Stem rust of wheat, barley, and rye in Canada in 1974[1]

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Wheat stem rust (*Puccinia graminis* f. sp. *tritici*) was more prevalent than usual in western Canada in 1974, but commercial varieties of common wheat (*Triticum aestivum)* and durum (*T. durum)* were resistant and there was no damage. The rust occurred in uniform rust nurseries in British Columbia, Saskatchewan, Manitoba, Ontario, and Quebec. Increased rust prevalence facilitated the identification of a large number (429) of isolates. Thirty-two races were found; eleven of them were new. Despite the broad variability of the population, there was no change in the main races and there was no evidence that any new race seriously threatened resistant varieties.

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En 1974, l'ouest du Canada a subi une épidémie de rouille de la tige du ble *Puccinia graminis* f. sp. *tritici* plus importante que l'habitude mais les varietes commerciales de ble ordinaire *Triticum aestivum* et dur *T. durum* y ont résisté et aucun dégât n'a ete enregistre. L'epidemie s'est manifestee dans les Parcelles Uniformes d'observation de la rouille de la Colombie-Britannique, et la Saskatchewan, du Manitoba, de l'Ontario et du Quebec. Cet accroissement a facilité l'identification d'un nombre important d'isolats (429). Ces derniers representaient 32 races dont 11 etaient inconnues jusqu'alors. Malgre une population tres variable, on n'a enregistre aucune modification des races principales et rien ne semble indiquer qu'une des nouvelles souches presente un danger reel pour les varietes resistantes.

Prevalence and importance in western Canada

In 1974, wheat stem rust (*Puccinia graminis* Pers. f. sp. *tritici* Eriks. and E. Henn.) was more prevalent in the central great plains of the United States than it has been for a number of years. Air-borne spores were blown into western Canada in early June but rust was first observed on July 17 on a susceptible variety in experimental plots at Morden, Manitoba. Rust development was slow because of dry conditions early in the season but development was more rapid during early August and by mid-August plots of susceptible varieties at Morden were heavily infected (70%). In the first week of August infections could be found easily on wild barley (*Hordeum jubatum* L.) in Manitoba and in early September wild barley was infected throughout Saskatchewan. Infections were much lighter in the west and only traces of stem rust were found in eastern Alberta. There was more wheat stem rust in Western Canada in 1974 than there has been for many years.

Despite the widespread and common incidence of wheat stem rust on susceptible varieties and wild barley in 1974, no infections were observed in commercial wheat fields. The resistance of *Triticum aestivum* L. 'Selkirk', 'Manitou', 'Neepawa', and 'Glenlea', and *T. durum* Desf. 'Hercules', and 'Wascana' continued to be excellent.

Stem rust of wheat, barley, and rye in the rust nurseries

Uniform rust nurseries were planted by cooperators at 31 locations across Canada in 1974. The nurseries included the susceptible wheat Red Bobs; the moderately susceptible Mindum; Lee, which is susceptible to all strains of "standard" race 15B; Pitic 62, which is susceptible to some strains of "standard" race group 11-32-113; the resistant commercial wheats Neepawa, Napayo, Glenlea, Hercules, and Wascana; and the resistant test varieties Kenya Farmer, C.I. 8154 X Frocor[2], Agatha, and D.T.332. Other varieties were included primarily for leaf rust investigations (Table 1). The cooperators harvested the plants at an appropriate time and sent small sheaves to Winnipeg where rust assessments were made and collections obtained for physiologic race identifications.

Wheat stem rust infections occurred in nurseries located in British Columbia, Saskatchewan, Manitoba, Ontario, and Quebec, (Table 1). There was no wheat stem rust in nurseries from the Maritime Provinces or Newfoundland. Stem rust was more widespread and infections were more severe in 1974 (19 nurseries infected) than in 1973 (9 nurseries infected). Infections were moderate or severe on Red Bobs except for two nurseries in Saskatchewan and two in Quebec where only a trace of rust was observed.

The widespread infections on Lee show that strains of "standard" race 15B were widely distributed. The heavy infections on Pitic 62 in eastern Canada contrasted with a single trace infection in the West and indicated that strains of "standard" race group 11-32-113 virulent on Pitic 62 were more common in the East. The commercial varieties Neepawa, Napayo, Glenlea, Hercules, and Wascana, and the test varieties C.I.8154 X Frocor[2], Agatha, and D.T.332 were free from infection. The test variety Kenya Farmer was lightly infected at New Liskeard, Ont., and segregated for resistance and susceptibility at Vineland, Ont. It is doubtful that these infections have much significance. Kenya Farmer has been grown in the rust nurseries since 1954 and has never been heavily infected.

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Table 1. Percent infection of stem rust (*Puccinia graminis* f. sp. *tritici*) on 17 wheat varieties in uniform rust nurseries at 19 locations* in Canada in 1974

Location	Common wheat														Durum wheat		
	Red Bobs	Lee	Pitic 62	Neepawa	Napayo	Kenya Farmer	CI 8154 X Frocor 2	Glenlea	Exchange	Frontana	Thatcher 6 X Transfer	R.L. 4255	Agatha	Hercules	Mindum	Wascana	D.T. 332
Creston, B.C.	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melfort, Sask.	tr**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Indian Head, Sask.	tr	0	0	0	0	0	0	0	0	0	0	tr	tr	0	10	0	0
Brandon, Man.	10	tr	0	0	0	0	0	0	tr	0	5	1	0	0	1	0	0
Durban, Man.	20	tr	0	0	0	0	0	0	0	0	tr	tr	tr	0	5	0	0
Morden, Man.	60	tr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glenlea, Man.	30	10	tr	0	tr	tr	0	0	tr	tr	tr	5	0	0	1	0	0
Thunder Bay, Ont.	50	40	tr	0	0	0	0	0	1	0	5	1	0	0	tr	0	0
New Liskeard, Ont.	60	50	1	0	0	10	0	0	1	5	1	5	tr	0	5	0	0
Guelph, Ont.	50	tr	5	0	0	0	0	0	30	tr	tr	0	0	0	0	0	0
Ottawa, Ont.	30	5	40	0	0	tr	0	0	1 0	5	2 0	1 0		0	5	0	0
Appleton, Ont.	60	1	10	0	0	0	0	0	tr	tr	5	5	0	0	tr	0	0
Sunbury, Ont.	60	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vineland, Ont.	10	5	0	0	0	tr, 60	0	0	tr	tr	tr	0	0	0	tr	0	0
La Pocatière, P.Q.	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quebec, P.Q.	80	25	0	0	0	0	0	0	0	0	0	0	0	0	tr	0	0
Macdonald College, P.Q.	tr	tr	30	tr	0	0	0	0	0	0	0	0	0	0	0	0	0
Lennoxville, P.Q.	1 0	0	-	-	0	0			-	-	-	-	-	0	-	0	0
Normandin, P.Q.	tr	tr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

** tr =trace

* No rust was observed in nurseries at 12 locations: Agassiz, B. C.; Edmonton, Beaverlodge, Lacombe and Lethbridge, Aita.; Scott, Sask.; Kemptville, Ont.; Truro and Kentville, N.S.; Fredericton, N.B.; Charlottetown, P.E.I.; St. John's, Nfld.

No data

Table 2. Percent infection by stem rust *(Puccinia graminis)* on three varieties of barley and one variety of rye in uniform rust nurseries at 15 locations* in Canada in 1974

Location	Barley			Rye
	Montcalm	Parkland	C.I. 10644	Prolific
Creston, B.C.	15	10	60	20
Indian Head, Sask.	5	5	5	40
Brandon, Man.	tr	0	0	0
Morden, Man.	0	0	0	80
Thunder Bay, Ont.	tr	0	0	0
New Liskeard, Ont.	50	0	0	5
Guelph, Ont.	0	0	0	tr
Ottawa, Ont.	20	0	0	70
Appleton, Ont.	0	0	tr	80
Sunbury, Ont.	5	1	20	50
Vineland, Ont.	0	0	0	5
La Pocatière, P.Q.	0	0	0	20
Macdonald College, P.Q.	0	0	0	tr
Lennoxville, P.Q.	0	0	0	60
Truro, N.S.	0	0	0	tr

* No rust was observed in nurseries at 16 locations: Agassiz, B.C.; Edmonton, Beaverlodge, Lacombe and Lethbridge, Alta.; Scott and Melfort, Sask.; Durban and Glenlea, Man.; Kemptville, Ont.; Quebec and Normandin, P.Q.; Kentville, N.S.; Fredericton, N.B.; Charlottetown, P.E.I.; St. John's Nfld.

Table 3. Distribution by provinces of physiologic races of *Puccinia graminis* f. sp. *tritici* on wheat, barley, and grasses, and frequency of isolation of *P. graminis* f. sp. *secalis* from barley and grasses in 1974

Virulence formula and (race) numbers	Virulence formula (eftectivelineffective host genes)	Number of isolates from: Que.	Ont.	Man.	Sask.	Alta.	B.C.	Total number of isolates	Percent of total isolates
C 9 (15B-1L)	6,7a,8,9a,9b,10,13,15,17,22,Tt2/5,9d,9e,11,14			2				2	0.5
C10 (15B-1)	6,7a,8,22,GB/5,9a,9b,9d,9e,10,11,13.14.1 5.17,Tt2			1	1			2	0.5
C15 (32)	6,7a,9d,9e,10,13,17,22,Tt2/5,8,9a,9b,11,14,15		1					1	0.2
C17 (56)	6,8,9a,9b,9d,9e,11,13.17,22,Tt2/5,7a,10,14,15	3	1					4	0.9
C18 (15B-1L)	6,8,9a,9b,13,15,17,22,Tt2/5,7a,9d,9e,10,11,14	1		27	20			48	11.2
C22 (32)	9a,9d,9e,13,22,Tt2/5,6,7a,8,9b,10,11,14.1 5.17			1				1	02
C23 (38-39)	9a,9e,11,Tt2/5,6,7a,8,10,15			1				1	02
C25 (38)	9a,9e,Tt2/5,6,7a,8,10,11,15		3	19	2			24	5.6
C27 (33)	6,8,9e,11,17,Tt2/5,7a,9a,10,15						3	3	0.7
C33 (15B-1L)	6,9a,9b,13,15,17,22,Tt2/5,7a,8,9d,9e,10,11,14	2	16	164	74	14		270	63.0
C35 (32-113)	9d,9e,10,11,13.17,22,Tt2/5,6,7a,8,9a,9b,14,15	2	6	2	1			11	26
C37 (15)	6,8,9a,9b,1 I,13,17,22,Tt2/5,7a,9d,9e,10,14,15			1				1	0.2
C38 (15B-1L)	6,8,9a,9b,13,17,22,Tt2/5,7a,9d,9e,10,11,14,15			2				2	0.5
C39 (32-113)	6,9d,9e,10,13,17,22,Tt2/5,7a,8,9a,9b,11,14,15		1					1	0.2
C40 (32-113)	6,9d,9e,10,13,17,22,Tt2/5,7a,8,9a,9b,11,14,15		1					1	0.2
C41 (32-113)	9d,9e,10,13,17,22,Tt2/5,6,7a,8,9a,9b,11,14,15		3	1				4	0.9
C42 (15)	6,8,9a,9b,11,13.15,17,22,Tt2/5,7a,9d,9e,10,14			3	1			4	0.9
C44 (15B-1L)	6,9a,9b,13,17,22,Tt2/5,7a,8,9d,9e,10,11,14,15		2					2	05
C46 (15B-1L)	6,8,9a,9b,13,15,22,Tt2/5,7a,9d,9e,10,11,14.17		1	7	3	2		13	3.1
C49 (15)	6,9a,9b,11,13,15,17,22,Tt2/5,7a,8,9d,9e,10,14			6	4			10	2.4
C53 (15B-1L)	6,9a,9b,13,15,22,Tt2/5,7a,8,9d,9e,10,11,14,17			1	2			3	0.7
C55 (15)	6,8,9a,9b,11,13,15,22,Tt2/5,7a,9d,9e,10.14.1 7			1				1	0.2
C56 (38-151)	6,7a,8,9e,10,11,Tt2/5,9a,15		6					6	1.4
C57 (32)	9a,9d,9e,22,Tt2/5,6,7a,8,9b,10,11,13,14,15,17		1	2				3	0.7
C58 (29)	5,9a,9b,9d,9e,11,13,15,22,Tt2/6,7a,8,10,14,17		1					1	0.2
C59 (31)	9d,9e,13,22,Tt2/5,6,7a,8,9a,9b,10,11,14,15,17			1				1	0.2
C60 (11)	6,7a,9a,9b,9d,9e,10,13,17,22,Tt2/5,8,11,14.15		2					2	0.5
C61 (38)	6,7a,9e,10,11,Tt2/5,8,9a,15,17		1	1				2	0.5
C62 (11)	6,8,9b,9d,9e,11,13,22,Tt2/5,7a,9a,10,14,15,17						1	1	0.2
C63 (32)	7a,9d,9e,10,11,13,17,22,Tt2/5,6,8,9a,9b,14,15		2					2	0.5
C64 (113)	6,8,9b,9d,9e,11,13.14,22,Tt2/5,7a,9a,10,15,17	1						1	0.2
C65 (38)	6,8,9e,11,17,Tt2/5,7a,9a,10,15	1						1	0.2
Total wheat stem rust isolates		10	48	243	108	16	4	429	100
Rye stem rust isolates			4	29	54	3		90	

The barley *(Hordeum vulgare* L. emend Lam.) varieties Parkland and C.1.10644 were not grown in the nurseries in 1974. In their place, the wheat-stem-rust-resistant rye-stem-rust-susceptible varieties Conquest (6-row) and Wpg M 7118-702-13 (2-row) were grown. The barley variety Montcalm, which is susceptible to wheat stem rust and rye stem rust, and the rye (*Secale cereale* L.) variety Prolific were retained.

Stem rust infected Prolific rye at 13 locations (Table 2) but apparently the barley varieties matured too early for appreciable rust development. The infection on barley varieties at Creston, B. C., and Sunbury, Ont., appear to be caused mainly by rye stem rust, while at New Liskeard, Ont., wheat rust predominated.

Physiologic races

The increased prevalence of wheat stem rust in 1974 made possible the collection of a large number of rust samples. A total of 429 isolates were obtained from susceptible varieties in experimental plots and from wild barley.

Physiologic races were identified by the "standard" and "formula" methods used in earlier years (2). The number of "standard" differentials was reduced from four to three *(T. aestivum* 'Marquis', *T. durum* 'Mindum', and *T. monococcum* L. 'Einkorn'), and resistance genes *Sr12*, *Sr16*, and *Sr18* were not used as "formula" differentials. Genes *Sr9e*, *Sr22*, and *SrTt2* continued to be useful and have been added to the formulas where possible. The characteristics of the identified genes used in the "formula" method have been described (2).

Thirty-two races were identified in 1974 (Table 3). In the previous 10 years from 10 to 19 races were found

Table 4. Formula (race) numbers, virulence formulas, and infection types produced on four wheat varieties by stem rust races found in Canada to 1974

Formula and (race) numbers	Virulence formula: Effective genes	Virulence formula: Ineffective genes	Infection type on: Sk	Mit	Np	Ptc62
1964						
C 1 (17)	5,6,7a,9a,9b,9d,9e,10,11,13,17,22,Tt2	8,14,15		*0*		
C 2 (17A)	5,6,7a,9a,9b,9d,9e,10,13,17,22,Tt2	8.11,14.15		*0*	23	
C 3 (29-4)	5,6,9a,9d,11	7a,8,9b,10,13,14,15,17			0	
C 4 (23)	5,6,8,9a,9e,11,17,Tt2	7a,10,15				
C 5 (29-1)	5,9a,9b,9d,9e,11,22,Tt2	6,7a,8,10,13,14,15,17,GB	3+		1	
C 6 (29-2)	5,9a,9b,9d,11,13,15,GB	6,7a,8,10,14,17	3+	*0'*	0	
C 7 (48)	5,9a,11,15	6,7a,8	2	*0*	0	
C 8 (48A)	5,11	6,7a,15,GB				
C 9 (15B-1L)	6,7a,8,9a,9b,10,13,15,17,22,Tt2	5,9d,9e,11,14				2
C10 (15B-1)	6,7a,8,22,GB	5,9a,9b,9d,9e,10,11,13.14.15,17,Tt2			;2	1
C11 (15B-4)	6.7a.8	5,9a,9b,9d,10,11,13.14.15,17,GB			2	
C12 (11)	6,7a,9a,9b,9d,10,13,14,17	5,8,11,15		*0'*	1	
C13 (32-113)	6,7a,9d,9e,10,11,13,17,22,Tt2	5,8,9a,9b,14,15			;1	
C14 (14,38)	6,7a,9e,10,11,15,Tt2	5,8,9a			;2	
C15 (11-32-113)	6,7a,9d,9e,10,13,17,22,Tt2	5,8,9a,9b,11,14,15			;3c	3+,;1
C16 (39)	6,7a,8,9e,11,Tt2	5,9a,10,15				
C17 (11,56)	6,8,9a,9b,9d,9e,11,13,17,22,Tt2	5,7a,10,14,15				
C18 (15B-1L)	6,8,9a,9b,13,15,17,22,Tt2	5,7a,9d,9e,10,11,14			;1	
C19 (10-38)	6,7a,9e,10,11,Tt2	5,8,9a,15			2	;,2
C20 (11,87)	7a,8,9d,9e,11,13,22,Tt2	5,6,9a,9b,10,14,15,17	3+	12	2	2
C21 (32)	9a,9d,9e,11,13,22,Tt2	5,6,7a,8,9b,10,14,15,17	23C	;3	;3-	23+
C22 (32)	9a,9d,9e,13,22,Tt2	5,6,7a,8,9b,10,11,14,15,17	3+	23	12	2
C23 (38)	9a,9e,11,Tt2	5,6,7a,8,10,15	2	23	;2	3+
1965						
C24 (17)	5,7a,9a,9b,9d,9e,10,13,17,22,Tt2	6,8,11,14,15		0	0	
C25 (38)	9a,9e,Tt2	5,6,7a,8,10,11,15	2'	3+	3±	2
C26 (15B-4)	6,7a,8,9b,13,15,17	5,9a,9d,10,11,14			12	
C27 (33,59)	6,8,9e,11,17,Tt2	5,7a,9a,10,15			1	1
C28 (18,54)	6,8,9b,9d,9e,11,15,17,22,Tt2	5,7a,9a,10,13,14	;1	*0'*	0	1
C29 (17)	5,6,7a,9a,9d,9e,10,11.1 3.17,22,Tt2	8,9b,14,15			0	
C30 (29)	9a,9b,9d,9e,22,Tt2	5,6,7a,8,10,11,13,14,15,17	3+cn	2	;3	2±
1966						
C31 (27)	5,6,7a,9b,9d,10,11,13,14,17	8,9a,15		*0*		
1967						
C32 (32)	9a,9b,9d,9e,11,13,22,Tt2	5,6,7a,8,10,14,15,17	3+c	3±	;3	2±
1968						
C33 (15B-1L,115)	6,9a,9b,13,15,17,22,Tt2	5,7a,8,9d,9e,10,11,14			;2	
C34 (32)	6,7a,9a,9b,9d,9e,11,22,Tt2	5,8,10,13,14,15,17	X+	;3	2	2
1969						
C35 (32-113)	9d,9e,10,11,13,17,22,Tt2	5,6,7a,8,9a,9b,14.15		3t	3±	3+
C36 (48)	5,6,7a,11	10,15				
C37 (15)	6,8,9a,9b,11,13,17,22,Tt2	5,7a,9d,9e,10,14,15			1	
1970						
C38 (15B-1L)	6,8,9a,9b,13,17,22,Tt2	5,7a,9d,9e,10,11,14,15				1
C39 (32-113)	6,9d,9e,10,13,17,22,Tt2	5,7a,8,9a,9b,11,14,15			13+	
C40 (32-113)	6,9d,9e,10,13,17,22,Tt2	5,7a,8,9a,9b,11,14.15			2	2,;
C41 (32-113)	9d,9e,10,13,17,22,Tt2	5,6,7a,8,9a,9b,11,14,15		3±	23	3+
C42 (15)	6,8,9a,9b,11,13,15,17,22,Tt2	5,7a,9d,9e,10,14				
C43 (32)	6,7a,8,9d,9e,11,22,Tt2	5,9a,9b,10,13,14,15,17				
1971						
C44 (15B-1L)	6,9a,9b,13,17,22,Tt2	5,7a,8,9d,9e,10,11.1 4,15			2	

Table 4. (ctd)

Formula and (race) numbers	Virulence formula: Effective genes	Virulence formula: Ineffective genes	Infection type on:* Sk	Mit	Np	Ptc62
1972						
C45 (56A)	8,9a,9b,9d,9e,11,13,17,22,Tt2	5,6,7a,10,14,15	3+,;	;	;	1
C46 (156-1L)	6,8,9a,9b,13,15,22,Tt2	5,7a,9d,9e,10,11,14,17		;	;2	
C47 (156-1L)	6,9a,9b,10,13,17,22,Tt2	5,7a,8,9d,9e,11,14,15		;	;1	
C48 (156-1L)	6,8,9a,9b,17,22,Tt2	5,7a,9d,9e,10,11,13,14,15		;	12	
C49 (15)	6,9a,9b,11,13,15,17,22,Tt2	5,7a,8,9d,9e,10,14		;	;1	
C50 (15B-5)	7a.8	5,6,9a,9b,9d,10,11,13,14,15,17	4	;1	X-	1+
C51 (32-113)	9d,9e,10,13,22,Tt2	5,6,7a,8,9a,9b,11,14,15,17	3+	23	23	3+
C52 (32-113)	9d,9e,10,11,13,22,Tt2	5,6,7a,8,9a,9b,14,15,17	3+	3t	3±	3+
1973						
C53 (15B-1L)	6,9a,9b,13,15,22,Tt2	5,7a,8,9d,9e,10,11,14,17	;1	;	;1	;
C54 (38)	6,7a,9e,10,11,17,22,Tt2	5,8,9a,15		;	2	;
1974						
C55 (15)	6,8,9a,9b,11,13,15,22,Tt2	5,7a,9d,9e,10,14,17	;1	;	;2	;1
C56 (38-151)	6,7a,8,9e,10,11,Tt2	5,9a,15		;	;2	;,2
C57 (32)	9a,9d,9e,22,Tt2	5,6,7a,8,9b,10,11,13.14,15,17	3+c	23+	23+	3-,3+
C58 (29)	5,9a,9b,9d,9e,11,13.15,22,Tt2	6,7a,8,10,14,17	3+	0	0	
C59 (31)	9d,9e,13,22,Tt2	5,6,7a,8,9a,9b,10,11,14,15,17	3+c	;3	;2	3+
C60 (11)	6,7a,9a,9b,9d,9e,10,13,17,22,Tt2	5.8.11,14,15			;2	
C61 (38)	6,7a,9e,10,11,Tt2	5,8,9a,15,17		;	;2	;,2
C62 (11)	6,8,9b,9d,9e,11,13,22,Tt2	5,7a,9a,10,14,15,17		,	,	
C63 (32)	7a,9d,9e,10,11,13,17,22,Tt2	5,6,8,9a,9b,14,15	X=	23	23	3
C64 (113)	6,8,9b,9d,9e,11,13,14,22,Tt2	5,7a,9a,10,15,17		;	;1	;,2
C65 (38)	6,8,9e,11,17,Tt2	5,7a,9a,10,15		;	;1	;,2

* Sk = Selkirk, Mit = Manitou, Np = Neepawa, Ptc62 = Pitic 62

each year. The large number of races in 1974 can be attributed partly to the increased size of the rust population that permitted the identification of many more isolates and partly to the sensitivity of ''single-gene'' differentials. The addition of resistance genes *Sr9e, Sr22,* and *SrTt2* did not increase the number of races. Gene *Sr17*, which has been used since 1970, is a good differential and has increased the number of races identified. Eleven of the 32 races identified are new. The number of new races identified from 1966 to 1973 in sequence are: 1,1,2,3,6,1,6,2. The 11 new "formula" races are strains of four "standard" races and together with the previously known races identified represent a broader range of variability than has been observed in the rust population for many years.

Race C33(15B-1L) predominated, as it has since 1970, and race C18(15B-1L) was again second in order of prevalence. They do not threaten the resistant varieties now grown in western Canada. Race C25(38) was third in prevalence and races C35(32-113), C46(15B-1L), and C49(15) were fairly common. Of the last three races, only race C49(15B-1L) was not present in 1973. Races C35(32-113) and C25(38) have potentially important virulence combinations. Although the other 25 races occurred rarely some are of considerable interest. Race C9(15B-1L) (2 isolates) was last found in 1970 (1 isolate). Race C10(15B-1) appeared for the second consecutive year after a long absence. The well-known race C17(56) reappeared after a 1-year absence. The new races, C55 to C65, were of rare or local occurrence. Three of them [C57(32), C59(31), and C63(32)] are moderately virulent on seedlings of commercial varieties (Table 4) and require further investigation. Their failure to infect commercial varieties in farm fields in 1974 suggests that they do not pose an immediate threat to western Canadian varieties but they are members of the "standard" race group 11-32-113 that has shown a tendency to increase in virulence on Thatcher derivatives such as Manitou, Neepawa, and Napayo.

The rare occurrence of an intermediate interaction on the Chinese Spring-*Sr11* line has been reported in races C33(15B-1L) and C35(32-113)(3). In 1974 the intermediate interaction on *Sr11* was again observed in the same races and in races C18(15B-1L), C49(15), and C57(32). Other interesting variants observed in the predominant race C33(15B-1L) were a culture that produced an intermediate interaction on Marquis, and one that produced a moderately susceptible reaction on Marquis-Sr*13*.

Cultures of rare races that were isolated many years ago were retested on present day differentials and some

Table 5. Percent of total isolates avirulent on single identified resistance genes and number of avirulent races in 1974 and (1973)*

Resistance gene	Avirulent isolates (%) 1974 (1973)	Number of avirulent races 1974 (1973)
Sr 5	0.2 (0)	1 (0)
Sr 6	88.9 (88.7)	23 (8)
Sr 7a	4.1 (10.3)	7 (3)
Sr 8	20.7 (14.1)	14 (4)
Sr 9a	91.3 (78.4)	17 (5)
Sr 9b	85.2 (78.4)	16 (5)
Sr 9d	7.7 (11.3)	14 (3)
Sr 9e	16.3	20
Sr10	7.5 (20.7)	10 (5)
Sr11	11.3 (19.8)	15 (4)
Sr13	90.2 (89.7)	24 (8)
Sr14	0.2 (0)	1 (0)
Sr15	82.2 (82.2)	9 (5)
Sr17	86.1 (87.9)	18 (6)
Sr22	91.6	32
Sr Tt2	99.5	31

* 1974 - 32 races: 1973 - 11 races.

formulas (Table 4) have been updated. A culture of race C12(11) produced infection type 3 on Chinese Spring-*Sr11*, and *Sr11* was moved to the ineffective side of formula. The difference probably occurred because Marquis-*Sr11* used in former years was more resistant to race group 11-32-113 than the Chinese Spring line used now. Similarly, in formula C19(10,38), *Sr7a* has been moved to the effective side on the basis of a recent test. Marquis-*Sr7a* has been an unstable differential and the recent test was probably performed under conditions more suitable for the expression of resistance.

Races avirulent on gene *Sr7a* have declined in prevalence (3) but in 1974 four new races from Ontario [C56(38-151), C60(11), C61(38), and C63(32)] were avirulent on *Sr7a*. These races were uncommon and may have originated on barberry. Except for one isolate they were found in an area where susceptible winter wheat varieties are grown and hence avirulence on *Sr7a* should not be a disadvantage.

In recent years most stem rust collections on wild barley were rye stem rust. To insure a larger number of wheat stem rust isolates in 1974, and to investigate whether intensive local sampling is adequate for survey purposes, large numbers of collections were made from specially planted plots of susceptible Klein Titan at Morden, and from Marquis in cooperative tests at Portage and Brandon, Manitoba. Fourteen of the 19 races identified in Manitoba were isolated from the 159 samples from the three locations; 12 of the 19 races were isolated from wheat and wild barley at 84 other locations. The isolates from Morden, Portage, and Brandon (65% of the total) revealed 74% of the races and the isolates

Table 6. Infection types produced on 30 resistant varieties by 12 composite collections of urediospores from 429 isolates of wheat stem rust collected in 1974

Variety	Lowest	Highest
Mida-McMurachy-Exchange 11-47-26		; to 3+
Frontana-K58-Newthatch II-50-17		; to 3+
Chris	; to 4	
Era		; to 2
Agent	2	
Agatha	2	
St 464	;1	2
WRT240 (Manitou with rye translocation)	,	
Bonny		
Kenya Farmer	1	23
Webster	2	23
Hercules	;1	
Esp 518/9		
Tama		;1±
Romany		; to 2
Saric 70	2	
N.D. 499	;1	2
D.T. 411		;1
Etoile de Choisi	2'	
R.L. 5405 (resistance from *Aegilops squarrosa*)	2	
C.T. 440	; to 3	; to 4
N.D. 506	1	2
C.T. 488	;	;1
Norquay	;	1
Wascana	;1	2
Wakooma	;1	2
Macoun	;1	
Rosner		
T^6 x (Rsc x Etoile de Choisi)	2	
$(P \times Mq^8)^6$ x (Rsc x Etoile de Choisi)	2	

from the other locations (35%) revealed 63% of the races. Apparently the more isolates identified the more races one can expect. Intensive local collecting seems to be an excellent method for determining prevalence of the main races and for detecting some of the rare races, but it would be unwise to depend on it exclusively.

The percentages of the isolates avirulent on each resistance gene (Table 5) did not change significantly from 1973. Genes Sr6 and *Sr13* continue to be effective against most races but Sr6 was ineffective against nine rare races and *Sr13* against two rare races. Genes Sr13 and Sr22 are in Marquis backcross lines. Consequently their effectiveness against the Marquis avirulent race group 38-151 is uncertain and these rust strains were not included in the percentages in Table 5. Eleven races were virulent on Renown Sel. carrying *Sr17*. Resistant winter wheats derived from Hope may be exerting selection pressure favoring virulence on *Sr17*. Marquis-*Sr22* was resistant to all isolates and gene *SrTt2* and effective against all races excepting C10(15B-1).

A group of 30 highly resistant varieties was inoculated with 12 composite collections of urediospores from all isolates identified. The results (Table *6)* are similar to those obtained in earlier years. Only the varieties Mida-McMurachy-Exchange 11-47-26, Frontana-K58-Newthatch 11-50-17, Chris, and C.T.440 had susceptible infections

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