Incidence of Cephalosporium Stripe as Influenced by Winter Wheat Management Practices

R. X. LATIN, Visiting Assistant Professor of Plant Pathology, R. W. HARDER, Professor of Soil Science, and M. V. WIESE, Professor of Crop Loss Research, Department of Plant and Soil Sciences, University of Idaho, Moscow 83843

ABSTRACT

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The incidence of Cephalosporium stripe was related to selected winter wheat management practices prevalent in the Palouse region of northern Idaho and eastern Washington in 1980. A study of rotation sequence, tillage method, cultivar, and the amount of nitrogen fertilizer applied was conducted in field plots seeded in a split plot, split block experimental design. Disease incidence was measured at the early milk stage and expressed as the percentage of tillers exhibiting symptoms of Cephalosporium stripe. The greatest differences in stripe incidence occurred among rotation and tillage factors. A 2-yr, winter wheat/spring pea rotation showed higher disease incidence than 3-yr rotations. Among tillage practices, Cephalosporium stripe was most severe in no-till and decreased progressively in minimal and conventional tillage plots.

Cephalosporium gramineum Nis. and Ika. (syn. *Hymenula cerealis* Ell. and Ev.) is a fungal pathogen of winter wheat and an inhabitant of soils in the Palouse region of northern Idaho and eastern Washington (1,2). It enters wheat and other gramineous hosts through injured or broken roots and establishes itself as a systemic pathogen readily colonizing vascular tissues of the culm and leaves (1,7,9,12,13). Symptoms of infection are longitudinal, chlorotic stripes on culms and leaves. The pathogen survives as a saprophyte in host residues, especially wheat straw, on or near the soil surface (4,14).

Various environmental and cultural factors affect the severity of Cephalosporium stripe in winter wheat fields. Poorly drained soils, continuous wheat-fallow rotations, early seeding, and conditions promoting abundant autumn root growth contribute to increased stripe development (1,5,9). Reduction of inoculum by deep plowing and burning or removal of infested crop residue decreases stripe incidence in subsequent host crops (9,14).

In northern Idaho and adjacent areas of Washington, winter wheat is most often grown in rotation with spring peas, lentils, or (in alternate years) following summer fallow. To a lesser extent, winter wheat is grown every third year following spring peas, spring wheat, spring barley and/or alfalfa, or summer fallow. Various tillage systems are also used in connection with soil conservation efforts. Because such cultural practices may influence disease development and yield losses caused by Cephalosporium stripe (3,10), this investigation evaluated Cephalosporium stripe incidence in winter wheat relative to rotation sequence, tillage practice, cultivar selection, and nitrogen fertilization. The study was prompted by the increased use of reduced tillage practices in recent years and by repeated observation of differential levels of Cephalosporium stripe in Palouse area wheat fields.

Current address of senior author: Department of Botany and Plant Pathology, Purdue University, West Lafayette, IN 47907.

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MATERIALS AND METHODS

In 1980, incidence of Cephalosporium stripe was evaluated in replicated winter wheat field plots that were seeded in a split plot, split block design. Rotation sequences and tillage practices served as whole plots, and cultivars and nitrogen fertilizer rates served as split plots. Rotations included winter wheat/spring pea, winter wheat/spring wheat/spring pea, and winter wheat/alfalfa + red clover + spring pea/alfalfa + red clover. All winter wheat plots were sown between 12 and 15 October 1979

The tillage practices in this study were conventional (moldboard plow, disc, and harrow), minimal (chisel planter [8]), and no-till (John Deere Power-Till Drill, John Deere Co., Moline, IL 61265). The winter wheat (*Triticum aestivum* L.) cultivars included Nugaines (CI 13968), Stephens (CI 17596), Daws (CI 17419), Luke (CI 14586), and McDermid (CI 14565).

Fertilizer (27-12-0-4 NPKS) was applied at 101 kg of nitrogen per hectare on all winter wheat plots in autumn. Additional nitrogen at rates of 17 and 34 kg/ha was applied in spring to all conventional and minimum tillage plots to create subplots with 101, 118, and 134 kg N/ha. Nitrogen was added at 28 and 56 kg/ha to no-till plots in spring to create subplots of 101, 129, and 157 kg N/ha.

Each experimental unit consisted of a 2.4-m strip of a single cultivar measuring 9.14 m in length. Plants were left to natural infection, and disease was evaluated by assessing the incidence of stripe symptoms at growth stage 73 (15) (early milk) on ten tillers at five locations in each experimental unit. Disease was assessed between 16 and 18 June 1980. Data were analyzed using SAS (11) packaged statistical programs.

RESULTS

Both rotation and tillage factors had significant ($P \leqslant 0.01$) effects on Cephalosporium stripe incidence. The interaction between these factors was also significant ($P \leqslant 0.01$). The 2-yr wheat/spring pea rotation resulted in the highest stripe incidence regardless of tillage practice (Fig. 1). When considered in combination with tillage practices, this rotation resulted in 33, 22, and 11% stripe incidence for no-till, minimal, and conventional tillage, respectively. All rotation-tillage combinations comprising rotations 2 and 3 (wheat seeded every third year) resulted in less than 10% and, in most cases, less than 3% stripe incidence (Fig. 1). Resultant disease incidences for all tillage practices under rotation 1 (2-yr, wheat/spring pea rotation) were significantly different ($P \leqslant 0.05$) from each other.

Significant ($P \leqslant 0.05$) differences were also observed among cultivars, and a significant ($P \leqslant 0.05$) cultivar × rotation interaction was identified (Fig. 2). Nugaines had the lowest percentage of stripe (17%) among cultivars under the disease-prone 2-yr rotation. Stripe incidence on Daws and Stephens under the 2-yr rotation (21%) was intermediate, whereas it was most severe on Luke and McDermid (26 and 25%, respectively).

The amount of applied nitrogen appeared to have no measurable effect on Cephalosporium stripe incidence, and

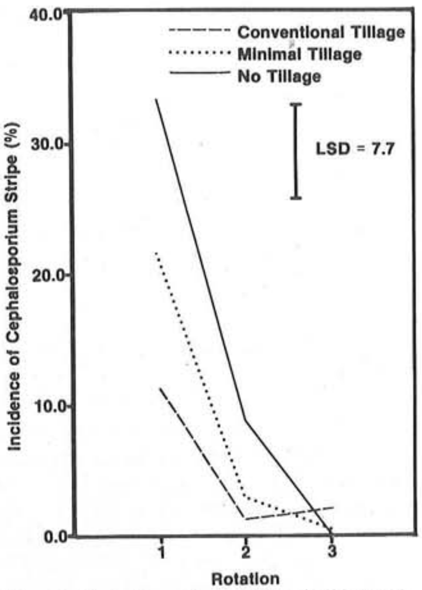

Fig. 1. Cephalosporium stripe incidence in nine rotation-tillage combinations. Rotation 1 = winter wheat/spring pea, 2 = winter wheat/spring wheat/spring pea, 3 = winter wheat/alfalfa + red clover + spring pea/alfalfa + red clover.

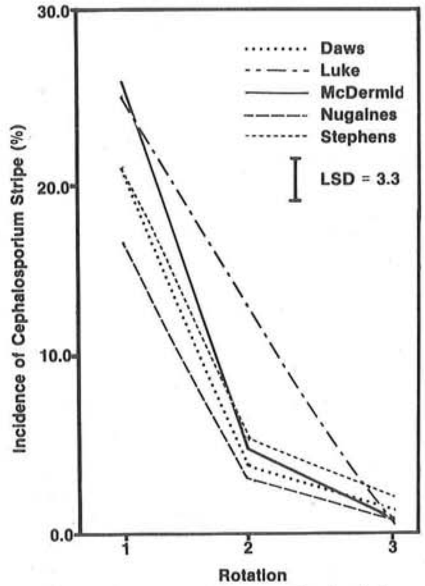

Fig. 2. Cephalosporium stripe incidence assessed in five winter wheat cultivars grown in three rotations. Rotation 1 = winter wheat/spring pea, 2 = winter wheat/spring wheat/spring pea, 3 = winter wheat/alfalfa + red clover + spring pea/alfalfa + red clover.

cultivar × tillage interactions were not significant ($P \geqslant 0.13$).

DISCUSSION

Wiese and Ravenscroft (14) suggested that Cephalosporium stripe can be controlled by cultural practices that increase the decomposition of, or eliminate, infested host residue at or near the soil surface. Longer rotations with nonhost crops generally result in reduced stripe relative to wheat-on-wheat culture (14). Results presented here are consistent with those findings in that winter wheat in the 3-yr rotations supported significantly less disease than wheat grown in the 2-yr rotation. The longer rotation sequence apparently reduced levels of initial inoculum.

The lower incidence of stripe symptoms on cultivars such as Nugaines suggests that retarded disease development on certain host genotypes can also contribute to reduced inoculum levels and, possibly, reduced stripe incidence in subsequent wheat crops. This is supported by the research of Morton and Mathre (6) and by our repeated observations in commercial wheat fields, where areas previously seeded to Nugaines sustained less disease in the subsequent wheat crop than similar areas seeded to more susceptible cultivars. Stripe resistance in Nugaines, however, does not appear sufficient to preclude serious losses to stripe under conditions favorable for disease development.

Current tillage methods devised to reduce soil erosion in the Palouse region may aggravate attempts to reduce inoculum levels and the incidence of Cephalosporium stripe (Fig. 1). Relative to conventional tillage, no-till and minimal tillage operations retain more host residue at or near the soil surface. Thus, more substrate for saprophytic survival of the pathogen would be available, and higher initial inoculum levels would be maintained (14).

Because of significant soil erosion problems in this part of the Pacific Northwest, soil conservation must maintain high priority in winter wheat management strategies. From this standpoint, minimal tillage has promise especially when combined with longer rotations, resistant wheat cultivars, and nonhost crops. Wheat management systems that favor both disease control and soil conservation are needed. Also, a more precise description of pathogen population growth and survival (14) might give justification to control methods aimed at reducing initial inoculum.

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