OVERWINTERING OF ERYSIPHE GRAMINIS F. SP. TRITICI ON MARITIME GROWN WINTER WHEAT[1]

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Abstract

Primary infection of winter wheat (Triticum aestivum) by Erysiphe graminis f. sp. tritici was observed to take place in October. The pathogen was capable of overwintering as conidia on the leaves providing the host did not winterkill. The recommendation is made that varieties of winter wheat resistant to powdery mildew should be available before any increase in winter wheat acreage occurs in the Maritime Provinces.

Resume

On a constaté que l'infection primaire du blé d'hiver par Erysiphe graminis f. sp. tritici survenait en octobre. L'organisme pathogène a pu hiverner sous forme de conidies sur les feuilles, pourvu que l'hôte n'était pas détruit par l'hiver. On recommande que des variétés de blé d'hiver résistantes au blanc soient rendues disponibles avant qu'on envisage une augmentation des superficies en blé dans les provinces Maritimes.

Powdery mildew of wheat (Triticum aestivum L.) incited by Erysiphe graminis DC. ex Merat f. sp. tritici Marchal has existed in eastern Canada for many years and is one of the major diseases on both spring and fall seeded wheat in the Maritime Provinces (3, 4, 9). Investigators in both Europe and North America have reported the overwintering of E. graminis as conidia on winter barley and on winter wheat (8, 11), but contradictory reports are also present (6). Several European authors have reported that ascospores discharged in spring from overwintered perethecia are largely ineffective in inciting primary infections and that overwintering conidia may be the more effective incitant (7, 12, 17).

Simultaneous cultivation of winter wheat and spring wheat in the same locality may provide an ideal environment for severe outbreaks of powdery mildew if the pathogen utilizes the autumn seeded wheat as a 'green-bridge'. Large amounts of inoculum produced on winter wheat in the spring may enhance disease severity in spring sown wheats, as has occurred with winter and spring barleys in Europe (8). The purpose of the studies described herein was to determine if fall sown wheat was serving as an overwintering host for powdery mildew in Prince Edward Island and thus perhaps increasing the disease severity on wheat seeded the following spring.

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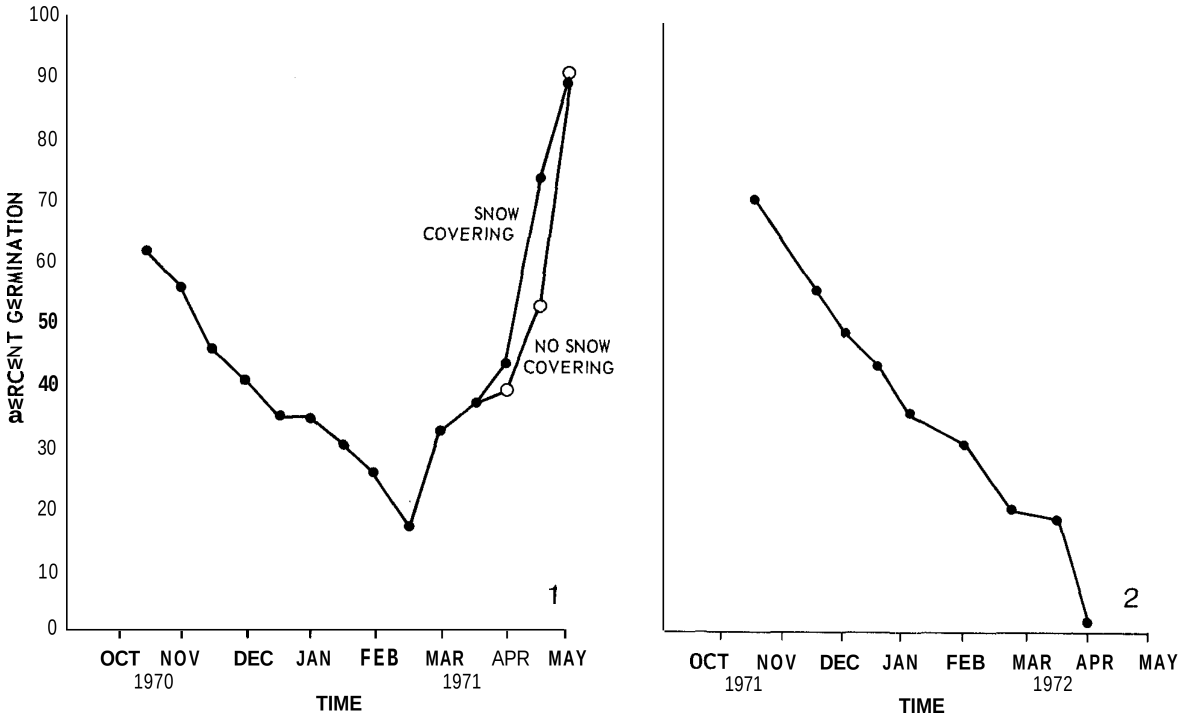
Materials and methods

Observations on the overwintering of the pathogen were carried out for 3 years on winter wheat, cultivar Yorkstar, which was sown by September 15 of each year near Charlottetown, Prince Edward Island. Initial collections of winter wheat leaves were made in early October and sampling was continued bi-weekly until mid-April of the following year. The wheat leaves collected were subjected to a 2-hour thawing period at room temperature, and were then placed on 2% water agar. On removal of the leaves, the viability of the conidia remaining on the agar was assessed by the percent germination after incubation for 48 h. For each determination of viability 4 counts of 50 spores were used. A conidium was considered to have germinated if the germ tube was equal in length to the width of the spore after 48 h on agar. Only single isolated spores were considered.

In the summers of 1971, 1972, and 1973, the severity of mildew was assessed on a number of spring wheat cultivars at charlottetown, P.E.I., and Kentville, N. S., by estimating the percent area of the flag and second leaves mildewed at the milky ripe stage of development. These estimates were then compared to winter survival data of the wheat.



Figures 1 and 2. Viability of powdery mildew conidia during the overwintering period 1) 1970-71, 2) 1971-72.

Results and discussion

No perithecia were found on leaves collected from the field; abundant lesions were found each season, but only mycelium and conidia were produced.

The germination of overwintering conidia in 1970-71 ranged from a high of 61% in November to a low of 16% in February (Fig. 1). conidia collected in April, however, did exhibit rapid germination. The mean minimum and maximum air temperatures during January were -13.7 C and -5.7 C respectively, the mean temperature being -9.7 C. February was a warmer month, the mean minimum and maximum air temperatures being -11.0 C and -8.9 C, respectively. Soil temperatures at a depth of 5 cm were higher and showed less variation than air temperatures, with mean monthly values of 1.1 C and 0.6 C during these two months, respectively. snowfall during the entire winter was 245 cm and very little exposure of the wheat crop took place (1). During spring thaws, more conidia were viable from leaves which had snow cover for a longer period of time than from leaves exposed directly to fluctuating air temperatures.

During 1971-72, germination of conidia ranged from a high of 72% in mid-October to a low approaching zero in early April, after which no conidial germination was detected (Fig. 2). Weather conditions in the 1971-72 winter were much more severe than in the previous year with mean minimum and mean maximum air temperatures in February of -13.0 C and -4.8 C, respectively, the average temperature being -9.2 C (2). Although these temperatures were not lower than the previous year, snow cover was minimal during the first month of the year. Lack of a snow cover during January and February of 1972 was considered to be correlated with a lower soil temperature at the 5 cm soil depth than in the comparable period of 1971. Thus, although air temperatures were considered similar from year to year, the year when mildew survival was greatest coincided with adequate snow cover to enable survival of the plant itself. Lack of winter survival of the mildew spores in 1972 was therefore attributed to the winterkilling of the wheat plants.

survival of the mildew fungus during the winter of 1972-73 was very similar to that in 1970-71. Mildew conidia remained viable throughout the winter and winterkill was limited to land areas unsuited to winter wheat. The low period of conidial germination was found to occur in early March when over 32% of the conidia were viable on water agar. The increased conidial germination observed an April could have been due to the production of new conidia.

At Kentville, N. S., powdery mildew was found to be more severe on spring sown wheat in 1972 than at Charlottetown where no winter wheat survived in 1971-72. In the other two years of observation mildew was also more severe at Kentville but there was less disparity between the two locations. severity of mildew recorded on Selkirk spring wheat at Charlottetown was 66%, 40%, and 93% of that recorded on the same variety at Kentville in 1971, 1972, and 1973, respectively. The Annapolis Valley has had a history of better winter wheat survival as compared to the Charlottetown area, and the greater severity of mildew at Kentville may perhaps be attributed to the availability early in the spring of inoculum that has overwintered on winter wheat.

Finney and Hall (5) have reported that fall infection of winter barley by powdery mildew reduces the production of adventitious roots. Lack of adequate root development in winter wheat infected by mildew may well be an important factor in the overwintering of this crop in the Maritime Provinces (16). Roots of wheat plants were not examined in the present study.

Infection data obtained through growing winter and spring cereals at the same locale was reported by smith & Davis (13) who found that the presence of an adjacent infected winter barley crop raised the number of air-borne powdery mildew spores over adjacent spring barley crops by 5-6 fold. Increases in disease severity are also directly related to the number of spores above the spring cereal crop (10).

In the Maritime Provinces, winter wheat will outyield spring wheat in years when winterkill is limited. A similar situation exists in Denmark with winter barley (13, 14). The success of the banning of winter barley cultivation in Denmark has been encumbered by the introduction of wind-blown mildew spores from neighboring countries (15). The use of mildew resistant winter wheats in the Maritimes would be a more practical means of reducing high levels of inoculum. The production cf mildew resistant winter wheat is considered necessary since the acreage devoted to this winter crop is still very low and should it increase before the introduction of resistant varieties, control of this disease in both winter and spring wheats would be more difficult in future years.

Acknowledgments

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Literature cited

1. Charlottetown Research Station. 1971. Weather data.

2. Charlottetown Research Station. 1972. Weather data.

3. Cherewick, W.J. 1944. studies on the biology of Erysiphe graminis DC. Can. J. Res. 22:52-86.

4. Dimitriou, G. 1909. The mildew Of cereals. First Annual Report, Quebec Soc. for the protection of plants from Insects and Fungus Disease, p. 16-19.

5. Finney, J. R., and D. W. Hall. 1972. The effect of an attack of mildew (Erysiphe graminis) on the growth and development of winter barley. Plant Pathol. 21:73-16.

6. Foster, W. R., and A. W. Winter. 1937. Overwintering of certain cereal pathogens in Alberta. Can. J. Res. C. 22:547-559.

7. Hermansen, J. E. 1964. Notes on the appearance of rusts and mildew on barley in Denmark during the years 1961-1963. Acta Agr. Scan. 14:33-51.

8. Hermansen, J. E. 1968. studies on the spread and survival of cereal rust and mildew diseases in Denmark. contribution 87, Dep. Plant Pathol., Royal Veterinary and Agricultural college, Copenhagen, 206 p.

9. Johnston, H. W. 1969. Disease of cereals in the Maritime Provinces in 1969. Can. Plant Dis. Surv. 49:122-125.

10. Polley, R. W., and J. E. King. 1973. A preliminary proposal for the detection of barley mildew infection periods. Plant Pathol. 22: 11-16.

11. Powers, H. R. 1957. Overwintering and spread of wheat powdery mildew in 1957. Plant Dis. Rep. 41:845-847.

12. smedegard-Peterson, V. 1967. studies on Erysiphe graminis DC. with a special view of the importance of the perithecia for attacks on barley and wheat in Denmark. Kgl. Vet. & Landohojskole Arssk, 1967: 1-28.

13. Smith, L. P., and R. R. Davies. 1973. Weather conditions and spore trap catches of barley mildew. Plant Pathol. 22: 1-10.

14. Stapel, Chr. 1966. Growing of winter barley in Denmark. Tidsskrift f. Landokonomi, 1966:67-84 (English summary).

15. Stapel, Chr., and J. E. Hermansen. 1968. Growing of winter barley forbidden in Denmark. Tiddskrift f. Landokonomi, 1968:218-230.

16. Suzuki, Michio. 1972. Winterkill patterns of forage crops and winter wheats in P. E. I. in 1972. Can. Plant Dis. Surv. 52: 150-159.

17. Turner, Dorothy M. 1956. studies on cereal mildew in Britain. Trans. Brit. Mycol. Soc. 39:495-509.