STEM RUST OF OATS IN CANADA IN 1967[1]

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Disease development and crop losses in Western Canada

Stem rust of oats caused by Puccinia graminis Pers. f. sp. avenae Erikss. and Henn. was less prevalent in Western Canada in 1967 than in any other year since 1961. Stem rust was first found in Manitoba on July 17. It developed slowly, and very few fields suffered significant losses in yield. No rust was found in Alberta or Saskatchewan.

Uniform rust nurseries

Rust nurseries consisting of 10 oat varieties were grown at 36 locations across Canada (Table 1) by cooperators at universities and Canada Department of Agriculture stations. The plants were sent to Winnipeg to be rated for disease. No stem rust was observed on nurseries west of Manitoba or east of Quebec. In Manitoba plants at only one nursery showed light infections. In Ontario and Quebec

Table 1. Percentage infection by Puccinia graminis f. sp. avenae on 10 oat varieties at 10 uniform rust nurseries* in Canada, 1967

Locality				Ceirc du Bac	Saia	Rodney ABDH	C.I. 3			
Morden, Man.	15	10	tr**	tr	0	0	0	0	tr	0
Alfred, Ont.	10	0	0	O	O	O	O	t r	O	0
Kemptville, Ont.	tr	0	0	O	O	O	O	t r	O	0
Fort William, Ont.	tr	0	0	0	0	0	0	0	0	0
Guelph, Ont.	20	60	25	20	0	1	3	3	tr-1	1
Ottawa, Ont.	2	0	0	0	0	tr	0	tr	2	0
Appleton, Ont.	tr	0	0	0	0	0	0	0	tr	0
St. Catherines, Ont.	0	0	tr	0	0	1	0	0	0	0
La Pocatière, Que.	5	15	5	5	0	0	0	2	0	0
Macdonald College, Que.	25	5	5	0	0	5	0	5	5	0

* No rust was observed in 26 other nurseries located at Agassiz, Creston, and Saanichton, B. C.; Beaverlodge, Edmonton, Lacombe, and Lethbridge, Alta.; Indian Head, Melfort and Scott, Sask.; Brandon, Glenlea, The Pas and Winnipeg, Man.; Verner, Williamstown, Douglas and Kapuskasing, Ont.; Quebec, Lennoxville, L'Assomption and Normandin, Que.; Kcntville and Truro, N. S.: Fredericton, N. B.: and St. John's, Nfld.

** tr = trace infection

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plants in six nurseries showed trace to light infections, and plants in two others had light to moderate infections.

Identification and distribution of physiologic races

Physiologic races were identified by their reactions on inoculated seedlings of the varieties 'Richland' (rust resistance gene Pg-2), 'Rodney! (Pg-4), 'Minrus' (Pg-1), 'Jostrain' (Pg-3), 'Eagle2 x C. I. 4023' (pg-8), and 'C. I. 5844-1' (pg-9). The designation of races by formula number (Table 2) follows the system of nomenclature now in use in Canada (1, 2). The alphabetical designations formerly used for stem rust resistance genes have been changed to conform to the standardized system proposed by Simons et al. (3). Both the old and the new designations for physiologic races of the pathogen and for resistance genes in the host are shown in Table 2.

A supplementary set of differential hosts composed of the varieties 'Rosen's Mutant', 'Saia', and 'C. I. 3034' was also used. The rust reactions of 'Rosen's Mutant' were similar to those of 'C. I. 5844-1' but were slightly more resistant. 'Saia' was resistant to all collections except one from Ontario. Reactions of 'C. I. 3034' in the seedling stage were similar to those of 'Minrus'.

Physiologic race C10 continues to predominate (66% of isolates) in Western Canada; races C3 (20%) and C5 (14%) comprised the remainder (Table 2). In Eastern Canada the race distribution changed relatively little during the period 1958 to 1966, when C9 and closely related races were prevalent. A shift appears to have occurred in 1967. In Ontario C9 was still the most prevalent race, but 47% of the isolates were of western affinity (races C3, C5, and C10). The shift, if it occurred, may have resulted from the barberry eradication program in Ontario. However, the population sample is too small to demonstrate conclusively that a major shift has occurred.

Virulence range of the pathogen population

Most of the pathogen population carries virulence capabilities that are apparently not necessary for the survival of the fungus in North America (Table 3). For instance, over 95% of the population is virulent on gene Pg-3 resistance, but significant amounts of this type of resistance are not known to have been present at any time in the host population in Canada or in the primary inoculum area to the south. Similarly, over half the pathogen population is able to attack pg-8 resistance, a form not known to have occurred in the host population. Virulence on pg-8 resistance does not appear to be associated with factors essential to survival, because races C3 (avirulent on pg-8) and C5 (virulent on pg-8) have coexisted for many years. Also, there is no obvious reason why 70% of the rust population in Eastern Canada is virulent on pg-9 resistance, because there has been no selection pressure for virulence to pg-9. While races capable of overcoming only the Pg-2 and Pg-4 types of resistance would be

Table 2. Distribution by provinces of physiologic races of Puccinia graminis f. sp. avenae isolated in Canada in 1967

Race		Virulence formula (effective/ineffective host genes)		Number of isolates from:				
Formula no.	Former designation	Pg gene designation	Alphabetical gene designation	Manitoba	Ontario	Quebec	Total isolates	Percentage of total isolates
c 3	7A-12A	2, 8/1, 3, 4, 9	AF/BDEH	12	1	0	13	16.5
c 5	6F	4, 9/1, 2, 3, 8	BH/ADEF	8	2	0	10	12.6
C6	8A-10A	1, 8/2, 3, 4, 9	DE/ABEH	0	1	0	1	1.3
c 9	6A-13A	8/1, 2, 3, 4, 9	F/ABDEH	0	7	4	11	13.9
C10	6AF	9/1, 2, 3, 4, 8	H/ABDEF	39	4	0	43	54.4
C17	11A	1, 3, 8/2, 4, 9	DEF/ABH	0	0	1	1	1.3
Total				59	15	5	79	

Table 3. Frequency of virulence in the stem rust population on various types of resistance in Canada in 1967

Geographic area	Percentage of isolates virulent on host varieties that have the following genes* for resistance: Pg-1 (D)	Pg-2 (A)	Pg-3 (E)	Pg-4 (B)	pg-8 (F)	pg-9 (H)	Total no. isolates	Mean virulence capability**
Eastern Canada	90	95	95	90	30	70	20	4.70
Western Canada	100	79.6	100	86.4	79.6	20	59	4.65

* The letters in brackets represent the designations for stem rust resistance genes used before the present standardized system of nomenclature (Simons et al., 1966) was adopted.

** Mean virulence capability = frequency of virulence on Pg-1 t...t pg-9/total number of isolates.

highly successful in North America, the prevailing population is maintaining the ability to attack an average of more than four types of resistance.

Crop loss hazard

The predominant races of stem rust in both Eastern and Western Canada are capable of attacking all commercial oat varieties, and varieties resistant to the prevailing races will not be available in the immediate future. Therefore, stem rust continues to present a serious threat *to* oat production in Canada. under favorable epidemiological conditions, heavy losses could occur. However, continued barberry eradication will reduce primary inoculum and minimize the chances of loss in Eastern Canada. Growers in Western Canada can minimize **losses** by planting their oat crops early.

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literature cited

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