STEM RUST OF OATS IN CANADA IN 1965

J. W. Martens and G. J. Green[1]

Disease development and crop losses in Western Canada

Stem rust of oats (Puccinia graminis Pers. f. sp. avenae Erickss. & Henn.) developed too late in the season to cause significant losses in Western Canada in 1965. The first traces were observed on wild oats in Manitoba and western Saskatchewan July 30. The rust did not build up very rapidly so that most of the oats reached maturity with relatively little stem rust infection. However, late fields in the Red River Valley of Manitoba had infections of up to 60% by the beginning of September. These fields undoubtedly suffered a considerable reduction in yield from rust infection, in addition to that caused by frost. Disease development was apparently delayed by the fact that the earliest spore showers consisted largely of race C5(6F) to which the bulk of the western oat population was resistant.

Uniform rust nurseries

Rust nurseries consisting of ten varieties (Table 1) were grown at 36 locations across Canada. The nurseries were planted, cared for and harvested by cooperating University and Canada Department of Agriculture personnel and then sent to Winnipeg for disease rating. No rust was observed on nurseries in Alberta. Infections were generally absent or light in British Columbia, Saskatchewan and Manitoba. Infections in the nurseries at Glenlea and Winnipeg, Manitoba were heavier than in most oat fields in the Red River Valley because they were planted late. Heavy infections were common in the barberry area of Ontario. Rust infections were light or absent east of Ontario.

Table 1. Percent infections of stem rust of oats (Puccinia graminis f. sp. avenae) in 10 varieties of oats in 14[a] uniform rust nurseries in Canada in 1965.

Locality	Bond	Tri rnia 4	Landh fer	Cér ch du B ach	S ia	Exe t r	Clint c	Rodney	Ga ry	C.I. 4023
Creston, B. C.	0	tr[b]	tr	tr	0	0	0	0	*0*	0
Melfort, Sask.	10	tr	2	5	0	2	5	0	0	tr
Brandon, Man.	5	0	tr	0	0	1	1	0	tr	0
Glenlea, Man.	60	5	tr	tr	tr	30	60	**20**	2	2
Morden. Man.	1	0	0	0	0	1	10	tr	0	0
The Pas, Man.	0	0	tr	0	0	0	*0*	*0*	*0*	*0*
Winnipeg, Man.	***30***	tr	tr	tr	**0**	**20**	50	5	tr	tr
Alfred, Ont.	**2**	1	tr	**0**	0	tr	tr	tr	0	0
Appleton, Ont.	80	80	60	50	**30**	*70*	*70*	*80*	*70*	**30**
Ft. William, Ont.	tr	tr	0	tr	0	0	0	*0*	0	0
Kemptville, Ont.	70	0	10	0	0	70	50	50	15	1
Merrickville, Ont.	60	60	30	40	5	60	60	60	40	30
Ottawa, Ont.	**50**	**30**	**20**	30	**0**	**25**	30	**40**	**30**	**0**
Macdonald Coll., P. Q.	0	tr	tr	5	tr	15	tr	10	tr	0

[a] No rust was observed in **22** other nurseries located at Saanichton and Agassiz, B. C., Edmonton, Beaverlodge, Lacombe, and Lethbridge, Alta., Indian Head and Scott, Sask., Guelph, Kapuskasing, St. Catharines, Williamstown and Verner, Ont., L'Assomption, Lennoxville, Normandin and Quebec, P. Q., Kentville and Nappan, N. S., Fredericton, N. B., Charlottetown, P. E. I., and Doyles, Nfld.

[1] Plant Pathologists, Canada Department of Agriculture, Research Station, Winnipeg, Manitoba.

Physiologic race identification and distribution

Physiologic races were identified using a host set consisting of 'Richland' (gene A), 'Rodney' (gene B), 'Minrus' (gene D), 'Jostrain' (gene E), 'Eagle2 x C.I. 4023' (gene F) and 'C. I. 5344-1' (gene H). The race designations used (Table 2) follow the system initiated by Green (1,2).

Table 2. Virulence formulae and numbers for races of oat stem rust identified in Canada from 1963 to 1965.

Formula No.	Formula (Effective/Ineffective Host Genes)	Race
C1	ABDEF/H	1
C2	ABDF/EH	2
c 3	AF/BDEH	7A-12A
c 4	BDFH/AE	8
c 5	BH/ADEF	6F
C6	DF/ABEH	8A-10A
c 7	D/ABEFH	8AF
C8	EF/ABDH	4A
C9	F/ABDEH	6A-13A
C10	H/ABDEF	6AF
C11	DF/ABE	8A
c12	DH/ABEF	8AF
C13	BF/ADEH	6
C14	FH/ABDE	6A
C15	BDF/AEH	8
C16	ABF/DEH	7
C17	DEF/ABH	11A
C18	ABFH/DE	7
C19	ABDFH/E	2

A supplementary set of 'Rosen's Mutant', 'Saia' and 'C.I. 3034' was also used. Reactions of 'Rosen's Mutant' were usually similar to but more resistant than those of 'C. I. 5844-1'. Nineteen of the 72 isolates avirulent on 'Rosen's Mutant' were moderately virulent on 'C. I. 5844-1'. Most of these 19 isolates were races C3(7A-12A) and C6(6A-13A). 'C. I. 3034', which has adult plant resistance to race C10(6AF), was susceptible to all isolates of this race in the seedling stage. It reacted like 'Minrus' to most isolates. 'Saia' was resistant to all isolates identified in 1965.

Races C10(6AF), C3(7A-12A) and C5(6F) accounted for 50%, 26% and 22%, respectively, of all isolates from Manitoba and Saskatchewan in 1965 (Table 3). Race C10, which can attack all commercially grown oat varieties, continued to increase in prevalence. It increased from 5% of all isolates from Manitoba and Saskatchewan in 1963 to 41% in 1964 to 50% in 1965.

The data in Table 4 indicate that the early incoming inoculum was not predominantly C10 as the above race distribution might suggest. The first isolates were obtained mostly from plants with no

Table 3. Distribution by provinces of physiologic races of Puccinia graminis f. sp. avenae identified in Canada in 1965.

Formula No.	Race	B. C.	Sask.	Man.	Ont.	Que.	No. of Isolates	Percent of Total Isolates
C1	1	1	0	0	0	0	1	.7
c 3	7A-12A	0	4	16	0	0	20	14.7
c 5	6F	0	7	10	0	0	17	12.5
C6	8A-10A	0	0	0	4	3	7	5.1
C8	4A	0	0	0	7	1	8	5.9
c 9	6A-13A	0	0	0	34	5	39	28.8
C10	6AF	0	4	34	0	0	38	27.9
C14	6A	0	0	0	2	0	2	1.5
C16	7	0	0	1	0	0	1	.7
C17	11A	0	0	0	1	0	1	.7
C19	2	2	0	0	0	0	2	1.5
Total		3	15	61	48	9	136	100.0

Table 4. Distribution by provinces of physiologic races of Puccinia graminis f. sp. avenae collected on varieties of cultivated oats with no rust resistance and wild oats in Canada in 1965.

Formula No.	Race	B. C.	Sask.	Man.	Ont.	Que.	No. of Isolates	Percent of Total Isolate
C3	7A-12A	0	0	2	0	0	2	10
c5	6F	0	5	7	0	0	12	60
C8	4A	0	0	0	1	0	1	5
C9	6A-13A	0	0	0	1	0	1	5
C10	6AF	0	0	3	0	0	3	15
C16	7	0	0	1	0	0	1	5
Total		0	5	13	2	0	20	100

rust resistance and they consisted largely of race C5(6F). However, the predominant host populations of 'Rodney' which is resistant to C5 and 'Garry' which is resistant to C5 and C3 in the west exerted a great selectionpressure in favor of C10 so that it increased rapidly. Early spore showers of race C10 could cause very serious losses in the immediate future.

In Ontario and Quebec race C9(6A-13A) comprised 68% of all isolates with C6(8A-10A) and C8 (4A) accounting for most of the remainder. All commercial oat varieties are susceptible to race C9. The absence of races C3, C5, and C10 from Eastern Canada in 1965 suggests that the origin of the primary inoculumin this area was different from that in Western Canada. Barberry was probably an important source of primary inoculum in Eastern Canada.

Several previously undescribed physiologic races wereisolated from oats in 1965. These include C14 = FH/ABDE and C17 = DEF/ABH from Ontario, C16 = ABF/DEH from Manitoba and C19 = ABDFH/E from British Columbia.

Acknowledgements

The authors are grateful for the technical assistance of J.C. Anderson, the rust nursery cooperators and those who submitted rust specimens from various parts of Canada.

literature cited

1. Green, G.J. 1963. Stem rust of oats in Canada in 1963. Can. Plant Dis. Survey 43: 173-178.
2. Green, G.J. 1965. Stem rust of oats in Canada in 1964. Can. Plant Dis. Survey 45: 19-22.