Crown rust of oats in Canada in 1974[1]

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Oat crown rust *(fuccinia coronata* f. sp. *avenae)* was general but light in western Canada in 1974, with some localized heavier infections near buckthorn *(Rhamnus cathartica)* plants. There was no increase from 1973 in the amount of infection on the commercial oat *(Avena sativa)* cultivar Hudson and on the importarrt resistance genes ***Pc 38*** and ***Pc39***. Virulence combinations in the crown rust population were determined on a set of oat lines carrying known resistance genes. The 201 isolates from western Canada and 56 isolates from eastern Canada comprised 37 and 16 virulence combinations respectively. There was marked increase in virulence on *Pc* ***40*** resistance, and lines carrying genes *Pc* ***46,*** *Pc* ***47,*** and Pc ***48*** were less effective in 1974 than in 1973.

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En 1974, la rouille couronnee de l'avoine *Puccinia coronata* f. sp. *avenae* s'est manifestee un peu partout dans l'ouest du Canada mais sans gravite sauf a proximité des nerpruns communs *Rhamnus cathartica* ou les infestations etaient plus importantes. Comparativement a 1973, aucune recrudescenced'infestation n'a été signalée sur le cultivar commercial d'avoine *Avena sativa* Hudson ni sur les lignees possedant les genes de resistance ***Pc 38*** et ***Pc 39***. On a observe la virulence de prelevements de nouille sur un groupe de lignees d'avoine portant des genes de resistance connus. Les 201 souches isolees dans l'ouest et les 56 provenant de l'est comprenaient respectivernent 37 et 16 cornbinaisons de virulence. On a remarqué une nette hausse de virulence pour le gene de resistance *Pc* 40 et chez les lignees portant les genes ***Pc 46, Pc 47*** et ***Pc 48*** qui ont ete moins resistantes en 1974 qu'en 1973.

Occurrence in western Canada

Oat crown rust, *Puccinia coronata* Cda. f. sp. *avenae* Eriks., was general but light throughout Manitoba and eastern Saskatchewan in 1974. There were no significant crop losses due to crown rust except in some small isolated areas. One such area was found near Morden, Manitoba, where buckthorn *(Rhamnus cathartica* **L.)** was found in a ravine adjacent to an oat field. Peak infection near the ravine was estimated at about 60%, and infection levels declined linearly with distance away from the ravine. Warm **dry** weather during most of the growing season prevented widespread infection and severe damage by crown rust.

Infection of oats adjacent to buckthorn was first observed on June 18, while general infection **of** the oat crop by inoculum from external sources did not occur until mid-July. Under more favorable weather conditions, it is

Table 1. Percentage infection of crown rust on 10 oat cultivars at 12* locations in Canada in 1974

Location	Hudson	C.I. 9139	C.I. 4023	C.I. 3034	Rodney	Fraser	R.L. 2924	R.L. 2925	R.L. 2926	R.L. 2970
Kentville, N. S.	0	***0***	0	0	0	tr†	**0**	***0***	**0**	tr
Lennoxville, Qué.	0	0	0	0	80	80	0	***0***	10	0
Macdonald College, Qué.	25	25	80	60	80	80	10	**0**	***60***	60
Quebec City, Qué.	5	0	20	0	25	60	0	**0**	5	tr
La Pocatière, Qué.	0	***0***	10	10	0	0	0	***0***	0	20
Appleton, Ont.	30	40	80	60	80	80	5	**0**	80	80
Ottawa, Ont.	30	30	80	50	80	80	0	***0***	50	30
Guelph, Ont.	0	tr	30	30	80	80	tr	***0***	**50**	10
New Liskeard, Ont.	0	0	10	0	10	30	0	***0***	**5**	0
Morden, Man.	5	10	25	15	40	40	0	**0**	**5**	5
Brandon, Man.	0	0	5	0	**tr**	tr	0	***0***	***0***	0
Indian Head, Sask.	0	tr	5	0	**5**	5	0	***0***	***0***	10

* Crown rust was not detected in nurseries at the following locations: St. John's West, Nfld.; Charlottetown, P.E.I.; Fredericton, N. B; Truro, N.S.; Normandin, Qué.; Vineland, Sunbury, and Thunder Bay, Ont.; Durban, Man.; Melfort and Scott, Sask.; Lethbridge, Lacombe, Beaverlodge, and Edmonton, Alta.; Agassiz and Creston, B.C.

† tr = trace

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Table 2. Virulence combinations of crown rust cultures isolated in western and eastern Canada in 1974 on oat lines containing substituted genes for crown rust resistance

Virulence formula (effective/ineffective host genes)*	West		East	
	No. of isolates	% of isolates	No. of isolates	% of isolates
1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	28	13.9	17	30.4
2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18/1	3	1.5	12	21.4
1,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18/2	1	0.5		
1,2,3,5,6,7,8,9,10,11,12,13,14,15,16,17,18/4	65	32.3	5	8.9
1,2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18/5	2	1.0	3	5.4
1,2,3,4,5,7,8,9,10,11,12,13,14,15,16,17,18/6	7	3.5		
1,2,3,4,5,6,7,8,10,11,12,13,14,15,16,17,18/9	7	3.5		
1,2,3,4,5,6,7,8,9,11,12,13,14,15,16,17,18/10	1	0.5	4	7.1
1,2,3,4,5,6,7,8,9,10,11,13,14,15,16,17,18/12			3	5.4
1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18/16	4	2.0		
3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18/1,2			1	1.8
2,3,5,6,7,8,9,10,11,12,13,14,15,16,17,18/1,4	3	1.5		
2,3,4,6,7,8,9,10,11,12,13,14,15,16,17,18/1,5			3	5.4
2,3,4,5,6,7,8,9,11,12,13,14,15,16,17,18/1,10			1	1.8
2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18/1,14	26	12.9	1	1.8
2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18/1,16	1	0.5		
1,2,3,5,6,7,8,10,11,12,13,14,15,16,17,18/4,9	4	2.0		
1,2,3,5,6,7,8,9,11,12,13,14,15,16,17,18/4,10	18	8.9		
1,2,3,5,6,7,8,9,10,11,12,13,14,15,17,18/4,16	1	0.5		
1,2,3,5,6,7,8,9,10,11,12,13,14,15,16,17/4,18	1	0.5		
1,2,3,4,6,7,8,10,11,12,13,14,15,16,17,18/5,9	1	0.5		
1,2,3,4,5,7,8,10,11,12,13,14,15,16,17,18/6,9	1	0.5		
1,2,3,4,5,6,7,8,10,11,12,13,15,16,17,18/9,14	1	0.5		
1,2,3,4,5,6,7,8,9,11,12,13,14,15,17,18/10,16	1	0.5		
3,4,5,6,7,8,9,10,11,12,13,15,16,17,18/1,2,14	1	0.5		
2,3,5,6,7,8,10,11,12,13,14,15,16,17,18/1,4,9	1	0.5		
2,3,5,6,7,8,9,10,11,12,13,15,16,17,18/1,4,14	2	1.0	1	1.8
2,3,5,6,7,8,9,10,11,12,13,14,16,17,18/1,4,15			1	1.8
2,3,4,7,8,9,10,11,12,13,14,15,16,17,18/1,5,6			1	1.8
2,3,4,5,7,8,9,10,11,12,13,15,16,17,18/1,6,14	4	2.0		
2,3,4,5,6,8,9,10,11,12,13,15,16,17,18/1,7,14	2	1.0		
2,3,4,5,6,7,8,10,11,13,14,15,16,17,18/1,9,12			1	1.8
2,3,4,5,6,7,8,10,11,12,13,15,16,17,18/1,9,14	2	1.0		
2,3,4,5,6,7,8,9,11,12,13,15,16,17,18/1,10,14	1	0.5		
2,3,4,5,6,7,8,9,10,11,12,13,16,17,18/1,14,15	1	0.5		
1,2,3,5,6,7,8,10,11,12,13,14,15,17,18/4,9,16			1	1.8
1,2,3,5,6,7,8,9,11,12,13,14,15,17,18/4,10,16	2	1.0		
1,2,3,4,7,8,9,11,12,13,14,15,16,17,18/5,6,10	1	0.5		
1,2,3,4,6,7,8,10,11,12,13,14,15,17,18/5,9,16	1	0.5		
1,2,3,4,6,7,8,9,11,12,13,14,15,17,18/5,10,16	1	0.5		
1,2,3,4,5,6,7,8,9,10,11,13,14,16,17/12,15,18			1	1.8
2,3,4,5,6,7,9,10,11,12,14,16,17,18/1,8,13,15	1	0.5		
2,3,4,5,6,7,8,9,11,12,13,15,17,18/1,10,14,16	2	1.0		
2,3,4,5,6,7,8,9,11,12,13,15,16,17/1,10,14,18	1	0.5		
1,3,4,5,7,8,10,11,13,14,16,17,18/2,6,9,12,15	1	0.5		
2,3,5,7,9,10,12,13,14,15,16,17/1,4,6,8,11,18	1	0.5		

* **No's** 1 **through** 12 **are lines of Pendek with substituted single** (*Pc*) **genes for crown rust resistance derived from** ***Avena sterilis*****. They are:** 1 = *Pc* 35, 2 = *Pc* 38, 3 = *Pc* 39, 4 = *Pc* 40, 5 = *Pc* 45, 6 = *Pc* 46. 7 = Pc 47, 8 = Pc 48, 9 = *Pc* 50, 10 = Pc 54, 11 = Pc 55, 12 = Pc 56. **No's** 13 **through 18 are**: Ascencao (*Pc* 14), 14 = X 475 II (*Pc* 5, 35), 15 = H 382 (*Pc* 36), 16 = X 434 II (*Pc* 51), 17 = X 421 (*Pc* 48, 52), and 18 = H 441 R (*Pc* 53).

likely that buckthorn would have been responsible for an earlier and greater incidence of crown rust infection than would otherwise have occurred.

Uniform rust nurseries

Ratings of crown rust intensity on 10 oat *(Avena sativa* **L.)** cultivars grown at 29 locations across Canada are given in Table 1. Locations at which no crown rust was detectable or from which leaves could not be scored are omitted from the table. There has been no increase in the amount of infection on the commercial cultivar Hudson and on R.L. 2924 and 2925, which carry genes *Pc 38* and *Pc 39* respectively.

Physiologic specialization

The basis for differentiating physiologic variants of *P. coronata* was changed in 1974. The "standard" (2) set of differential oat cultivars was dropped in favor of adding more lines *of* better defined resistance genotype. The differential set consisted of a) substituted single gene lines of 'Pendek' containing *Avena sterilis* L. derived genes *Pc 35, 38, 39, 40, 45, 46, 47, 48, 50, 54, 55,* and *56;* and b) Ascencao *(Pc 14),* **X** 475 **II** *(Pc* 5, *35*), H 382 *(Pc 36), X* 434 **II** *(Pc 51),* **X** 421 *(Pc 48, 52),* and H 441 **R** *(Pc 53).* The latter "b' series was obtained from **M.** D. Simons, Iowa State University. The set is open-ended and subject to future changes, hence no race numbers were assigned.

The virulence combinations *of* crown rust isolates found in Canada in 1974 are given in Table 2. The 201 isolates from western Canada and the 56 isolates from eastern Canada comprised 37 and 16 virulence combinations respctively. There were some marked shifts in the virulence patterns as compared to 1973 (1). When considering only genes *Pc 35, 38, 39, 40, 45, 46, 47, 48,* and *50* as used in 1973, there was a decrease in 1974 in western Canada from 52.7% to 16.9% in the number *of* isolates avirulent on all of the lines with these genes. There was little change in the number of avirulent isolates from eastern Canada. There was a sharp increase in virulence on *Pc 40* resistance, from 4.2% and 1.2%, respectively, in western and eastern Canada in 1973 to 48.3% and 14.5% in 1974 (Table 3). There was new virulence in the field on *Pc 45* resistance in western Canada, and on *Pc 48* in all *of* Canada. There was reappearance in 1974 of virulence on lines with genes *Pc 46* and *47.* There was a marked decrease in the incidence of isolates virulent on the lint: with gene *Pc* 50 in western Canada, and a slight decrease in eastern Canada. The position of genes *Pc 38* and *33* has not changed, and these two genes in combination have remained highly effective. This is important as genes *Pc 38* and *39* currently provide the major crown rust resistance in the oat breeding program at Winnipeg.

The effectiveness of the newly isolated *A. sterilis*-derived genes *Pc 54,* 55 and 56 needs further assessment, although gene *Pc 54* is ineffective against a substantial 13.9% of western Canada isolates. The resistance of Hudson, the most recently licensed oat cultivar at Winnipeg, remained moderately effective, as in 1973.

Table 3. Distribution of virulence of isolates of *Puccinia coronata* in 1974 on lines of oats with known crown rust resistance genotype and on the commercial oat cultivar Hudson

Resistance gene or cultivar	Western Canada		Eastern Canada	
	No. of virulent isolates	% of isolates	No. of virulent isolates	% of isolates
Pc 35	52	25.9	22	40.0
Pc 38	3	1.5	0	0.0
Pc 39	0	0.0	0	0.0
Pc 40	97	48.3	8	14.5
Pc 45	6	3.0	6	10.9
Pc 46	14	7.0	1	1.8
Pc 47	2	1.0	0	0.0
Pc 48	1	0.5	0	0.0
Pc 50	19	9.5	2	3.6
Pc 54	28	13.9	5	9.1
Pc 55	1	0.5	0	0.0
Pc 56	1	0.5	5	9.1
Ascencao (*Pc* 14)	1	0.5	0	0.0
X 475 II (*Pc* 5, Pc 35)	43	21.4	2	3.6
H 382 (*Pc* 36)	3	1.5	2	3.6
X 434 II (*Pc* 51)	13	6.5	1	1.8
X 421 (*Pc* 52, 48)	0	0.0	0	0.0
H 441 (*Pc* 53)	3	1.5	1	1.8
Hudson	13	6.5	7	12.7

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