

Stem rust of oats in Canada in 1978¹

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Stem rust (*Puccinia graminis* f. sp. *avenae*) was first observed on oats (*Avena sativa*) in Manitoba in mid-July. Light infections occurred throughout Manitoba and eastern Saskatchewan by the third week in August but crop losses were confined to late-seeded fields in eastern and central Manitoba. A new system of race nomenclature for North America, including an expanded set of differential lines has been adopted for use in Canada. Physiologic races NA27 (9,13,15,16,a/1,2,3,4,8) and NA16 (2,4,9,13,15,16,a/1,3,8) continued to predominate in western Canada. Race NA25 (8,13,16,a/1,2,3,4,9,15) was the most common in eastern Canada. A late fall survey of southern Alberta indicated the widespread presence of a distinct rust population dominated by race NA5 (1,2,4,8,9,13,16,a/3,15). None of the 206 field isolates studied were virulent on lines with resistance conferred by genes Pg-13, Pg-16 or the Pg-a complex.

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La rouille de la tige (*Puccinia graminis* f. sp. *avenae*) en 1978 a fait sa première apparition au Manitoba vers la mi-juillet et, dans la troisième semaine d'août, de légers foyers d'infection s'étaient déclarés un peu partout dans la province et dans l'est de la Saskatchewan, encore que les pertes de récolte se limitaient aux semis tardifs de l'est et du centre du Manitoba. On a adopté cette année une nouvelle nomenclature des rouilles pour l'Amérique du Nord et le groupe des variétés différentielles (réactifs) pour le Canada a été élargi. Les races physiologiques NA27 (9,13, 15, 16, a/1, 2, 3, 4, 8) et NA16 (2, 4, 9, 13, 15, 16, a/1, 3, 8) ont conservé leur prépondérance dans l'Ouest, tandis que NA25 (8, 13, 16, a/1, 2, 3, 4, 9, 15) était la plus fréquente dans l'Est. Une enquête effectuée en fin d'automne dans le sud de l'Alberta a révélé la présence généralisée d'une population de rouilles caractéristique dominée par NA5 (1, 2, 4, 8, 9, 13, 16, a/3, 15). Aucun des 206 isolats de terrain examinés n'a manifesté de virulence envers les lignées pourvues des gènes de résistance Pg-13, Pg-16 ou du complexe Pg-a.

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 in mid-July in 1978. Light infections occurred throughout Manitoba and eastern Saskatchewan by the third week in August but crop losses were confined to late-seeded fields in eastern and central Manitoba where infections of up to 80% were observed at the end of August. A survey in late September indicated that oat stem rust was common across southern Alberta at least as far west as Lethbridge in 1978.

The commonly grown cultivars Harmon, Kelsey, Random, Rodney and Terra are susceptible to stem rust, but Hudson, which comprised 25.1% and 5.3% of the hectareage in Manitoba and Saskatchewan, respectively, continued to be moderately resistant to all the races of stem rust occurring in western Canada.

Uniform rust nurseries

Rust nurseries comprising the oat cultivars Fraser (Pg-2, -4), Hudson (Pg-2-4-9), Rodney (Pg-4), RL 903 (Pg-8), RL 996 (Pg-a), RL 1005 (Pg-15), RL 1008, RL 2924, RL 2925, RL 2926, and W 76121 were grown at 28 locations across Canada. Trace to light infections were observed on nurseries grown at Guelph, Vineland and Kapuskasing, Ont.; and Durban and Morden, Man.;

Indian Head, Sask.; Lethbridge, Alta.; and Creston, B.C. Heavy infections occurred on the nursery grown at Brandon, Man. No rust infections were observed on nurseries grown at Charlottetown, P.E.I.; Kentville and Truro, N.S.; Fredericton, N.B.; La Pocatière, Macdonald College, Normandin and Quebec, Que.; Appleton, New Liskeard, Ottawa, Sudbury and Thunder Bay, Ont.; Melfort and Scott, Sask.; Beaverlodge, Edmonton and Lacombe, Alta.; and Agassiz, B.C.

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 avirulence/virulence combinations were determined by the infection types produced on seedlings of the differential lines shown in Table 1. This expanded group of differential lines form the basis of a new system of race nomenclature now in use in North America (3). The lines not previously used as differentials are CI 9351, RL 997 (Pg-15) with resistance derived from *A. sterilis* L. collected near Uskudar, Turkey, CI 9352, RL 822 (Pg-16) a 44 chromosome disomic addition line with resistance from *A. barbata* (J.E. Pott ex Link) line No. D203, and the genetically undefined (Pg-12 and additional factor(s)) line designated Pg-a with resistance derived from CI 9139. Except for the Pg-a line, all the differentials are backcross derived lines in the Rodney O (CI 9317, RL 805) oat background. Lines carrying the Pg-14 resistance gene (1) were tested with approximately 125 isolates, including race NA1 virulent only on the Pg-15 line, but no avirulent reactions were observed.

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Table 1. Avirulence/virulence combinations of *Puccinia graminis* avenae field isolates on back-cross lines with single-gene resistance to stem rust in Canada in 1978.

North American No.	Avirulence/virulence formula ^a	No. of isolates from				Total isolates	Percentage of total isolates
		N.S., Ont. & Que.	Man.	Sask.	Alta.		
A. Combined isolates from all hosts							
NA1	1, 2, 3, 4, 8, 9, 13, 16, a/15			1		1	0.5
NA5	1, 2, 4, 8, 9, 13, 16, a/3, 15				19	19	9.0
NA10	1, 4, 8, 9, 13, 16, a/2, 3, 15	2			1	3	1.4
NA15	2, 4, 8, 9, 13, 15, 16, a/1, 3			2		2	0.9
NA16	2, 4, 9, 13, 15, 16, a/1, 3, 8	1	13	14	1	29	13.5
NA20	3, 8, 13, 16, a/1, 2, 4, 9, 15		1	2		3	1.4
NA24	8, 9, 13, 16, a/1, 2, 3, 4, 15			3		3	1.4
NA25	8, 13, 16, a/1, 2, 3, 4, 9, 15	6				6	2.8
NA27	9, 13, 15, 16, a/1, 2, 3, 4, 8	2	92	45	9	148	69.1
Total		11	106	67	30	214	
B. Isolates from cultivars with known stem rust resistance genes							
NA10		2				2	2.4
NA15				1		1	1.2
NA16		1	1	2		4	4.8
NA20				1		1	1.2
NA24				1		1	1.2
NA25		6				6	7.2
NA27		2	43	19	4	68	82.0
Total		11	44	24	4	83	
C. Isolates from wild oats and cultivars with no known stem rust resistance genes							
NA1				1		1	0.8
NA5					19	19	14.5
NA10					1	1	0.8
NA15				1		1	0.8
NA16			12	12	1	24	18.3
NA20			1	1		2	1.5
NA24				2		2	1.5
NA27			49	25	5	81	61.8
Total			62	43	26	131	

Races NA27 and NA16 continued to predominate in western Canada (2) and comprised about 69% and 14% of all field isolates, respectively (Table 1). The isolates obtained from Alberta in late September consisted primarily of race NA5 which is similar to a race commonly found in the winter oat area of the southern United States, especially Texas (4). This race was reported only from the southern United States and Mexico in 1977 (4) and it almost certainly did not come from the Great Plains region. The Occurrence of the relatively avirulent races NA1 and NA15 in Saskatche-

wan is also noteworthy. In eastern Canada the traditional race NA25 continued to predominate (2) and the rare race NA10 was isolated for only the second time since 1964. The separation of isolates by origin (Table 1, B + C) illustrates the bias in population sampling caused by cultivars with genes for resistance.

None of the field isolates from eastern or western Canada were virulent on lines with genes Pg-13, -16 or the a-complex resistance (Table 2). The next most resistant were lines with Pg-9 and -15 vs. western isolates and

Pg-8 vs. eastern isolates. Virulence on lines with genes Pg-1 through Pg-4 continued at high levels with slight declines from the previous year for all except Pg-3 attributable largely to the relatively avirulent NA5 isolates from Alberta.

In a continuing effort to detect new virulence combinations in the rust population natural-infection trap

nurseries consisting of breeding lines and various other genotypes were planted at Glenlea and Portage la Prairie, Manitoba. The 124 isolates obtained from these nurseries (Table 3) included more races than the 106 field isolates (6 vs. 3) from Manitoba. However, none of the races identified were new or constitute a threat to the resistance being used in the breeding program.

Table 2. Frequency of virulence (% of isolates) in the oat stem rust population in eastern and western Canada on oat lines with single resistance genes in 1978.

Source of isolates	Genes for resistance										Total no. isolates	Mean virulence capability*
	Pg-1	Pg-2	Pg-3	Pg-4	Pg-8	Pg-9	Pg-13	Pg-15	Pg-16	Pg-a		
East	82.0	90.9	100	72.7	27.3	54.5	0.0	72.7	0.0	0.0	11	5.0
West	89.6	75.4	98.0	75.0	85.7	1.5	0.0	14.8	0.0	0.0	203	4.4

* Mean virulence capability = No. of isolates virulent on Pg-1 + . . . Pg-a / total no. of isolates.

Table 3. Avirulence/virulence combinations isolated from *P. graminis avenae* trap nurseries comprising backcross lines with single-gene resistance planted at Glenlea and Portage la Prairie, Manitoba in 1978.

North American No.	Avirulence/virulence formula	No of isolates	Percent of isolates
NA1	1, 2, 3, 4, 8, 9, 13, 16, a/15	2	1.6
NA5	1, 2, 4, 8, 9, 13, 16, a/3, 15	3	2.4
NA6	1, 2, 4, 8, 13, 16, a/3, 9, 15	4	3.2
NA7	1, 2, 4, 8, 16, a/3, 9, 13, 15	4	3.2
NA16	2, 4, 9, 13, 15, 16, 1/1, 3, 8	24	19.4
NA27	9, 13, 15, 16, a/1, 2, 3, 4, 8	87	70.2
Total		124	

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Literature cited

1. MacKey, J. and B. Mattsson. 1972. Breeding for race specific resistance against Scandinavian oat stem rust. Utsadesforenings Tidskrift 82:186-203.

- Martens, J.W. 1978. Stem rust of oats in Canada in 1977. Can. Plant Dis. Surv. 58:51-52.
- Martens, J.W., A.P. Roelfs, R.I.H. McKenzie, P.G. Rothman, D.D. Stuthman and D.P. Brown. 1979. A system of nomenclature for races of *Puccinia graminis* f. sp. *avenae*. Phytopathology: 69(3):293-294.
- Roelfs, A.P., D.H. Casper and D.J. Lang. 1978. Races of *Puccinia graminis* f. sp. *avenae* in the United States during 1977. Plant Dis. Repr. 62:600-604.