml.) Sprague and A. G. Johnson.

The variety was collected on native and introduced grasses and wheat from New South Wales, Australian Capital Territory, Tasmania, South Australia and the Northern Territory, as set out in Table 2. The hosts, grouped on a tribe basis, were as follows:

Festuceae: *Dactylis glomerata* L., *Festuca elatior* L., \*†"*Poa caespitosa* Forst.", *Vulpia Myuros* (L.) Gmel.

Hordeae: *Agropyron*-wheat hybrid, \**Agropyron scabrum* (Labill.) Beauv., *Triticum vulgare* Host.

Aveneae: \**Amphibromus Neesii* Steud., \**Anisopogon avenaceus* R. Br., \**Danthonia caespitosa* Gaud., \**D. pallida* R. Br., \**D. penicillata* (Labill.) F. Muell., \**D. racemosa* R. Br., *Danthonia* sp.

Agrostideae: \**Aristida vagans* Cav., \**Deyeuxia monticola* var. *valida* (Roem. & Schult.) J. Vickery, \**Dichelachne rara* (R. Br.) J. Vickery, *Phleum pratense* L., *Sporobolus capensis* Kunth., \**S. elongatus* R. Br., \**Stipa aristiglumis* F. Muell., \**S. variabilis* Hugh, *Stipa* sp.

Zoisiaceae: \**Neurachne Muelleri* Hack.

Oryzeae: \**Microlaena stipoides* (Labill.) (R. Br.).

Lesions were of the eye spot or "frog-eye" type, with pale buff to white interiors bounded by distinct reddish-brown to purple borders (Plate ix, 1). They occurred most commonly on the stems, sheaths and leaves, and sometimes on the glumes, as in the case of *Anisopogon avenaceum*. Pycnidia occurred in rows in the buff centres.

In some collections (those of *Microlaena stipoides*, *Deyeuxia monticola* var. *valida* and *Danthonia pallida*) a diffuse reddish tinge surrounded the eyespot. The lesions of *Microlaena stipoides* were of perfectly-formed eyespots, but each lesion was only about 1 mm.  $\times$   $\frac{1}{2}$  mm., so that to the naked eye heavily infected leaves looked as if they had large reddish-brown lesions, which were in reality made up of many small eyespots.

The lesions varied according to the host and the part of the plant infected, but were usually about 3-6 mm. long by 1-2 mm. wide. A few of the accessions (nos. 234, 681, 780, 787, and 802) were of old material, and no spots were evident.

\* Native species.

† "*Poa caespitosa* Forst." is regarded as a complex of Tussock grasses requiring further taxonomic study.