Stem rust of oats in Canada in 1977[1]

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Stem rust *(Puccinia graminis* f. sp. *avenae)* was first found on oats *(Avena sativa)* in Manitoba on July 11. Light infections were observed in Manitoba and eastern Saskatchewan by late July and these developed explosively, resulting in very heavy infections and the most severe crop losses in several decades. Race C10 (U.S. race 31) was the predominant race in both eastern and western Canada comprising 89% of the 319 isolates identified. Virulence on the differential host Rodney O^2 x C.I. 9139 was observed for the first time in isolates of both races C10 and C23 (U.S. race 61).

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C'est le 11 juillet que sont apparus les premiers symptômes d'infection de l'avoine par la rouille de la tige *(Puccinia graminis* f. sp. *avenae)* au Manitoba. De faibles infections ont ete observees vers la fin de juillet dans cette province et dans l'est de la Saskatchewan; puis l'infestation a pris une tournure explosive et a entraîné les pertes culturales les plus importantes qu'on ait subies depuis plusieurs decennies. La race C10 (race 31 aux Etats-Unis) a ete le pathotype dominant dans l'est et dans l'ouest du Canada comptant pour 89% des 319 isolats identifies. Cette année pour la premiere fois, des isolats des deux races C10 et C23 (race 61 aux Etats-Unis) ont manifeste de la virulence sur l'hôte differentiel Rodney O^2 x C.I. 9139.

Prevalence and crop losses in western Canada

Stem rust of oats *(Avena sativa* L.) caused by *Puccinia graminis* Pers. f. sp. *avenae* Eriks. and E. Henn. was first observed in southern Manitoba on July 11, 1977. Light infections were observed in Manitoba and eastern Saskatchewan by late July and favourable climatic conditions resulted in explosive disease development, very heavy infections and the most severe crop losses in several decades. About one-third of the oat crop in the rust area escaped significant damage due to early planting. The estimated losses for the remainder of the crop ranged from 5% to nearly 100% and averaged about 35% for a total loss of 385,000 tonnes.

The commonly grown cultivars Harmon, Kelsey, Random, Rodney and Terra are susceptible to stem rust, but Hudson, which comprised 12.5% and 4.2% of the hectarage in Manitoba and Saskatchewan, respectively, is moderately resistant to this disease.

Physiologic specialization

Rust isolates obtained from wild oats (A. *fatua* L.), commercial oats and rust nurseries grown across Canada were established on the susceptible cultivar Victory and virulence combinations were determined by the infection types produced on seedlings of "Rodney O'' single-gene backcross lines (Table 1). The oat line Rodney O^2 x C.I. 9139 (Pg X), an undetermined genotype thought to have Pg 12 plus one or more other resistance genes, was used as a supplementary differential. One field culture (race C10) from Saskatchewan was virulent on Pg (X). Races C10 (U.S. 31) and C23 (U.S. 61) continued to predominate in western Canada and comprised about 90% and 9% of all isolates (Table 1), respectively. This is similar to results obtained in the United States (3) where C10 and C23 comprised 95% and 3%, respectively, of the isolates identified. Only one other race (C2) was found in western Canada, possibly because the great race C10 epidemic everwhelmed any other races that may have been present.

In eastern Canada, where race C9 (U.S. 87) traditionally predominates (1, 2) C10 was also the most common race, comprising 84% (vs 13% for C9) of all isolates identified in 1977. Although the rust populations of eastern and western Canada are usually distinct, it appears that the epidemic in the south central states and western Canada may have affected the rust population of eastern Canada in 1977.

Virulence on resistance conferred by gene Pg 8 increased sharply in eastern Canada (84% vs 35% for 1976) while that on Pg 9 and Pg 13 (Table 2) decreased, due to the shift from race C9 to race C10. The increased virulence on resistance conferred by genes Pg 2 and Pg 4 in western Canada is also attributable to the increased prevalence of race C10.

In an effort to detect the evolution of new virulence combinations in the rust population, a natural-infection trap nursery consisting of breeding lines and various other genotypes was planted at Glenlea, Manitoba. The isolates obtained from this material (Table 3) were less variable than in previous years (2). Probably the race C10 epidemic masked the presence of other virulence combinations. This nursery produced only one race (C1) not found in the field survey (Table 1) but it also produced several isolates of race C10 and one of C23 virulent on Rod O^2 x C.I. 9139 (Pg X). However, these isolates are not virulent on Pg 9 and Pg 13 resistance and so present no immediate threat to the breeding program.

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Table 1. Virulence combinations of oat stem rust field isolates on backcross lines with single-gene resistance to stem rust in Canada in 1977

Designation	Avirulence/virulence formula (Pg gene)	No. of isolates from: Ont.	Man.	Sask.	Total isolates	Percentage of total isolates
c2	1,2,4,8,13/3,9		3		3	0.9
C8	3,8,13/1,2,4,9	1			1	0.3
C9	8,13/1,2,3,4,9	4			4	1.2
C10	9,13/1,2,3,4,8	27	182	76	285	89.3
C23	2,4,9,13/1,3,8		9	17	26	8.1
TOTAL		32	194	93	319	

Table 2. Frequency of virulence in the oat stem rust population on various types of resistance in eastern and western Canada in 1977

Source of isolates	Percentage of isolates virulent on cultivars with the following genes for resistance: Pg 1	Pg2	Pg3	Pg4	Pg8	Pg 9	Pg 13	Pg (X)	Total no. isolates	Mean virulence capability*
East	100	100	97	100	84	16	0	0	32	4.9
West	99	90	100	90	99	1	0	0.3	287	4.8

*Mean virulence capability = No. of isolates virulent on Pg 1 + Pg (X) / total no. of isolates.

Table 3. Virulence combinations of oat stem rust isolates obtained from a trap nursery at Glenlea, Manitoba in 1977 on backcross lines with single-gene resistance to stem rust

Designation	Avirulence/virulence formula	No. of isolates	% of total
C1	1,2,3,4,8/9,13	7	3.1
C2	1,2,4,8/3,9,13	10	4.8
C10	9,13/1,2,3,4,8	207	91.
C23	2,4,9,13/1,3,8	3	1.3
TOTAL		227	

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