Comparative Pathogenicity of *Septoria nodorum* Isolated from *Triticum aestivum* and *Agropyron* Species

J. M. Krupinsky

Plant pathologist, USDA, ARS, Northern Great Plains Research Center, P.O. Box 459, Mandan, ND 58554.
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ABSTRACT

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Septoria nodorum was isolated from *Agropyron cristatum*, *A. desertorum*, a hybrid of *A. cristatum* × *A. desertorum*, a hybrid of *A. repens* × *A. desertorum*, *A. intermedium*, *A. smithii*, and *Triticum aestivum*. The isolates from *Agropyron* spp. could not be distinguished from isolates from *T. aestivum* in cultural growth, spore production, or size of pycnidiospores. The *S. nodorum* isolates from the *Agropyron* spp. infected wheat plants, but did not induce as much damage as isolates from *T. aestivum*. *S. nodorum* has not been reported previously neither on *A. cristatum*, *A. desertorum*, or *A. intermedium* nor on the two interspecific hybrids.

Septoria nodorum (Berk.) Berk. (perfect state = *Leptosphaeria nodorum* Müller) has been reported on a wide range of gramineous hosts (2,6,12,13). Isolates of *S. nodorum* from wheat, *Triticum aestivum* L., infect alternative hosts (1,3,7,9,14,15). These isolates also change their ability to infect wheat after passage through an alternative host (1,3,7).

Objectives of the present studies were to determine whether or not isolates of *S. nodorum* from naturally infected perennial wheatgrasses (*Agropyron* spp.) could be distinguished from isolates obtained from wheat, and to determine the pathogenicity of these isolates from wheatgrass on wheat.

MATERIALS AND METHODS

Isolates of *S. nodorum* were obtained from wheat and grass samples collected from forage grass breeding nurseries and experimental plots at Mandan, ND. Cultures of *S. nodorum* were maintained on V-8 juice agar (18% V-8 juice, 2 g $CaCO_3$ per liter, 2% agar) at 21 ± 1 C. A 22-hr photoperiod was provided by cool-white fluorescent tubes. Cultures were kept in a sporulating condition by transferring cirrhi every 3 wk.

Spore size. Spore measurements on eight isolates from *T. aestivum* were compared with 12 isolates from *Agropyron* spp., including intermediate wheatgrass, *A. intermedium* (Host.) Beauv.; western wheatgrass, *A. smithii* Rydb.; diploid crested wheatgrass, *A. cristatum* (L.) Gaertn.; tetraploid crested wheatgrass, *A. desertorum* (Link) Schult.; a hybrid of *A. cristatum* × *A. desertorum*; and a hybrid of quackgrass, *A. repens* (L.) Beauv. × *A. desertorum*. One hundred spores of each isolate were measured. The spores were obtained from cirrhi which were either produced on infected leaves incubated on water agar or produced on cultures growing on V-8 juice agar. Slides of spores were prepared with lactophenol mounting medium (11). The coverslips were sealed with clear fingernail polish and the slides were kept at least 24 hr before spores were measured.

Cultural growth. Growth and spore production of isolates of *S. nodorum* from *T. aestivum*, *A. desertorum*, *A. intermedium*, and *A. smithii* were compared on: Difco wort agar (WRA), yeast extract agar (YEA), BBL potato-dextrose agar (PDA), and V-8 juice agar (V-8A) (5). Each combination of medium and isolate was replicated four times. A different set of isolates from the four hosts was used for the growth analysis and the spore production in two tests. All cultures were started with a mass transfer of cirrhi and were grown under cool-white fluorescent light with a 22-hr photoperiod at 21 ± 1 C. Linear growth was determined by measurement of colony diameter 7 and 14 days after transfer. Spore production was measured after 18 days by blending four plates of the same medium and isolate in 500 ml of distilled water. The spore suspension was screened twice through four layers of cheesecloth, then placed on a magnetic stirrer to keep the spores in suspension. Six spore samples from each treatment were counted on a hemacytometer to determine the number of spores per milliliter. An analysis of variance was conducted on colony diameter measurements and spore counts, and comparisons among treatments were made with Tukey's *w* test (10).

Inoculations. Seven isolates of *S. nodorum* were used to inoculate 3-wk old plants of two wheat cultivars, Kitt (CI 17297) and Angus (CI 17744) (Table 1). Each inoculum contained comparable numbers of spores per milliliter ($4.8–7.4 \times 10^6$) in the first inoculation. The spore concentration in the inoculum from the *Agropyron* species was increased to $1.03–3.36 \times 10^7$ in a second inoculation, whereas the inoculum ($4.4–4.6 \times 10^6$) from the *T. aestivum* isolates remained the same (Table 1). After inoculation, the plants were maintained in a plastic chamber in a mist-saturated atmosphere for 48 hr and then moved to a glasshouse bench. Plants were rated for symptoms 12 days after inoculation. The first two leaves of six plants were visually assessed for percent necrosis. The numbers of lesions on the green and chlorotic tissue were counted whereas lesions were not counted on completely necrotic tissue.

RESULTS AND DISCUSSION

S. nodorum was isolated only a few times from leaves of *A. intermedium* and *A. smithii* but was commonly isolated from the leaves and nodes of all the other *Agropyron* spp. and interspecific hybrids included in the study. *S. nodorum* was not reported previously either on *A. cristatum*, *A. desertorum*, or *A. intermedium* or on the two interspecific hybrids.

Spore size. The average size of spores from the *Agropyron* species (16.5×2.2 μm) was slightly smaller than the average spore size of isolates from *T. aestivum* (18.5×2.5 μm), but still within the size range reported by Sprague ($15–32 \times 2–4$ μm) (12) and Jørstad ($12–35 \times 2–3.5$ μm) (4). The only isolates with an average length less than 15 μm were one isolate from *A. intermedium* (14 μm) and one isolate from the *A. repens* × *A. desertorum* hybrid (13 μm).

Cultural growth. Growth and spore production were significantly better on V-8A than on PDA, WRA, or YEA. Isolates from *T. aestivum*, *A. desertorum*, *A. intermedium*, and *A. smithii*

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TABLE 1. Disease ratings on wheat inoculated with isolates of *Septoria nodorum* from wheat and wheatgrasses

Isolate	Isolated from	First leaf[a] (% necrosis)		Second leaf[a] (% necrosis)		Second leaf[b] (Lesions/cm)	
		Kitt	Angus	Kitt	Angus	Kitt	Angus
Study 1							
79-1021	*Agropyron intermedium*	6	19	2	3	1.2	1.6
79-1094-1	*Agropyron smithii*	1	4	0	1	0.1	0.5
79-2794	*Agropyron cristatum*	3	5	0	1	0.5	0.5
79-1090	*Agropyron desertorum* (*A. d.*)	5	4	1	1	1.9	0.6
79-1087	*Agropyron repens* × *A. d.*	4	25	1	2	1.7	1.3
79-2023-1	*Triticum aestivum*	82	87	62	37	24.9	12.2
79-23112	*Triticum aestivum*	93	97	57	45	17.6	13.7
Study 2							
79-1021	*Agropyron intermedium*	82	100	29	75	7.0	11.8
79-1094-1	*Agropyron smithii*	100	75	39	53	3.1	4.2
79-2794	*Agropyron cristatum*	63	87	13	23	2.7	4.1
79-1090	*Agropyron desertorum*	44	87	7	36	1.4	2.4
79-1087	*Agropyron repens* × *A. d.*	75	90	19	43	4.6	3.9
79-2023-1	*Triticum aestivum*	100	100	72	63	18.3	16.3
79-23112	*Triticum aestivum*	100	100	85	78	13.7	13.6

[a] Average of six leaves.
[b] Average number of lesions per square centimeter on green tissue of six leaves. Lesions were not counted on completely necrotic tissue.

could be distinguished from one another within individual studies. When the isolates were ranked according to cultural growth, the ranking was not consistent between the two studies. Considering cultural variability of *S. nodorum* isolates from wheat reported by Scharen and Krupinsky (8), it is not surprising that significant differences were found when comparing isolates from different hosts within a study. A general statement on the cultural growth of all isolates from a particular host is not appropriate because variation among isolates from a single host was as great as variation among isolates from different hosts. There was no significant difference in spore production among isolates from the various hosts. Thus, the isolates of *S. nodorum* from various hosts could not be distinguished based on colony diameter, spore production, or spore size.

Inoculations. More necrosis and more lesions per square centimeter were produced by the isolates of *T. aestivum* than by those of *Agropyron* when inoculum containing comparable levels of viable spores per milliliter were used (Table 1). As the number of spores per milliliter was increased in the inoculum from the *Agropyron* spp., necrosis and lesions per square centimeter increased, but did not reach the level of virulence of the *T. aestivum* isolates. Isolates from the *Agropyron* spp. caused damage comparable to that of the isolates from *T. aestivum* in only three of 20 comparisons of necrosis. Thus, isolates from the *Agropyron* spp. infect wheat, but they induce less damage than isolates from *T. aestivum*. The perennial nature of the wheatgrasses and their presence in wheat growing areas can facilitate overwintering and survival of *S. nodorum* and the grass hosts provide a primary source of inoculum that may be disseminated to wheat. Considering the change in virulence of *S. nodorum* after passage through alternative hosts (1,3,7), it seems likely that after several passages through wheat, the isolates from the *Agropyron* spp. may adapt and increase their virulence. The importance of this initial infection with less virulent isolates of *S. nodorum* from *Agropyron* spp. in the epidemiology of *S. nodorum* on wheat in North Dakota has not been determined.

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