A STEM EYESPOT OF RED FESCUE IN NORTHERN ALBERTA[1]

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Abstract

A stem eyespot of creeping red fescue, Festuca rubra L. subsp. rubra was found affecting all crops of this grass surveyed in the Beaverlodge area of northern Alberta in July 1968 The fungus Phleospora idahoensis Sprague was consistently isolated from lesioned plant material and shown to be pathogenic. It sporulated sparingly in culture. The fungus was isolated from inflorescences, and spores were recovered from seed washings, indicating that the disease may be seed-borne. The disease was more severe in parkland locations than in the open prairie.

In July 1967, a stem eyespot was noted in two seed crops of creeping red fescue, Festuca rubra L. subsp., rubra in the Beaverlodge area in northern Alberta. Both growers reported poor seed yields in the 1966 seed crop. About 11.3 million lb of creeping red fescue seed were produced in Canada in 1967, mostly in the Peace River Region of Alberta and British Columbia. In the 1967/68 crop year[5] 10.8 million lb were exported. The subspecies is used extensively in pastures, for the reclamation of cleared and burned-over bushland in the Black, Transition, and Gray Wooded Soil Zones in some parts of the western provinces of Canada, and for amenity turf (5).

Disease incidence

In mid-July 1968, 20 seed crops of creeping red fescue (comprising about 1000 acres) were examined in the Beaverlodge area and estimates were made of the percentage of infected culms in each (Table 1). Six crops in the open prairie to the south and east of Beaverlodge had less than 5% infection. The remainder, in rolling parkland and cleared bush to the north and east of the center, were more heavily infected

Table 1. Incidence of infected culms in crops of creeping red fescue, 1968

Infection (%)	Number of crops
0	0
1-5	6
6-10	2
11-25	2
26-50	3
51-90	6
91-100	1

On flowering culms, symptoms varied from vague brown or brown-purple spots, linear in outline, through sharp brown linear streaks to clear eyespots with dark brown or purple-brown margins and white or gray-white centers. Lesions usually did not exceed 1 cm in length but were occasionally confluent (Fig. 1). On the exterior of leaf sheaths the outline of a spot was less definite than on the culms (Fig. 2); inside the leaf sheath brown streaking was apparent. On culms which had ceased to elongate, spots on the outside of the sheath corresponded with lesions on the stem inside. On culms which were still elongating, lesions on the exserted stems could be related to those on the leaf sheath through which the stem had grown. Spots occurred on the rachis, rachillae, and glumes of plants in heavily infected crops. Leaf blade lesions were infrequent.

Pathogen

A fungus was found associated with stem, sheath, and inflorescence lesions. No spores or

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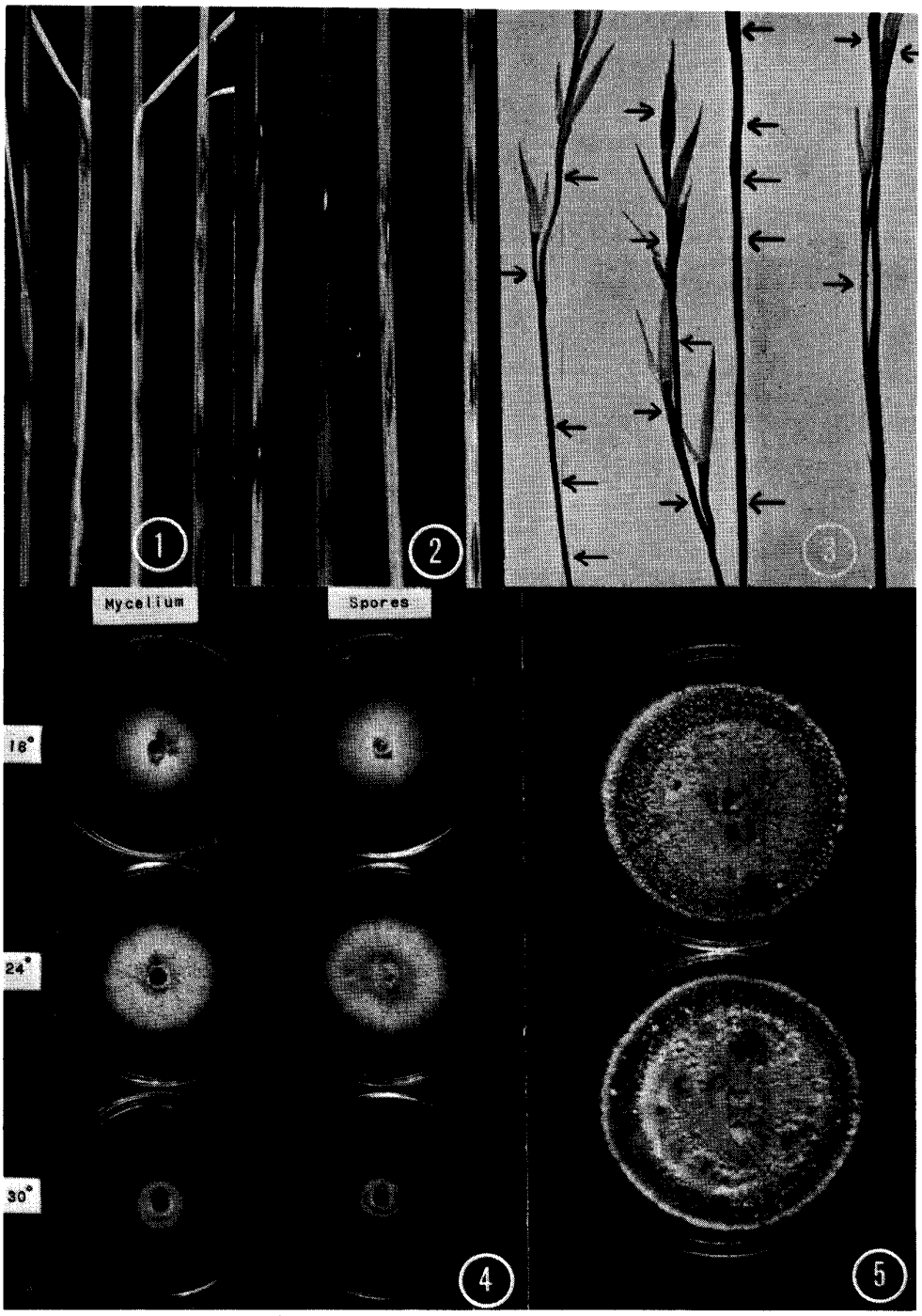
[5] Crop years ending 30 June. Data from Plant Products Division, Production and Marketing Branch, Canada Department of Agriculture, Ottawa.



Figures 1–3. Lesions on 1) leaf sheaths, 2) culms, and 3) inflorescences of *Festuca rubra*. Figure 4. Growth of mycelial and spore isolates of Phleospora idohoensis on PDA at three temperatures. Figure 5. Spore isolate (upper) and mycelial isolate (lower) on PDA, showing stromatic cushions. (Figures 1–5. Francis Dolezsar)

sporophores were seen on field material in 1967. In 1968, a few pink spore masses were found on a lesioned culm and an inflorescence in fresh samples from two of the 20 crops. Pycnidia were found, eventually, by sectioning through the dried spore mass on a stem lesion. Spores were found in washings of seeds from heavily infected culms. Occasional spores were found in five of 40 commercial seed samples from the Beaverlodge area in 1968.

After incubation of diseased stems in a moist chamber, the superficial mycelium could be picked from "clean" eyespot lesions with a sterile needle. The fungus was readily isolated by plating fragments, from sheath and inflorescence lesions after surface sterilization with 70% alchol, on potato dextrose agar (PDA) containing 50 µg/ml streptomycin and vancomycin. The fungus made satisfactory vegetative growth on a wide range of natural, semi-defined, and defined media. Growth was not enhanced in six isolates by riboflavin, nictoinic acid, pyridoxine, thiamine, biotin, folic acid, pantothenic acid, p-amino-benzoic acid and yeast nucleic acid when these were incorporated in minimal medium (10). The optimum temperature for growth in six isolates was about 24C; **some** growth occurred at 3C and 30C on minimal medium and PDA (Fig. **4).**

Colonies on PDA in petri dishes were at first white, later gray-white with occasional faint green, yellow or brown tints in the aerial mycelium. Small white stromatic cushions of mycelium developed behind the advancing margin as the colonies aged (Fig. 5). The surfaces of older colonies in tubes became crenellated, and, as they aged, the bases darkened through light brown to creosote brown. **A** brown pigment diffused into the medium of older cultures when the fungus was grown at 18C and above. Dark chestnut-brown sectors commonly occurred and brown drops of exudate appeared on them. The fungus did not penetrate deeply into agar media and it grew superficially on sterile straws. Racquet-cells developed in culture. In water agar, seeded with inoculated straw, mycelial loops developed; these were precursors of stromatic cushions. Single-spore isolates produced colonies indistinguishable morphologically from those of mycelial origin (Figs. **4,** 5), even to the extent of producing chestnut-brown sectors. Cultures made from approximately 150 isolates in 1967 and 1968 had a similar morphology. Pycnidia and spores developed sparingly in culture.*

Mycelium on the lesions was mostly superficial, hyaline, septate, without clamps, much branched, thin-walled, sharply curved towards the tips, and 1.0-1.5 µ in diameter.

Pycnidia were inconspicuous, immersed, intraepidermal, globose, 100-150 µ diam., with a small circular opening (Fig. 6). The pycnidium wall consisted of two layers of thin-walled, yellow rectangular cells 6-8 x 3-5µ. Conidiophores were hyaline, slightly curved, thin-walled, mostly aseptate, rarely 1- or 3-septate, 30-62 x (3) 5-6 µ, pointed at the apex, truncate at the base with an inconspicuous scar, with finely granular cytoplasm when observed in water, and with guttules when mounted in lactic acid (Fig. 7). Conidia accumulated in a slimy white to pink mass outside the pycnidium and provided the best indication of the location of the easily overlooked pycnidia. Conidia germinated from either or both ends within 12 hours on PDA at room temperature.

The fungus matched well the original description and illustration given by Sprague (12) but was not compared with the type. It was distinct from two other Phleospora species: P. graminearum Sprague & Hardison on Agropyron repens (L.) Beauv. and Elymus canadensis L., and P. muhlenbergiae Sprague & Solheim in Solheim on Muhlenbergia arizonica Scribn., particularly in spore color, size, and septation (13).

Pycnidia were not obvious or abundant on heavily infected flowering stems of F. rubra subsp. rubra collected in mid-July at Beaverlodge. These structures may have just commenced development then. However, they have not yetbeenfoundon overwintered potted material with abundant stem spots.

Pathogenicity tests

Lesions similar to those occurring on plants in the field developed on flowering culms of F. rubra and F. ovina following inoculation. Fragments of mycelium from cultures of several isolates were placed on moist cotton gauze. The gauze was applied to the culm and fastened with masking tape. Lesions developed after incubation for 7 days in an illuminated moist chamber in the greenhouse. Check culms showed no lesions. The fungus was reisolated from the infected tissues.

Discussion

The disease was probably responsible for considerable reductions in seed yield of some creeping red fescue crops. Three experienced growers in the Beaverlodge area in whose crops the disease was found, reported that potential seed yields of about 600 lb/ac were reduced to less than 300 lb in 1968. More extensive, detailed surveys in the seed growing areas in western Canada are indicated, since the

* A few pycnidia and spores developed in about 5% of the isolates from refrigerated culm material in February 1969. Isolation was effected on PDA containing vancomycin and streptomycin; and spores developed in the first subculture on slopes of lima bean agar after 14 days' growth at 18C in 12 hr fluorescent light. Spore morphology in culture was similar to that reported from plant material (JDS).

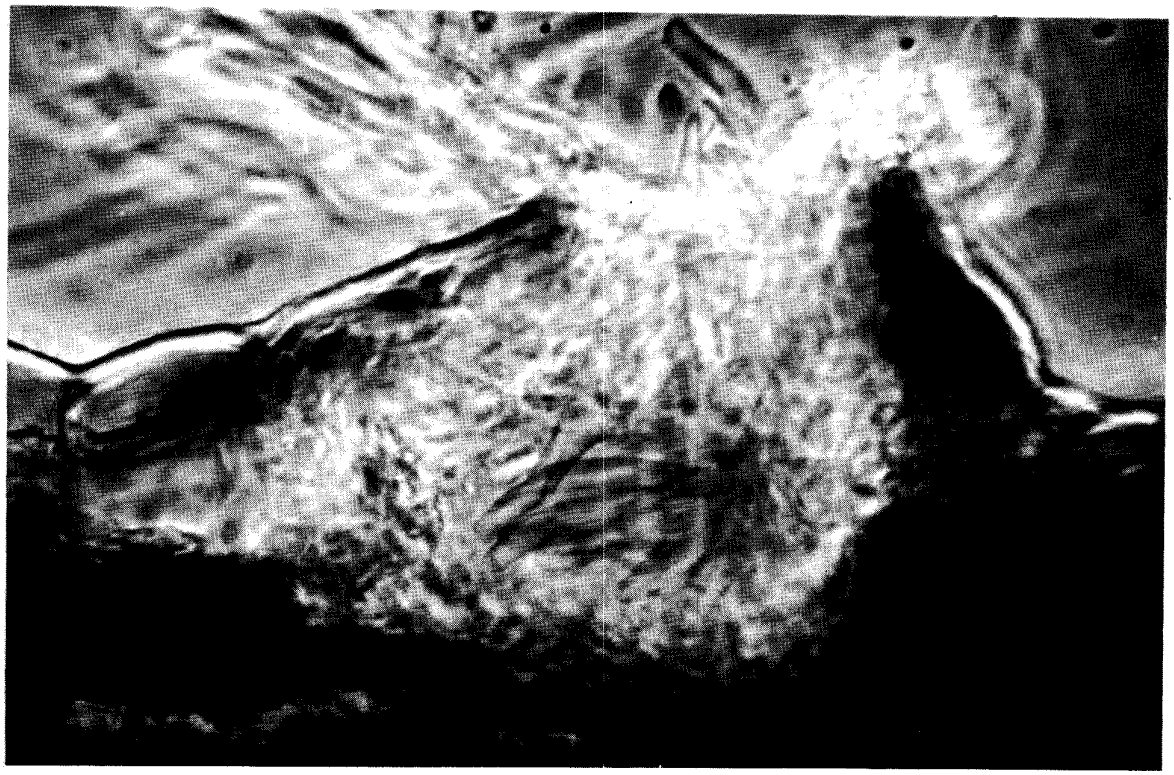


Figure 6. Intraepidermal pycnidium and spores (x1000).

disease may be of considerable economic importance.

Spores of the fungus were found in seed washings, indicating that the disease is potentially seedborne. However, the paucity of spores of P. idahoensis in concentrated washings compared with the abundance of spores of such pathogens as Selenophoma spp. and Colletotrichum graminicola (Ces.) Wils. suggests a low risk of seed transmission of the disease.

The severity of the disease on crops of creeping red fescue appeared to be related to microclimate. Crops in the more sheltered rolling parkland and cleared bush, where the evaporation ratr is usually lower, were more severely affected than those in the open prairie.

P. idahornsis was first described on F. idahoensis Elmer (8) from Idaho in 1948 (12). The next record was on F. elatior and F. rubra from Alaska in 1955 (14). It was not recorded in Canada (3).

The sudden appearance of this severe diseasr is of considerable epidemiological interest. The

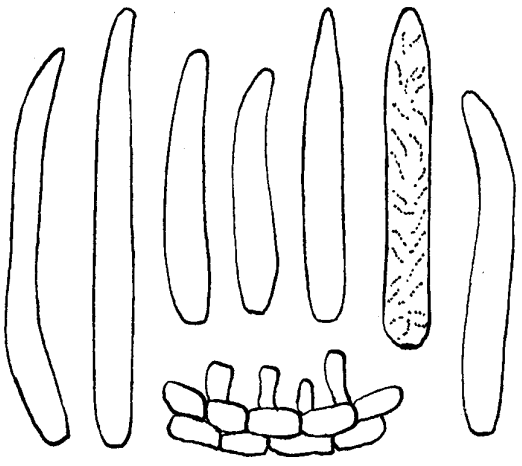


Figure 7. Pycnidium wall cells, conidiophores, and conidia (x1000).
Figures 6 and 7 from DAOM 126188.

possibility that the pathogen is endemic on the native F. idahoensis and F. scabrella in the western prairies (2, 4, 7) should be examined. Since F. rubra subsp. rubra is an introduction (5), the native fescues may be the original source of inoculum. Infected F. idahoensis, the dominant species in the Palouse prairie of western Idaho and Eastern Washington (2), was reported to be localized in this zone in the area west of Yellowstone National Park (12). However, the distribution of the pathogen, as Sprague (loc cit) comments, "remains somewhat of a mystery:' There is a floristic continuity from the Palouse prairie through the valleys of British Columbia and mountain passes into Montana and southern Alberta (7, 11). It has been suggested that many of our Canadian species have moved in through this route (7). Their pathogens may have moved in with them. F. scabrella is the dominant species in the native grasslands of central and southwestern Alberta, taking the place of the F. idahoensis of the Palouse prairie in the south (7). The F. scabrella association extends into the mixed prairie of the parkland belt of Alberta and Saskatchewan, but the Peace River grasslands lack F. scabrella (6). Both F. scabrella and F. idahoensis are found together in the Cypress Hills of southeastern Alberta and southwestern Saskatchewan (1). It may be rewarding from an ecological and epidemiological standpoint to determine the distribution of P. idahoensis on the native fescues in Saskatchewan, Alberta, and British Columbia.

Studies have commenced on the control of the pathogen by crop sanitation and the development of resistant varieties.

Acknowledgments

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