Canadian Plant Disease Survey

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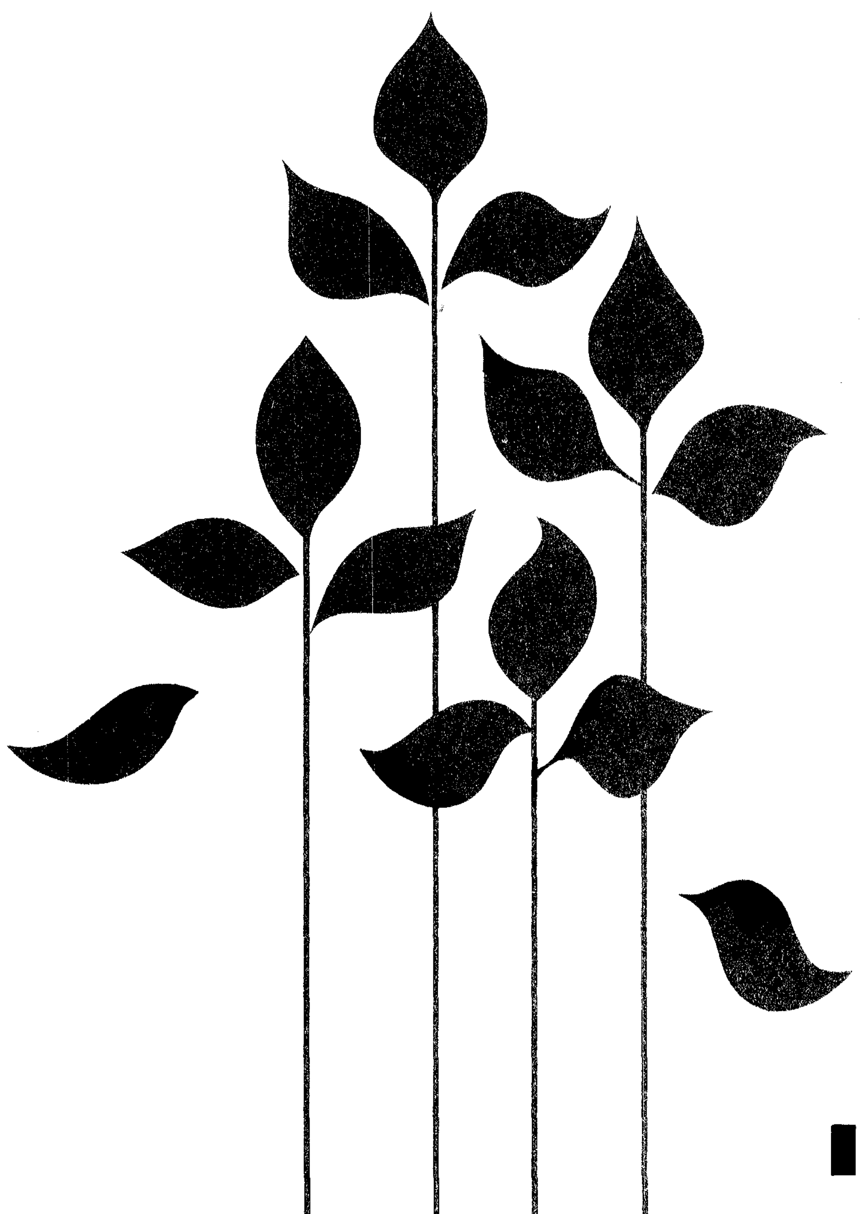

Agriculture Canada

Canadian Plant Disease Survey

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Contents

The *Canadian Plant Disease Survey* is a periodical of information and record on the occurrence and severity of plant diseases in Canada and on the assessment of losses from disease. Other original information such as the development of methods of investigation and control, including the evaluation of new materials, will also be accepted. Review papers and compilations of practical value to plant pathologists will be included from time to time.

Canadian Plant Disease Survey est un périodique d'information sur la fréquence des maladies des plantes au Canada, leur gravité, et les pertes qu'elles occasionnent. La rédaction accepte d'autres communications originales notamment sur la mise au point de nouvelles méthodes d'enquête et de lutte ainsi que sur l'évaluation des nouveaux produits. De temps à autre, il inclut des revues et des synthèses de rapports d'intérêt immédiat pour les phytopathologistes.

Research Branch, Agriculture Canada
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Pourridié fusarien et maladies du feuillage chez la luzerne au Québec en 1974[1]

C. Richard et C. Gagnon

Un inventaire préliminaire, entrepris au Québec en 1974, montre la prédominance de quatre maladies du feuillage (la tache commune, la tige noir, la tache stemphylienne, et la tache leptosphaerulinienne) et du pourridié fusarien chez la luzerne. Les pertes dues à ce dernier ont été estimées expérimentalement à 18 pourcent.

Can. Plant Dis. Surv. 55: 45-47. 1975

A preliminary survey of alfalfa in Quebec showed that in 1974 the predominant diseases were fusarium root rot and four foliage diseases, common leaf spot [*Pseudopeziza medicaginis*], black stem [*Phoma medicaginis* var. *medicaginis*], stemphylium leafspot [*Stemphylium botryosum*], and pepper spot [*Leptosphaerulina briosiana*]. Losses due to root rot were experimentally estimated at 18%.

Le dernier inventaire des maladies de la luzerne remonte à 1966 (1). Depuis, quelques maladies ont été rapportées à l'occasion dans le rapport annuel du *Canadian Plant Disease Survey*. Un inventaire préliminaire fut donc entrepris en 1974 pour connaître l'état des maladies du feuillage et surtout du pourridié fusarien de la racine et de la couronne chez la luzerne. De plus, nous avons tenté de déterminer l'effet de la pourriture sur le rendement des plants de luzerne.

Matériel et méthodes

L'inventaire couvre la partie agricole de la province de Québec (Figure 1). La région de Montréal n'a pas été couverte, la luzerne étant pratiquement disparue à la suite de deux hivers dévastateurs successifs. La distribution des luzernières par rapport à leur âge est la suivante: 7 de 1 an, 12 de 2 ans, 9 de 3 ans, 4 de 4 ans, 1 de 5 ans et 1 de 6 ans. L'inventaire a été effectué sur une période allant du 14 septembre au 22 octobre, soit avant la dernière coupe.

Les champs de luzerne ont été choisis, en cours de route, en fonction de leur représentativité régionale. Dans chaque champ, le pourcentage de couverture a été noté et cinq places-échantillons représentatives ont été choisies. A chaque place-échantillon, nous avons prélevé cinq plants de luzerne pour l'analyse des maladies. L'indice des maladies du feuillage et celui du pourridié fusarien ont été pris le même jour sur le matériel conservé dans une glacière. Pour déterminer l'indice de pourriture, les racines ont été fendues longitudinalement à partir de la couronne, et l'indice a été déterminé selon l'échelle suivante:

Indices/Critères

0 Tissue sain
1 Léger brunissement, tissu affecté 0-10%
2 Brunissement, présence de nécrose, 10-50%
3 Brunissement général, forte proportion de nécrose, 50-90%
4 Nécrose générale, 90-100%
5 Plant mort, nécrose 100%

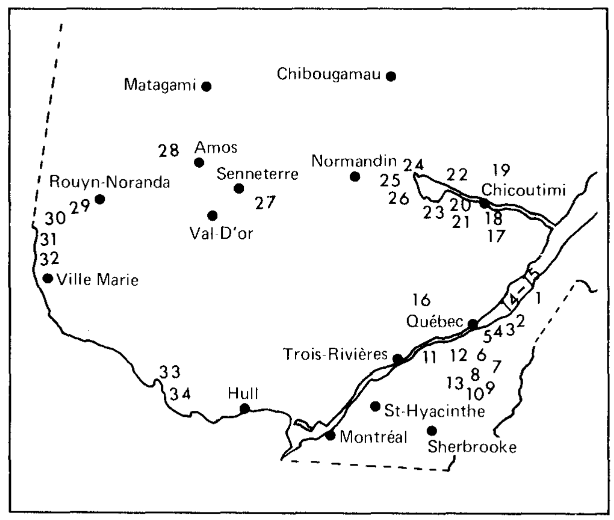

Figure 1. Endroit visités lors de l'inventaire des maladies (les chiffres indiquent les points d'échantillonnage).

Nous avons déterminé l'indice des maladies du feuillage selon une méthode semblable à celle de Berkenkamp (2). Pour la tige noire et les taches leptosphaerulinienne et stemphylienne, l'indice a été basé sur le pourcentage moyen de feuilles atteintes sur les 25 plantes cueillis dans chaque champ. Dans le cas de la tige noire, nous avons tenu compte également de la proportion de la tige affectée pour evaluer la defoliation. L'indice de la tache commune a, pour sa part, été basé sur les symptômes, la proportion de feuilles affectées, et leur distribution sur le plant tel que decrit par Berkenkamp(2).

[1] *Contribution no. 53, Station de recherche, Agriculture Canada, 2560 chemin Gomin, Sainte-Foy, Québec G1V 2J3*

Tableau 1. Indice de pourriture et intensité des maladies du feuillage observées au Québec

		Indice* de maladie				
Comptés	Numero de champs	Pourriture	Tache commune	Tache leptosphaerulinienne	Tache stemphylienne	Tige noire
L'Islet	1	0.72				
Montmagny	2,3	0.68	1	0	1	8
Bellechasse	4,5	0.96	1	0	0	8
Lévis	6	0.40	1	1	15	25
Dorchester	7,8	1.44	13	1	7.5	13
Beauce	9	1.68	50	0	1	15
Lotbinière	10-12	0.73	25.3	1	5.7	21.7
Mégantic	13	1.09	25	0	1	25
Montmorency	14,15	0.78	50	0	1	25
Portneuf	16	0.96	25	1	1	1
Chicoutimi	17-19	0.91	16.7	5	1	1
Lac St-Jean Est	20-22	0.65	17	10.3	5.3	5.7
Lac St-Jean Ouest	23-26	1.00	18.8	22.5	1	11.5
Abitibi	27,28	0.92	1	0	1	8
Témiscamingue	29,30	0.87	31.5	1	4.3	8
Pontiac	33,34	1.16	50	1	1	13

* Pourriture 0—5, maladies du feuillage 0—100.

Pour déterminer l'influence de la pourriture sur le rendement, 124 plantes de luzerne de 5 ans, pris au hasard dans une parcelle de 18 × 6 pieds (5.5 × 1.8 m), furent transplantés dans du terreau à l'automne 1974 et déposés en serres dans des conditions de croissance favorables (température, luminosité, etc.). Ils ont été coupés une première fois à 5% de floraison, et le rendement a été noté à la deuxième coupe après laquelle l'indice de pourriture et le diamètre de la racine au collet ont été déterminés.

Resultats

Les résultats de l'inventaire sont résumés au tableau 1. La pourriture de racine est présente partout. Les maladies du feuillage rencontrées ont été par ordre d'importance, la tache commune, [*Pseudopeziza medicaginis* (Lib.) Sacc.], la tige noire [*Phoma medicaginis* Malbr. & Roum. var. *medicaginis*], la tache stemphylienne [*Stemphylium botryosum* Wallr.], et la tache leptosphaerulinienne [*Leptosphaerulina briosiana* (Poll.) Graham & Luttrell].

Le tableau 2 et la figure 2 illustrent les relations établies entre le degré de pourriture et le rendement. Comme on pouvait s'y attendre, le rendement des plants diminue considérablement à mesure que l'indice de pourriture augmente. Du moins, c'est la tendance que montrent les courbes des classes de 13 et 15 mm de diamètre. Les classes de 5, 17 et 19 mm de diamètre ne sont pas représentées à cause du trop petit nombre de plants.

Discussion et conclusion

Les maladies du feuillage observées chez la luzerne au cours du présent inventaire avaient aussi été rapportées par Aubé (1967), avec relativement la même gravité et la même fréquence dans le cas de la tache commune et de la tige noire. Aubé a aussi rapporté les taches stemphylienne et leptosphaerulinienne avec la même gravité, mais avec une fréquence moins élevée.

On savait, expérimentalement, que les *Fusarium* peuvent endommager considérablement les plants auxquels on les inocule, causant la fonte des semis et la pourriture

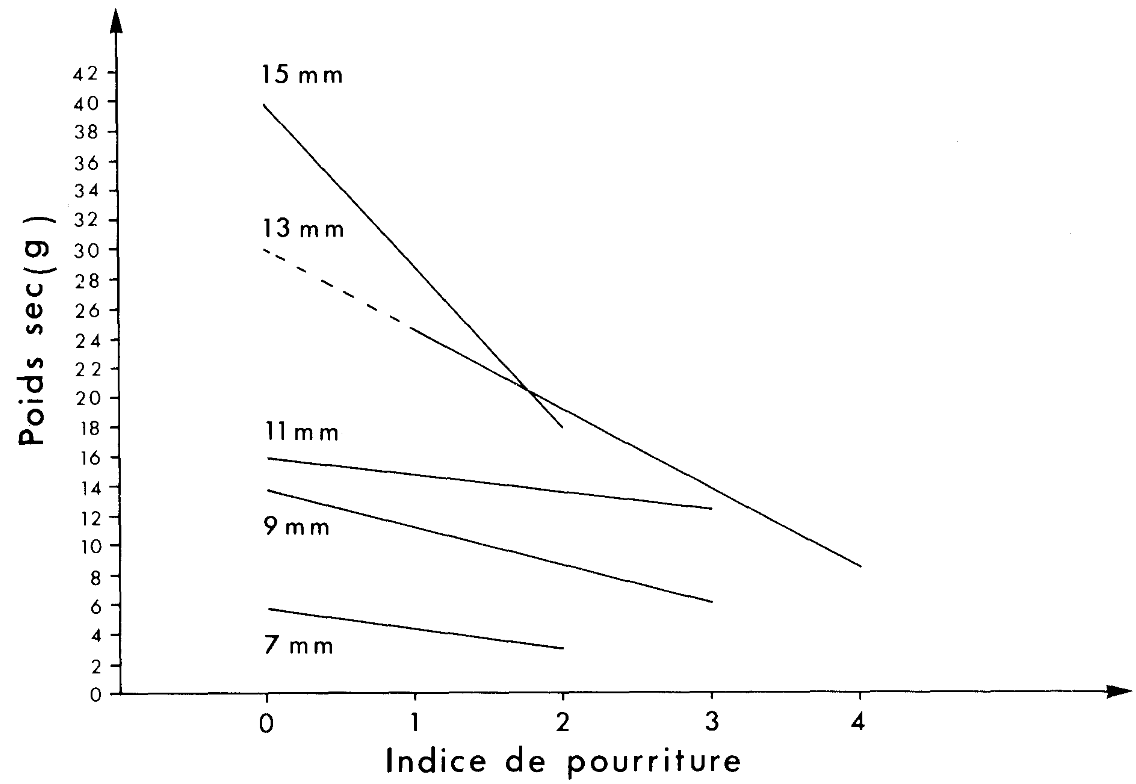

Figure 2. Rendement en poids sec des plants en fonction de l'indice de pourriture (par classe de diamètre).

Tableau 2. Poids sec (g) de plants de luzerne par indice de pourriture et classe de diamètre de la racine

Classe de diamètre	Indice* 0	1	2	3	4
7	7.5(4)†	3.8(4)	6.5(3)		
9	8.9(4)	14.3(17)	5.0(8)	13.8(5)	
11	16.4(8)	14.1(13)	12.8(11)	14.4(7)	
13		23.4(14)	20.2(8)	12.9(4)	1.2(1)
15	41.7(2)	26.4(1)	19.6(4)		

* 0 = tissu sain, 5 = plant mort. † (nombre de mesures).

de la couronne et de la racine (3), mais on ignorait si la pourriture affecte le rendement des plants et jusqu'à quel point. Les courbes de rendement des plants transplantés du champ à la serre indiquent que la pourriture réduit bel et bien le rendement des plants.

Comme l'indice moyen des plants dans la province se situe près de 1, on peut calculer, à l'aide des courbes de rendement, la perte subie par les plants d'indice 1 par rapport à ceux d'indice O. En assumant que les mêmes classes de diamamètre sont représentées dans le champ, on arrive à une perte moyenne de 3.8 g par plant, chez les classes de 7 à 15 mm de diamètre, comparativement à une production moyenne de 21.2 g par plant, pour les plants sains chez les mêmes classes de diamètres. La perte imputable à la pourriture serait de l'ordre de 18 pourcent. Ce pourcentage, calculé à partir de plants ayant crû en serres, exprime un ordre de grandeur de la perte de rendement due à la pourriture, perte que l'on peut donc qualifier de très importante au Québec.

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Air-borne rust inoculum over western Canada in 1974[1]

G. J. Green

In 1974 urediospores of *Puccinia graminis* and *P. recondita* were trapped from May 28 to August 5. Spores were carried into western Canada in early June, but their numbers increased slowly because dry weather limited rust development. Rapid rust development in early August did not affect the spore counts. During 1960-1974, when spore trapping began about mid-May and ended August 31, the numbers of urediospores caught varied widely, even in years when field observations indicated about equal prevalence. The numbers of spores caught are an inexact measure of rust prevalence and damage, but together with field observations they are usually good indicators of the amount and distribution of infection.

Can. Plant Dis. Surv. 55: 48-50. 1975

En 1974, la récolte d'urédospores de *Puccinia graminis* et de *P. recondita* a duré du 28 mai au 5 août. Les années précédentes, on commençait la collecte vers la mi-mai pour la terminer le 31 août. Au début de juin 1974, les spores se sont disséminées dans l'ouest du Canada mais leur nombre a augmenté lentement car le temps sec a ralenti la croissance de la rouille. Le développement rapide de la rouille au début du mois d'août n'a pas influé sur le dénombrement des spores.
Entre 1960 et 1974, la quantité d'urédospores recueillie a varié même lorsque les observations in situ semblaient prévoir une dissémination d'importance égale. Le nombre de spores recueilli est une mesure inexacte de l'étendue de la rouille et des dégâts qu'elle comment mais en le combinant aux observations in situ on obtient généralement une bonne indication de la distribution et de l'étendue de l'infection.

The amount of air-borne inoculum of leaf and stem rusts of cereals over western Canada in 1974 was estimated by counting the number of urediospores caught on vaseline-coated microscope slides exposed for 48-hour periods in spore traps, as reported annually since 1960 in the *Canadian Plant Disease Survey*. Slides exposed at all locations excepting Saskatoon were examined at Winnipeg. The slides exposed at Saskatoon were examined by the staff of the Agriculture Canada Research Station, Saskatoon, Saskatchewan.

In previous years slide exposures began about mid-May and ended about August 31. In 1974, exposures began on May 28 and ended on August 5. This is the critical period for rust development in western Canada. The date on which infections first appear and subsequent development during June and July usually indicate whether or not the rusts have destructive potential although the greatest numbers of spores are caught during August.

The spore trap data for June and July obtained since 1960, together with a generalized assessment of rust prevalence and rust damage (Table 2), show a good correlation between the observed prevalence of leaf rust and estimated damage, but there is no close relationship between these observations and the numbers of spores of both rusts caught on the slides. A relationship between the stem rust spore counts and damage was not expected because the varieties grown in the rust area of Manitoba and Saskatchewan from 1960 to 1973 were resistant and there was little or no damage. Stem rust prevalence was assessed by observing rust development on susceptible varieties in experimental plots and on susceptible wild barley (*Hordeum jubatum* L.). The numbers of spores caught in each category of prevalence vary considerably, although spore counts were highest in the years of greatest prevalence. In 1960 and 1961 the main variety Selkirk was resistant to leaf rust, and from 1967 to 1969 the widely grown variety Manitou was also resistant. Leaf rust prevalence and damage were slight during these periods but the number of leaf rust spores caught varied from 242 to 6913. In years when varieties were moderately susceptible and prevalence was moderate, spore counts ranged from 2392 in 1971, when damage was moderate, to 20,696 in 1964, when damage was light. In 1963 and 1965, when prevalence was high, large numbers of spores were caught. Evidently the number of spores caught during the critical period of June and July is an inexact indication of the amount of rust damage, presumably because of differences between the relative rates of crop growth and disease development. However, spore trap data and field observations, taken together, are usually good indicators of infection severity and distribution.

In the winter wheat area of the central United States wheat stem rust was more prevalent in 1974 than it has been for several years and wheat leaf rust also was widespread. However, the total numbers of spores caught on the slides in 1974 (Table 1) was much lower than usual (Tables 1 and 2). Spores from the south were carried into western Canada in early June but the numbers of spores caught increased slowly. The early

[1] *Contribution No. 651, Agriculture Canada, Research Station, Winnipeg, Manitoba. R3T 2M9.*

Table 1. Number of urediospores of stem rust and leaf rust per square inch observed on vaseline-coated slides exposed for 48-hour periods at three locations in Manitoba and three locations in Saskatchewan in 1974

	Winnipeg		Morden		Brandon		Indian Head		Regina		Saskatoon	
Date	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust
May 28-29	0	0	0	0	0	0	0	0	0	0	0	0
30-31	0	0	0	0	0	0	0	0	0	0	0	0
May total	0	0	0	0	0	0	0	0	0	0	0	0
June 1-2	0	1	0	0	0	0	0	0	0	0	0	0
3-4	0	0	0	0	0	0	0	5	0	0	0	0
5-6	0	0	0	2	0	1	0	4	0	3	0	0
7-8	0	10	0	1	0	0	0	0	0	1	0	0
9-10	0	0	0	0	0	0	0	0	0	0	0	0
11-12	0	0	0	0	0	0	0	1	1	0	0	0
13-14	0	0	0	1	0	6	0	2	0	3	0	0
15-16	0	4	0	2	0	1	0	0	0	1	0	0
17-18	0	1	1	3	0	0	0	5	0	14	0	0
19-20	0	1	0	11	0	10	0	9	0	60	0	0
21-22	0	1	0	2	0	1	0	7	0	6	0	0
23-24	1	5	0	12	0	9	0	30	0	36	1	2
25-26	0	48	0	109	0	26	7	46	19	143	1	8
27-28	3	5	3	11	8	41	2	10	4	9	0	7
29-30	0	1	0	3	1	7	1	8	1	7	0	6
June total	4	77	4	157	9	102	10	127	25	283	2	23
July 1-2	0	1	0	2	0	3	0	3	0	3	0	12
3-4	0	1	0	1	0	2	0	6	0	7	0	22
5-6	1	9	4	31	0	1	0	5	0	1	0	3
7-8	1	4	0	1	0	1	0	1	0	3	0	5
9-10	0	1	1	6	0	2	0	9	0	9	0	17
11-12	0	3	0	10	0	3	0	4	0	6	0	8
13-14	0	3	0	1	0	2	0	1	0	2	0	4
15-16	0	3	0	2	0	1	0	3	1	15	0	11
17-18	1	3	0	0	0	0	0	2	0	3	0	1
19-20	0	1	3	9	0	1	0	1	0	2	0	14
21-22	1	1	0	1	1	2	0	1	0	3	1	30
23-24	0	3	1	7	0	1	0	0	0	4	4	71
25-26	1	7	0	16	1	12	0	13	1	21	0	67
27-28	3	9	0	6	0	25	1	26	1	50	0	39
29-30	0	4	0	17	0	1	1	3	3	20	0	170
31-1	3	8	0	12	1	17	0	13	3	38	3	168
July total	11	61	9	122	3	74	2	91	9	187	8	642
Aug. 2-3	0	6	2	10	0	3	0	0	0	8	3	16
4-5	2	7	0	1	0	6	0	5	2	22	8	180
Aug. total	2	13	2	11	0	9	0	5	2	30	11	196
1973 total	17	151	15	290	12	185	12	223	36	500	21	861

Table 2. Numbers of stem rust and leaf rust urediospores caught in spore traps at six locations during June and July from 1960 to 1972, with the prevalence and damage to wheat for each rust

Location	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Average
Stem rust														
Winnipeg	486	15	242	697	970	70	122	56	32	6	659	34	41	264
Morden	494	25	740	1,217	1,774	86	125	55	70	12	141	69	58	375
Brandon	47	6	240	460	506	119	50	14	11	12	20	29	94	124
Indian Head	9	13	57	639	300	1,018	202	5	15	21	52	15	43	184
Regina	13	9	23	1,186	1,111	3,465	108	42	11	4	74	33	106	476
Saskatoon	0	6	8	271	59	427	30	0	1	0	0	0	14	63
Total	1,049	74	1,310	4,470	4,720	5,185	637	172	140	55	946	180	356	
Average	175	13	219	745	787	865	107	29	24	10	158	30	60	
Prevalence*	T	T	M	M	M	M	T	Sl	T	T	Sl	Sl	Sl	
Damage*	Sl	Sl	Sl	Sl	Sl	Sl	Sl	Sl	Sl	Sl	Sl	Sl	Sl	
Leaf rust														
Winnipeg	502	29	250	6,160	6,077	1,998	847	303	3,154	57	2,559	279	1,034	1,789
Morden	1,197	51	2,203	16,081	6,718	2,759	1,728	1,407	2,292	44	905	835	1,090	2,870
Brandon	236	22	758	6,242	2,750	5,216	500	173	301	62	254	300	1,347	1,397
Indian Head	154	19	279	24,159	1,428	30,982	7,512	130	453	82	763	186	1,249	5,185
Regina	94	34	303	29,726	3,551	51,433	7,473	178	382	17	947	185	2,208	7,426
Saskatoon	326	87	261	49,707	172	40,777	11,265	281	331	347	1,693	607	1,082	8,226
Total	2,509	242	4,054	132,075	20,696	133,165	29,325	2,472	6,913	609	7,121	2,392	8,010	
Average	419	41	676	22,013	3,450	22,195	4,888	412	1,153	102	1,187	399	1,335	
Prevalence	Sl	Sl	H**	H	M	H	Sl	Sl	Sl	Sl	M	M	M	
Damage	Sl	Sl	L	M	L	S	Sl	Sl	L	Sl	M	M	M	

* Prevalence: T = trace, Sl = slight, M = moderate, H = high.
Damage: Sl = slight, L = light, M = moderate, S = severe.

** Late rust development.

part of the growing season in 1974 was dry and rust developed slowly on cereal crops. Nevertheless, stem rust developed on susceptible varieties and on wild barley in Manitoba, Saskatchewan, and eastern Alberta, and wheat leaf rust also was prevalent before harvest. This rust development occurred mainly in August and consequently did not affect the spore counts during June and July.

Acknowledgments

The assistance of Agriculture Canada personnel at the spore trap locations and of Miss S. Thompson is gratefully acknowledged.

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

G. J. Green

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.

Can. Plant Dis. Surv. 55: 51-57. 1975

En 1974, l'ouest du Canada a subi une épidémie de rouille de la tige du blé *Puccinia graminis* f. sp. *tritici* plus importante que l'habitude mais les variétés commerciales de blé ordinaire *Triticum aestivum* et dur *T. durum* y ont résisté et aucun dégât n'a été enregistré. L'épidémie s'est manifestée dans les Parcelles Uniformes d'observation de la rouille de la Colombie-Britannique, et la Saskatchewan, du Manitoba, de l'Ontario et du Québec. Cet accroissement a facilité l'identification d'un nombre important d'isolats (429). Ces derniers représentaient 32 races dont 11 étaient inconnues jusqu'alors. Malgré une population très variable, on n'a enregistré aucune modification des races principales et rien ne semble indiquer qu'une des nouvelles souches présente un danger réel pour les variétés résistantes.

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.

[1] *Contribution No. 653, Agriculture Canada, Research Station, Winnipeg, Manitoba R3T 2M9*

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

	Common wheat														Durum wheat		
Location	Red Bobs	Lee	Pitic 62	Neepawa	Napayo	Kenya Farmer	CI 8154 X Frocor2	Glenlea	Exchange	Frontana	Thatcher6 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	10	5	20	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.	10	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, Alta.; 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

	Barley			Rye
Location	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 (effective/ineffective host genes)	Number of isolates from:						Total number of isolates	Percent of total isolates
		Que.	Ont.	Man.	Sask.	Alta.	B.C.		
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,10,11,13,14,15,17,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,10,11,14,15,17			1				1	0.2
C23 (38-39)	9a,9e,11,Tt2/5,6,7a,8,10,15			1				1	0.2
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	2.6
C37 (15)	6,8,9a,9b,11,13,17,22,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	0.5
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,10,14,17			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.I.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	;		;3^{c}	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	23^{c}	;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,10,11,13,17,22,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	;	3±	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,10,11,14,15	;	;	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 (15B-1L)	6,8,9a,9b,13,15,22,Tt2	5,7a,9d,9e,10,11,14,17	;	;	;2	;
C47 (15B-1L)	6,9a,9b,10,13,17,22,Tt2	5,7a,8,9d,9e,11,14,15	;	;	;1	;
C48 (15B-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+	3±	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-*Sr13*.

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
SrTt2	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 II-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 x $Mq^8)^6$ 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 II-47-26, Frontana-K58-Newthatch II-50-17, Chris, and C.T.440 had susceptible infections.

Acknowledgments

I am grateful to the cooperators who planted and cared for the rust nurseries and to those who forwarded rust collections for identification. Mr. J. H. Campbell was responsible for the technical aspects of the survey and for recording rust intensities in the nurseries.

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Leaf rust of wheat in Canada in 1974[1]

D. J. Samborski

Conditions were favorable for a leaf rust (*Puccinia recondita*) epidemic on the Prairies in the spring of 1974 since a large acreage was planted late to moderately susceptible varieties of wheat (*Triticum aestivum*) and there were heavy leaf rust infections in southern areas of the United States. However, very dry conditions during the summer delayed rust development and leaf rust did not cause any significant damage. The survey for races of leaf rust showed an increased level of virulence in the rust population on alleles for resistance at the *Lr2* locus in wheat.

Can. Plant Dis. Surv. 55: 58-60. 1975

Les semailles tardives de variétés de blé *Triticum aestivum* et *T. durum* moyennement sensibles à la rouille et d'importantes infestations de la rouille de la feuille *Puccinia recondita* dans le sud des Etats-Unis ont favorisé une épidémie de cette dernière maladie dans les Prairies au printemps de 1974. Cependant, l'été très sec a retardé la croissance du champignon et celui-ci n'a pas occasionné de dégâts d'importance. Un relevé des races de rouille a révélé une recrudescence de la virulence des populations de rouille sur les allèles de résistance situés au locus *Lr2*.

Disease development and crop losses in western Canada

The late planting of moderately susceptible varieties of wheat and reports of considerable leaf rust in southern areas of the United States indicated that appreciable losses could occur in wheat from leaf rust in 1974. However, very dry conditions during the summer delayed rust development and only trace to light infections of leaf rust occurred on wheat in most of Manitoba and Saskatchewan. These infections did not cause any significant damage to the wheat crop.

Leaf rust in the rust nurseries

Ratings of leaf rust intensity on 17 wheat varieties grown at nurseries across Canada are shown in Table 1. The dry conditions limited rust development at all nurseries in Manitoba and Saskatchewan. Leaf rust infections on individual varieties were similar to those observed in 1973. The commercial durum (*Triticum durum* Desf.) varieties Hercules and Wascana are not as resistant to leaf rust as older varieties such as Mindum.

Physiologic specialization

Field collections of leaf rust were established on Little Club wheat (*T. aestivum* L.) in the greenhouse and one single-pustule isolate was taken from each collection. A total of 179 cultures were established. Most of the collections were obtained from commercial fields of wheat varieties that do not possess any genes for seedling resistance.

The single-gene backcross lines used to study physiologic specialization in leaf rust have been described previously (1).

The distribution of virulence on the individual single-gene lines (Table 2) shows some marked differences from that obtained in 1973 (1). Virulence on gene *Lr1* increased in Ontario and Quebec, and a marked increase in virulence occurred on alleles of the *Lr2* locus. Gene *Lr2a* is present in some spring wheat varieties grown in the United States and the acreage is apparently sufficient to influence the leaf rust population. Virulence on *Lr16* has declined markedly in recent years. In 1966, when the variety Selkirk occupied most of the wheat acreage in Manitoba, over 50% of the leaf rust isolates from Manitoba were virulent on *Lr16*. At present, Manitou and Neepawa wheats, which do not possess *Lr16*, occupy most of the wheat acreage in Manitoba.

Twenty-two virulence combinations were obtained in 1974 (Table 3). The leaf rust population in eastern Canada was particularly variable; 15 races were identified in the 31 isolates obtained from Ontario.

Composite collections of leaf rust were used to inoculate a number of highly resistant varieties of wheat (1) but no unusual virulence was detected.

[1] *Contribution No. 650, Research Station, Agriculture Canada, Winnipeg, Manitoba R3T 2M9*

Table 1. Percentage infection by *Puccinia recondita* on 17 wheat varieties in uniform rust nurseries at 18 locations in Canada in 1974

Location	Red Bobs	Lee	Pitic 62	Neepawa	Napayo	Kenya Farmer	C.I. 8154 X Frocor^2	Glenlea	Exchange	Thatcher^6 X Transfer	Frontana	R.L. 4255	Agatha	Hercules	Mindum	Wascana	D.T. 332
Agassiz, B.C.	10	0	0	0	0	0 0	0	0	0	0	0	0	0	0	0	0	0
Creston, B.C.	50	0	tr*	0	tr	tr	0	0	0	0	0	0	0	20	tr	25	25
Indian Head, Sask.	20	5	10	10	10	10	tr	0	0	0	0	0	0	20	tr	5	10
Melfort, Sask.	10	tr	5	tr	0	tr	0	0	0	0	0	0	0	0	0	tr	0
Brandon, Man.	10	5	5	tr	tr	5	0	0	0	0	0	0	0	0	0	0	0
Durban, Man.	40	10	10	20	20	5	5	0	0	0	0	0	0	5	tr	5	20
Morden, Man.	15	tr	tr	10	10	10	0	0	0	0	0	0	0	0	0	tr	0
New Liskeard, Ont.	65	30	35	5	10	30	5	5	0	0	0	0	0	15	tr	10	10
Thunder Bay, Ont.	15	5	5	5	tr	tr	0	0	0	0	0	0	0	0	0	0	0
Guelph, Ont.	60	tr	15	5	10	20	5	5	0	0	0	0	0	20	tr	5	25
Ottawa, Ont.	80	10	30	20	25	25	tr	5	0	0	0	0	0	30	tr	30	30
Appleton, Ont.	80	tr	tr	tr	15	tr	tr	0	0	0	0	0	0	30	0	tr	25
Sunbury, Ont.	20	0	5	tr	0	0	5	0	0	0	0	0	0	0	0	5	0
La Pocatière, Qué.	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	tr
Québec, Qué.	70	tr	15	tr	5	5	tr	5	0	0	0	0	0	10	tr	5	10
Macdonald College, Qué.	20	10	tr	tr	tr	tr	tr	0	0	0	0	0	0	10	0	10	10
Lennoxville, Qué.	40	tr	0	0	5	0	0	0	0	0	0	0	0	5	0	tr	5
Normandin, Qué.	30	0	tr	tr	tr	tr	0	0	0	0	0	0	0	0	0	tr	5

* tr = trace

Table 2. Virulence of isolates of *Puccinia recondita* on backcross lines containing single genes for resistance to leaf rust in Canada in 1974

Resistance genes	No. of virulent isolates from: Que.	Ont.	Man.	Sask.	Alta.	B.C.	Total no. of virulent isolates	% total isolates
Lr1	2	12	0	1	0	0	15	8.3
Lr2a	0	1	3	4	0	0	8	4.4
Lr2d	8	22	4	7	13	10	64	35.4
Lr3	5	23	46	66	5	2	147	81.2
Lr3ka	4	10	0	0	0	0	14	7.8
Lr10	3	14	3	45	13	10	88	48.6
Lr16	0	0	0	1	0	0	1	0.6
Lr17	0	2	0	4	5	2	13	7.2
Lr18	8	20	11	13	8	8	68	37.6

Table 3. Virulence combinations of *Puccinia recondita* isolates on backcross lines containing single genes for resistance to leaf rust in Canada in 1974

Avirulence/virulence formula	No. of isolates from: Qué.	Ont.	Man.	Sask.	Alta.	B.C.	Total no. of isolates
1,2a,2d,3ka,10,16,17,18/3	0	2	9	17	0	0	28
1,2a,3,3ka,10,16,17,18/2d	1	1	0	0	0	0	2
1,2a,2d,3ka,16,17,18/3,10	1	4	24	31	0	0	60
1,2a,3,3ka,10,16,17/2d,18	4	8	0	0	0	0	12
1,2a,2d,3ka,10,16,17/3,18	0	1	5	5	0	0	11
1,2a,2d,10,16,17,18/3,3ka	1	0	0	0	0	0	1
2a,2d,3ka,10,16,17,18/1,3	0	1	0	0	0	0	1
1,2a,2d,3ka,17,18/3,10,16	0	0	0	1	0	0	1
1,2a,2d,3ka,16,17/3,10,18	0	0	5	6	0	0	11
1,2a,2d,10,16,17/3,3ka,18	1	0	0	0	0	0	1
1,2a,3,3ka,16,17/2d,10,18	1	1	1	0	8	8	19
2a,2d,3ka,16,17,18/1,3,10	0	1	0	0	0	0	1
1,2a,3ka,16,18/2d,3,10,17	0	0	0	3	5	2	10
1,2a,10,16,17/2d,3,3ka,18	0	2	0	0	0	0	2
1,3ka,16,17,18/2a,2d,3,10	0	0	3	1	0	0	4
1,3ka,16,17/2a,2d,3,10,18	0	0	0	2	0	0	2
3,3ka,16,18/1,2a,2d,10,17	0	2	0	1	0	0	3
2a,10,16,17/1,2d,3,3ka,18	1	3	0	0	0	0	4
3ka,10,16,17/1,2a,2d,3,18	0	1	0	0	0	0	1
2a,16,17/1,2d,3,3ka,10,18	1	2	0	0	0	0	3
2a,3ka,16,18/1,2d,3,10,17	0	1	0	0	0	0	1
2a,16,18/1,2d,3,3ka,10,17	0	1	0	0	0	0	1

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I am grateful for assistance given by cooperators in the care of the rust nurseries and the collection of rust specimens. Mr. W. Ostapyk performed the technical aspects of the program.

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Stem rust of oats in Canada in 1974[1]

J. W. Martens

Stem rust (*Puccinia graminis* f. sp. *avenae*) was first found on oats (*Avena sativa*) in Manitoba in late July. Light infections developed throughout most of Manitoba and eastern Saskatchewan causing little crop damage except in southeastern and southcentral Manitoba where infections of up to 60% caused moderate crop losses. Only two rust races, C10 and C23 were isolated from field collections in western Canada. Race C9 continued to predominate in eastern Canada. The most significant physiologic race change in 1974 was the appearance of virulence on resistance gene *pg 13* in field cultures of race C9 from Ontario.

Can. Plant Dis. Surv. 55: 61-62. 1975

Au Manitoba on a relevé la présence de la rouille de la tige *Puccinia graminis* f. sp. *avenae* sur l'avoine *Avena sativa* pour la première fois en fin de juillet. De légères infestations se sont étendues à l'ensemble du Manitoba et à l'est de la Saskatchewan causant peu de dégâts aux cultures, sauf dans le sud-est et dans le centre-sud du Manitoba où jusqu'à 60% des cultures ont été atteintes entraînant des pertes moyennes. Deux races seulement, C10 et C23, ont pu être isolées des échantillons prélevés dans les champs de l'ouest du Canada. La souche C9 reste la race dominante dans l'est du Canada. La mutation physiologique la plus importante en 1974 a été l'apparition de virulence envers le gène de résistance *pg 13* chez des isolats de race C9 prélevés au champ en Ontario.

Prevalence and crop losses in western Canada

Stem rust of oats caused by *Puccinia graminis* Pers. f. sp. *avenae* Eriks. and E. Henn. was first found in southern Manitoba in late July. Light infections developed throughout most of Manitoba and eastern Saskatchewan causing little or no crop damage except in southeastern and southcentral Manitoba where rust infections covering up to 60% of the stem area of the plants caused moderate crop losses in late fields which were numerous because of a late, wet spring.

Uniform rust nurseries

Rust nurseries comprising the oat (*Avena sativa* L.) cultivars Fraser, Hudson, Rodney, C.I. 4023, C.I. 9139, R.L. 2924, R.L. 2925, R.L. 2926, and R.L. 2970 were grown at 28 locations across Canada. Rust was observed in light to moderate amounts at Ottawa, Sunbury, and Thunder Bay, Ontario, and at Brandon, Durban, and Morden, Manitoba. No rust was observed in nurseries grown at St. John's West, Nfld.; Charlottetown, P.E.I.; Fredericton, N.B.; Kentville and Truro, N.S.; MacDonald College, Normandin, and La Pocatière, Que.; Appleton, Guelph, Kemptville, New Liskeard, and Vineland, Ont.; Indian Head, Melfort, and Scott, Sask.; Beaverlodge, Edmonton, Lacombe, and Lethbridge, Alta.; and Agassiz and Creston, B.C..

Identification and distribution of physiologic races

Physiologic races were identified by the infection types produced on seedlings of 'Rodney O' single-gene lines as indicated in Table 1. A suppiementary set comprising the cultivars C.I. 9139 (unknown genotype) and R.L. 2926 (*pg 13*) was used. All 204 field cultures were avirulent on C.I. 9139 resistance but 6 of 35 cultures of race C9 from Ontario were virulent on *pg 13* resistance. While all field cultures from western Canada were avirulent on *pg 13*, a number of isolates of C1 (*Pg* 1,2,3,4,8/9) and C24 (*Pg* 1,2,8/3,4,9,13), both virulent on *pg 13* were obtained from *pg 13* single gene line increase plots at Glenlea, Manitoba. The race distribution in western Canada (Table 1) remained relatively unchanged from 1973, with only two races, C10 and C23, being isolated from the field population; however, race C23 decreased sharply from 33% in 1973 to 7% in 1974, the second consecutive decline (1). If the present race distribution is maintained the cultivar Hudson, which combines resistance genes *Pg 2*, *Pg 4* and *Pg 9*, should provide adequate protection. This cultivar performed well under heavy field epidemic conditions in 1974.

Changes in the distribution of virulence on the lines carrying single resistance genes (Table 2) reflect the shift from race C23 to race C10 in western Canada. The most significant change is the appearance of field virulence on *pg 13* in eastern Canada. Very high levels of virulence on lines with *Pg 1*, *Pg 3*, and *pg 8*, and in eastern Canada *pg 9*, continue to persist even though these genes do not occur in the host population.

In an effort to detect the evolution of any new virulence combinations a large number of isolates, mostly small, "resistant' type pustules, were taken from breeding material in a naturally rust infected breeding nursery at Glenlea, Manitoba. Of the 150 isolates successfully cultured, 35 were identified as race C1, 90 as C10, 18 as C23, and 7 as C24.

[1] *Contribution No. 649, Research Station, Agriculture Canada, Winnipeg, Manitoba R3T 2M9*

Table 1. Distribution of physiologic races of oat stem rust in Canada in 1974

Race no.	Virulence formula (effective/ineffective *Pg* host genes)	No. of isolates from: Ont.	Man.	Sask.	Total isolates	Percentage of total isolates
C 6	1,8/2,3,4,9	1			1	0.5
C 8	3,8/1,2,4,9	2			2	1.0
C 9	8/1,2,3,4,9	35			35	17.2
C10	9/1,2,3,4,8	7	115	33	155	76.0
C23	2,4,9,13/1,3,8		10	1	11	5.4
Total		45	125	34	204	

Table 2. Frequency of virulence in the oat stem rust population on various types of resistance in eastern and western Canada in 1974

Source of isolates	Percentage of isolates virulent on cultivars with the following genes for resistance: *Pg 1*	*Pg 2*	*Pg 3*	*Pg 4*	*Pg 8*	*Pg 9*	*Pg 13*	Total no. isolates	Mean virulence capability*
East	97.8	100.0	95.6	100.0	15.5	84.5	13.3	45	5.93
West	100.0	92.1	100.0	92.1	100.0	0.0	0.0		4.82

* Mean virulence capability = No. of isolates virulent on Pg 1 + . . . pg 13/total no. of isolates.

Acknowledgments

The assistance of cooperators who cared for rust nurseries and submitted rust samples from various parts of Canada is gratefully acknowledged. Peter K. Anema performed the technical operations necessary for the identification of physiologic races.

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Crown rust of oats in Canada in 1974[1]

D. E. Harder

Oat crown rust (*Puccinia 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 important 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.

Can. Plant Dis. Surv. 55: 63-65. 1975

En 1974, la rouille couronnée de l'avoine *Puccinia coronata* f. sp. *avenae* s'est manifestée un peu partout dans l'ouest du Canada mais sans gravité sauf à proximité des nerpruns communs *Rhamnus cathartica* où les infestations étaient plus importantes. Comparativement à 1973, aucune recrudescence d'infestation n'a été signalée sur le cultivar commercial d'avoine *Avena sativa* Hudson ni sur les lignées possédant les gènes de résistance *Pc 38* et *Pc 39*. On a observé la virulence de prélèvements de nouille sur un groupe de lignées d'avoine portant des gènes de résistance connus. Les 201 souches isolées dans l'ouest et les 56 provenant de l'est comprenaient respectivement 37 et 16 combinaisons de virulence. On a remarqué une nette hausse de virulence pour le gène de résistance *Pc 40* et chez les lignées portant les gènes *Pc 46, Pc 47* et *Pc 48* qui ont été moins résistantes 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
Québec 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 No. of isolates	West % of isolates	East No. of isolates	East % 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 441R (*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 line with gene *Pc 50* in western Canada, and a slight decrease in eastern Canada. The position of genes *Pc 38* and *39* 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

	Western Canada		Eastern Canada	
Resistance gene or cultivar	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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Reaction of strawberry cultivars to clover phyllody (green petal) agent transmitted by Aphrodes bicincta[1]

L.N. Chiykowski[2] *and D.L. Craig*[3]

Considerable variation was found in the reaction of 9 strawberry (*Fragaria chiloensis*) cultivars to the clover phyllody (green petal) agent transmitted by the leafhopper *Aphrodes bicincta* under greenhouse conditions. Cultivars Sparkle, Redcoat, and Redchief showed relatively high susceptibility while the Kentville, Nova Scotia, selection K64-462 and the cultivar Vibrant appeared to be relatively resistant. The cultivar Redcoat was more susceptible under controlled conditions than in the field suggesting that disease incidence in the field is dependent on cultiavr preference by the vector as well as on cultivar susceptibility to the causal agent.

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Neuf cultivars de fraisiers *Fragaria chiloensis* ont réagi de façon fort variée à l'agent de la phyllodie du fraisier transmis en serre par la cicadelle *Aphrodes bicincta*. Les cultivars Sparkle, Redcoat et Redchief s'y sont révélés assez sensibles alors que les cultivars K64-462 (sélectionné à Kentville en Nouvelle-Ecosse) et Vibrant ont semblé y être relativement résistants. Le cultivar Redcoat était plus sensible au virus en ambiance contrôlée que dans les champs, ce qui laisse sous-entendre que l'apparition de la maladie dans les champs dépend de la préférence de vecteur en matière de cultivar ainsi que de la sensibilité du cultivar à l'agent causal.

The clover phyllody agent (CPA) is a mycoplasma-like microorganism (6,7) which causes the clover phyllody and strawberry green petal diseases (1). Observations by Collins and Morgan (4) on the nature and distribution of strawberry green petal disease in New Brunswick led them to conclude that the vector migrated into the strawberry plots primarily from adjoining meadow areas since the greatest infection occurred in the periphery of the plantation. They also suggested the possibility of cultivar resistance to the disease although most commercial cultivars examined in the field were susceptible. Several reports have indicated that cultivars may differ in susceptibility to green petal but all have been based on observations made in field plots in which plants had been exposed to natural infection (2,4,5,8,9). Since no information is available on leafhopper vector populations in the various cultivars, it is not possible to determine to what extent the observed differences in green petal infection are due to actual cultivar susceptibility to the causal agent, to the attractiveness of the cultivar to the insect vectors, or to a combination of both.

The present study was undertaken to determine the reaction of several strawberry cultivars exposed to the clover phyllody agent (CPA) transmitted by the leafhopper *Aphrodes bicincta* (Schrank) under controlled conditions.

Materials and methods

The CPA isolate (isolate O) used in the first series of tests was obtained in 1962 from infected strawberry (*Fragaria chiloensis* (L.) Duchesne) from Nova Scotia and was subsequently maintained in aster (*Callistephus chinensis* Nees) and Ladino clover (*Trifolium repens* L.). In 1972 a second isolate (isolate P) was obtained from infected strawberry from Prince Edward Island and was maintained in Ladino clover. Source insects for inoculating plants were obtained by caging *A. bicincta* nymphs, reared from diapausing eggs (3), on infected clover for 3 weeks and then maintaining them on healthy clover for an additional 3 weeks. Under such conditions, approximately 70% of the leafhoppers became inoculative.

The reaction of the various cultivars to CPA was determined by confining a small group of source insects (3 to 8 per group) on each test plant for 7 days. Each group of insects was then transferred to Ladino clover for 5 days to confirm their inoculativity. Inoculated test plants were held in a greenhouse (21°-26°C) for 8 weeks for symptom development. Plants that had not developed symptoms by this time were given a cold treatment (4°-6°C) in an unlighted room for 6 weeks and again returned to the greenhouse. Such treatment stimulates the production of new foliage and flowers in which the disease is often readily expressed.

Nine cultivars were exposed to CPA isolate O in the first series of tests (Table 1) and 8 cultivars were used in a second series of tests in which the two CPA isolates were compared (Table 2). The number of plants of each cultivar used in the tests varied from 1 to 4 depending on the availability of plants and insects. However, whithin each test, the same number of plants was used for each cultivar. Similarly, the number of insects used per plant varied (3 to 8) but within each test all plants received the same number.

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Table 1. Reaction of strawberry cultivars to clover phyllody agent (isolate 0) transmitted by the leafhopper *Aphrodes bicincta*

	Green petal transmission to:			
	Strawberry		Clover*	
Cultivar	Infected/tested	%	Infected/tested	%
Sparkle	8/22	36	21/22	95
Redcoat	6/22	27	21/22	95
Veestar	6/22	27	19/21	90
Redchief	5/22	23	22/22	100
K65-436**	5/22	23	17/22	77
Bounty	5/22	23	19/22	86
Midway	3/22	14	19/22	86
Vibrant	2/22	9	18/21	86
K64-462**	1/22	5	19/22	86
TOTAL	41/197	21	175/196	89

* Following confinement for 7 days on strawberry, each group of leafhoppers was transferred to Ladino clover for 5 days to test their inoculativity.

** K65-436 - a Kentville selection derived from Acadia X Senga Sengana; K64-462 - derived from Redstar X Senga Sengana.

Table 2. Reaction of strawberry cultivars to two isolates of clover phyllody agent transmitted by the leafhopper *Aphrodes bicincta*

	Isolate O		Isolate P	
Cultivar	Infected/tested	%	Infected/tested	%
Redchief	8/13	62	3/17	18
Sparkle	3/12	25	7/15	47
Midway	3/12	25	1/15	7
Redcoat	2/12	15	1/17	6
Vibrant	1/12	8	0/16	0
K64-462*	1/12	8	0/15	0
Bounty	1/13	8	3/15	20
Veestar	0/13	0	0/15	0
TOTAL	19/100	19	15/125	12

* K64-462 - a Kentville selection derived from Redstar X Senga Sengana.

Results and discussion

The percentage of strawberry plants that developed symptoms when inoculated with isolate O varied among cultivars and indicated differences in their susceptibility to CPA (Table 1). Sparkle, with 36% of the plants infected, was the most susceptible cultivar while the Kentville selection K64-462, with an infection of 5%, was the most resistant cultivar. The overall level of infection in strawberry (21%), however, was considerably lower than that obtained in clover (77-100%) plants on which the leafhoppers were placed following their confinement on strawberry. The high percentage infection in clover was indicative of the infectivity of the causal agent and of the effectiveness of the insects in transmitting CPA. The relatively low infectivity in strawberry suggested that some degree of resistance to green petal was present in all cultivars tested.

Isolate O had been maintained in clover and aster in the greenhouse for several years without passage through strawberry and this isolate may have undergone a change in its ability to infect strawberry. Therefore, a second series of tests was conducted to compare the reaction of cultivars to isolate O and to isolate P, newly isolated from infected strawberry.

In the second series of tests, the overall percentage of plants that became infected with isolate O (19%) was similar to that of the first test and was greater than that with isolate P (12%), indicating that the infectivity of isolate O toward strawberry had not been attenuated during maintenance in clover and aster (Table 2). Differences in susceptibility to the two isolates of CPA were observed with such cultivars as Redchief, Sparkle, and Bounty but more extensive testing is required to determine whether these differences are due to differential reaction or to experimental variation. A comparison of the performance of isolate O in the two tests indicates the variation that can occur with the same isolate used at different times. The overall percentage of plants infected by isolate O was about the same in both series of tests but the order of susceptibility of the cultivars was different.

Although considerable variation was observed between isolates and tests, certain trends are indicated. Cultivars Sparkle and Redchief consistently appeared high and K64-462 and Vibrant low in the order of susceptibility, and these results correspond to their reaction under field conditions (4). However, the susceptibility of Redcoat was higher than expected from its field performance (3,4) and may suggest that although it is readily susceptible to the causal agent, its attractiveness to insects under field conditions may be less than that of other cultivars, resulting in lower field infection.

Further studies are contemplated to investigate possible effects of plant and insect age on infection of strawberry with CPA in an attempt to explain the variation in cultivar susceptibility between tests.

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Diseases of specialty crops in Saskatchewan: 1. Notes on buckwheat and sunflower 1972-73

R. A. A. Morrall and D. L. McKenzie[1]

Surveys of a small number of fields in 1972 and 1973 showed that the most prevalent disease of buckwheat was botrytis stem rot. The most common disorders of sunflower were herbicide injury and rust. *Rhizoctonia* sp. in 1972 and *Sclerotinia sclerotiorum* in 1973 were recorded for the first time on buckwheat in Canada.

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L'étude de quelques champs de sarrasin *Fagopyron esculentum* en 1972 et en 1973 a révélé que la maladie la plus courante de cette récolte est la pourriture de la tige par *Botrytis*. Les troubles les plus fréquents observés sur le tournesol *Helianthus annuus* sont causés par les herbicides et la rouille. *Rhizoctonia* sp. et *Sclerotinia sclerotiorum* ont été respectivement trouvés pour la première fois en 1972 et 1973 sur le sarrasin au Canada.

As part of a continuing program in our laboratory on the diseases of specialty crops in Saskatchewan (2,3,5), surveys were conducted in 1972 and 1973 on buckwheat (*Fagopyrum esculentum* Moench) and sunflower (*Helianthus annuus* L.). These crops are important to individual farmers who grow them under contract, but the total provincial acreages in the years concerned were minute compared with crops like rapeseed and wheat. Indeed, acreages of both buckwheat and sunflower declined compared with 1971 (5). Estimated provincial acreages of buckwheat were 5,500 in 1972 and 3,500 in 1973, and of sunflower 23,000 in 1972 and 2,500 in 1973.

Methods

Since much of the survey was done in conjunction with other work (2,3), it was not possible to survey fields in the same parts of Saskatchewan in both years, nor to obtain representative samples of the provincial acreages. Thus, for buckwheat five fields were surveyed in 1972 in the Kerrobert area (about 100 miles W of Saskatoon), and, in 1973, two fields in the Prince Albert area (about 90 miles N of Saskatoon) and six fields in the Nipawin-Carrot River area (150 miles NE of Saskatoon) were surveyed. In the case of sunflower, four fields, all in a large area about 100 miles WSW of Saskatoon and one field near Outlook (60 miles S of Saskatoon) were surveyed in 1972, while in 1973 the survey included seven fields in SE Saskatchewan, one in the Saskatoon area and two in the North Battleford area. All except the Outlook field were on dry land. In most cases the fields were visited only once, in either late August or early September, shortly before harvest. However, all the buckwheat fields in 1973 were examined on July 11, when the plants were in the seedling stage, as well as at the end of the growing season.

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Quantitative estimates of disease were made in each field at the end of the season. In both crops the presence or absence of each disease was scored on a total of 200 plants per field. In 1972 the 200 plants consisted of 50 plants from a row in each of four parts (usually the four corners) of the field. In 1973, to save time, 100 plants were scored from each of two well-separated parts of the field. The percentages of plants infected were subsequently calculated. Diseases that were observed outside the sampling areas were also noted, but were not considered in the calculation of percentages of infected plants. No attempt was made in the case of foliar diseases to assess percentage leaf areas infected. When the cause of a disease was uncertain, isolations were made from infected tissues using routine laboratory procedures.

Results

The causal agents of diseases or disorders recorded in this survey (Tables 1, 2) were as follows: Buckwheat: botrytis stem rot [*Botrytis cinerea* Pers.], fusarium root rot [*Fusarium* spp.], rhizoctonia root rot [*Rhizoctonia* sp.], sclerotinia stem rot [*Sclerotinia sclerotiorum* (Lib.) de Bary], aster yellows [?mycoplasma]; Sunflower: herbicide injury (herbicide drift), rust [*Puccinia helianthi* Schu.], fusarium root rot [*Fusarium* spp.], rhizoctonia root rot [*Rhizoctonia* sp.], sclerotinia stem rot and head rot [*S. sclerotiorum*], rhizopus head rot [*Rhizopus* spp., probably mostly *R. arrhizus* Fischer (5)], downy mildew [*Plasmopara halstedii* (Farl.) Berl. & de Toni].

The most common disease of buckwheat was botrytis stem rot (Table 1), with one field showing a 14.5% infection. Though the infected plants were often either severely wilted, or dead, with dense fungal sporulation on the infected tissue, it is doubtful if losses due to the disease were equivalent to the percentages of infected plants. Some plants were obviously killed at an early stage of growth, when compensation from other plants in the row could be effective. On September 4, 1973, in

Table 1. Diseases of buckwheat

Date	Variable	Botrytis stem rot	Fusarium root rot	Rhizoctonia root rot	Sclerotinia stem rot	Aster yellows
2 Sept. 1972	Percentage of fields with infection	100	80	40	0	0
	Range of percentage infection in sampling areas	3.5–14.5	0 – 3.0	0 – 3.8	–*	–
	Mean percentage infection in sampling areas	8.5	1.1	1.0	–	–
11 July 1973	Percentage of fields with infection	0	25	0	0	0
4 Sept. 1973	Percentage of fields with infection	62.5	25	0	37.5	12.5
	Range of percentage infection in sampling areas	0 – 2.5	0 – 1.0	–	0 – 3.0	–
	Mean percentage infection in sampling areas	0.7	0.2	–	0.8	–

* – = not applicable.

one field a slight infection of leaves by *B. cinerea* was also observed. Other buckwheat diseases (Table 1) were of relatively minor importance. Rhizoctonia root rot, observed in two fields in 1972, was not found at all in 1973 and had not been observed in surveys in 1970 and 1971 (5). Both sclerotinia stem rot and rhizoctonia root rot represent new Canadian records on buckwheat (1, 4, 5).

On sunflower in both 1972 and 1973, herbicide injury and rust not only occurred in a high percentage of fields but also affected appreciable mean percentages of plants (Table 2). Subjectively, it appeared that rust infections had not developed until late season and did not affect a large percentage of total leaf area. Sclerotinia stem rot, though found in a high percentage of fields in 1973, affected a very low percentage of the plants. Downy mildew, a common sunflower disease in adjacent Manitoba, was observed in trace amounts in one field in 1973, but verticillium leaf mottle, another common disease in Manitoba, has still not been reported from Saskatchewan (1, 5). As mentioned in a previous discussion (5), this undoubtedly relates to the infrequency of sunflower cultivation in Saskatchewan.

Discussion

The future of buckwheat and sunflower as crops in Saskatchewan seems very uncertain in view of the decline in acreage in the last three or four years (see above and (5)). However, even if only small acreages continue to be cultivated, some attention will have to be given to diseases. The greatest threat to buckwheat production seems to be from botrytis stem rot, since the

Table 2. Disorders of sunflower at the end of the growing season

		Disease							
Year	Variable	Herbicide injury	Rust	Fusarium root rot	Rhizoctonia root rot	Sclerotinia stem rot	Sclerotinia head blight	Rhizopus head rot	Downy mildew
1972	Percentage of fields with infection	100	80	20	40	60	20	40	0
	Range of percentage infection in sampling areas	0 –47.5	0 –21.0	0 – 1.0	0 – 2.0	—*	—	—	—
	Mean percentage infection in sampling areas	18.7	6.5	0.2	0.5	—	—	—	—
1973	Percentage of fields with infection	60	70	0	0	70	0	20	10
	Range of percentage infection in sampling areas	0 –22.0	0 –85.0	—	—	0 – 1.0	—	—	—
	Mean percentage infection in sampling areas	5.7	19.6	—	—	0.2	—	—	—

* — = not applicable.

causal organism is an almost ubiquitous fungus and has also been shown to be freely seedborne on buckwheat (4). However, any of the diseases listed in Table 1 could be quite destructive in individual fields depending on weather conditions and rotational practices. In sunflower, the only disorder that seems to have been generally destructive in Saskatchewan in the period 1970-73 (5) is herbicide injury, and such injury seems likely to recur when sunflower fields are surrounded by cereals. Several other diseases listed in Table 2 could become serious problems if sunflower cultivation in certain parts of the Province were to become as widespread as in Manitoba, and given appropriate meteorological conditions.

The weather in the west-central part of Saskatchewan in 1972, where the surveys were conducted, was considered to be abnormally dry, but in those areas surveyed in 1973, especially in the Nipawin area, it was exceptionally wet. Thus, it is paradoxical that higher levels of infection with botrytis stem rot were recorded on buckwheat in 1972 than in 1973. However, the relative levels of certain other diseases in the 2 years (Tables 1, 2) seem to be consistent with the weather conditions, at least as far as can be judged from the limited number of fields sampled.

Acknowledgments

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Incidence of bacterial blight of field beans in southwestern Ontario in 1973 and 1974[1]

V.R. Wallen and D.A. Galway

In 1973 and 1974, 76 bean (*Phaseolus vulgaris*) fields (624 hectares) and 97 fields (1,008 hectares), respectively, in the Hensall, Ontario, area were aerially photographed using infrared film to determine the incidence of bacterial blight. In both years, only trace amounts of blight were found. In 1974, 18 fields (99 hectares) were also aerially photographed in the Chatham area. Of the 18, 10 were affected and the overall infected area was 0.2% of the total area photographed. A low incidence of seed-borne infection was primarily responsible for avoiding an epiphytotic, as temperature and humidity conditions were optimum for development and spread of the disease.

Can. Plant Dis. Surv. 55: 73-74. 1975

En 1973 et en 1974, on a respectivement pris des photographies aériennes infrarouge de 76 (624 hectares) et de 97 (1008 hectares) champs de haricots *Phaseolus vulgaris* dans la région de Hensall (Ont.) afin de déterminer l'étendue de la brulure bactérienne. Les deux années, les champs n'ont présenté que de petites attaques de la brûlure. En 1974, 18 champs (99 hectares) dans la région de Chatham ont également été photographiés d'un avion. Sur 18, 10 champs étaient infestés sur une superficie totale égale à 0.2% de la région photographiée. L'épidémie n'a pu être évitée que par suite du faible taux d'infection des semences, car la température et l'humidité étaient idéales pour le developpement et la propagation de la maladie.

Over the past 6 years, aerial photographic surveys combined with ground truth surveys in southwestern Ontario have shown a decline in the overall incidence of bacterial blight caused by *Xanthomonas phaseoli* (E.F. Sm.) Dows. in field beans. For example, in the Hensall area, where detailed measurements of blight on an acreage basis have been determined by aerial photography followed by scanning procedures (2,3), 4.63% and 6.56% of the crop were infected with blight in 1968 and 1970, respectively. In 1972, blight declined to 0.67% (1). This report indicates a further decline in the incidence of blight in the Hensall area in 1973 and 1974.

Methods

In 1973, 76 fields representing 624 hectares of field beans were aerially photographed in the Hensall area. In 1974, field bean acreage increased to 1,008 hectares (97 fields) under the same flight pathway. As well, 99 hectares (18 fields) of field beans were aerially photographed in the Chatham area in 1974.

All photography was taken at a scale of 1:6,000 at an altitude of flight of 6,900 feet above sea level. A Zeiss camera with 12 inch focal length, and Kodak Aerochrome Infrared 2443 film, 9 x 9 inch format, developed as a positive, were used. In 1973, photography took place on August 16 in the Hensall area. In 1974, the photographs were taken on August 26 in the Chatham area and on August 20 in the Hensall area; those dates were optimum for disease recognition in both areas.

Each year extensive ground truth surveys were conducted from August 1 until August 26. A portion of not less than 1 acre of each field in both areas was examined for symptoms of bacterial blight. Leaf samples were taken of infected plants and forwarded to the laboratory at Ottawa for the identification of the causal agent, either *Xanthomonas phaseoli* (E.F. Sm.) Dows. or *Xanthomonas phaseoli* var. *fuscans* Burkh. (Starr. & Burkh.).

Disease interpretations were made from 9 x 9 inch color IR prints and from ground truth notes. Field infection percentages were determined using the drum scanner method (4).

Results and discussion

Hensall area

The incidence of blight in the Hensall area showed a further decline from that of previous years (1). In 1973, although 19 of 76 fields were infected (Table 1), the levels were too samll to measure and consisted primarily of a few leaves infected on one or more plants in a field. In 1974, only 4 of 97 fields showed blight, all in trace amounts. Two factors are primarily responsible for this decrease, a lower incidence of seed infection and dry weather conditions.

The overall amount of blight has declined steadily in the Hensall area since 1968 (Fig. 1). Several growers of Select field bean seed are located in this area, with the result that there is a strong influence on other growers to use disease-free seed. The effectiveness of the Select Seed Program (the use of disease-free pedigreed seed initially, followed by field inspection of the crop and laboratory analysis of the seed to maintain disease-free status in the ensuing crop) has been monitored in this area by the aerial IR photographic survey.

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Table 1. Incidence of bacterial blight of field beans in Hensall and Chatham areas, 1973 and 1974

Location	No. fields surveyed	Area (ha)	No. fields affected: Ground truth survey	No. fields affected: Aerial IR survey	Causal organism: *X. phaseoli*	Causal organism: *X. phaseoli* var. *fuscans*
Chatham 1974	18	99	6	10	6	0
Hensall 1973	76	624	19	—*	14†	1
Hensall 1974	97	1,008	4	—*	3	1

* Infection level in trace amounts not detectable by aerial photography.

† In addition to the 14 pathogenic *X. phaseoli* types, 4 nonpathogenic *X. phaseoli* cultures were isolated.

Although the number of infected fields did not show a decline until 1973 (Fig. 1), the amount of blight has declined to the point where it cannot be dtermined by the drum scanner method (4).

Chatham area

In 1974, 10 of 18 fields in the Chatham area were infected (Table 2). Weather conditions for blight were excellent and disease development within infection foci was severe. Pod infection was well advanced in some foci by August 20. Although weather conditions were ideal, the overall infection level in the crops was only 0.2 percent, primarily because of low levels of seed infection.

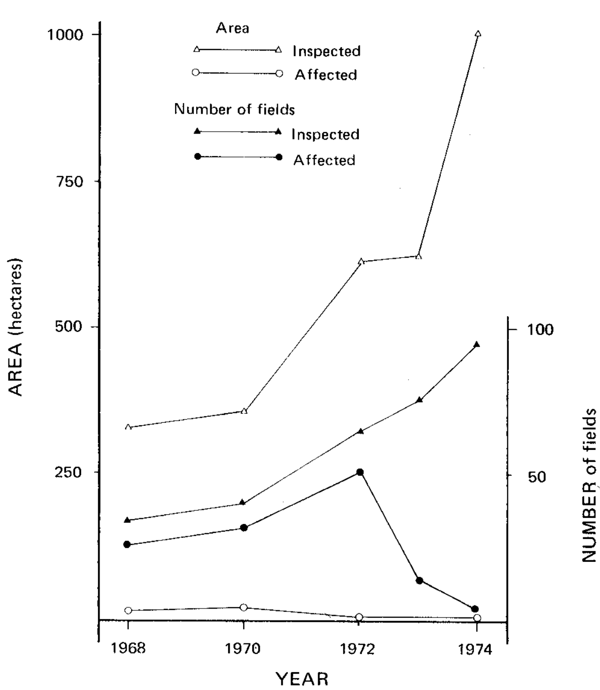

Figure 1. Area of field beans and incidence of bacterial blight in Hensall, Ontario, area, 1968-74.

Table 2. Incidence of bacterial blight in the Chatham area, 1974

Field no.	Total area (ha)	Infected area (ha)	Percent infection
1	6.19	0	0
2	3.99	0	0
3	4.29	0.0846	1.972
4	4.18	0	0
5	9.78	0.0016	0.018
6	9.49	0.0146	0.153
7	0.54	0	0
8	0.59	0.0048	0.808
9	5.22	0.0129	0.245
10	9.60	0.0530	0.554
11	18.76	0.0129	0.070
12	8.06	0	0
13	1.56	0.0053	0.338
14	1.37	0	0
15	8.52	0.0073	0.084
16	0.57	0	0
17	4.26	0.0004	0.013
18	3.30	0	0
Total	100.27	0.1974	
Overall % infection			0.2

Pathogens isolated

Xanthomonas phaseoli was the main cause of blight in 1974 (Table 1). Seventeen pathogenic cultures of *X. phaseoli* and two pathogenic cultures of *X. phaseoli* var. *fuscans* were isolated from infected leaf material.

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Diseases of rapeseed in Manitoba, 1973-74

R. G. Platford[1] *and C. C. Bernier*[2]

In northwestern Manitoba in 1973 and 1974, all fields of turnip rape (*Brassica campestris*) examined were affected by the staghead form of white rust [*Albugo cruciferarum*], but damage was much less severe than in the previous 2 years. Black spot [*Alternaria* spp.] was found in trace amounts in most rape (*B. napus*) fields; in *B. campestris* severity ratings were slightly higher, but damage was less severe than in 1971-1972. Stem blight [*Sclerotinia sclerotiorum*] was the most serious disease of *B. napus* in 1973, causing premature ripening and pod infection; damage was less common in turnip rape.

Can. Plant Dis. Surv. 55: 75-76. 1975

Tous les champs de navette *Brassica campestris* examinés dans le nord-ouest du Manitoba en 1973 et en 1974 étaient marqués par les déformations de la rouille blanche *Albugo cruciferarum* mais les dégâts étaient beaucoup moins importants que ceux des deux années précédentes. La plupart des champs de colza *B. napus* étaient attaqués par la tache noire *Alternaria* sp. à l'état de trace; les champs de *B. campestris* l'étaient davantage mais les dégâts étaient moins importants qu'en 1971-1972. La sclérotiniose *Sclerotinia sclerotiorum* est la maladie qui a le plus gravement atteint *B. napus* en 1973. Cette maladie provoque une maturité trop hâtive et attaque la gousse. On l'a trouvée moins couramment dans les champs de navette.

Surveys of 28 rapeseed fields in the northwestern area of Manitoba between Neepawa and Swan River were made during the latter half of August in 1973 and 1974. In both years, the staghead form of white rust [*Albugo cruciferarum* S. F. Gray], black spot [*Alternaria* spp.], and stem blight [*Sclerotinia sclerotiorum* (Lib.) de Bary] were the only important diseases encountered. In 1974, diseases were less severe than in previous years, probably because of the dry weather that prevailed during most of July and August.

White rust–Albugo cruciferarum

In 1973 and 1974, all fields of turnip rape (*Brassica campestris* L.) were affected by the staghead form of white rust (Table 1), but severity was very low. The majority of stagheads were very small and were formed at the tips of branches, indicating that infection occurred late in the season. All stagheads examined showed infection by downy mildew [*Peronospora parasitica* (Pers. ex Fr.) Fr.]. The disease was much more severe in 1971 and 1972, when many of the staghead infections involved the entire head, causing complete loss of seed producing ability (1, 2).

Black spot–Alternaria spp.

In both years slightly over 70% of the rape (*Brassica napus* L.) fields examined were affected by trace amounts of black spot (Table 1). In turnip rape, the percentage of fields affected dropped from 100% in 1973 to 29% in 1974, but in both years severity ratings were slightly higher than in rape. The trace to light infections of black spot in these surveys were in contrast to those in 1971 and 1972, when infections reached the moderate and severe ranges.

Stem blight–Sclerotinia sclerotiorum

In 1973, stem blight was much more prevalent than in previous years and was by far the most serious disease of rape in northwestern Manitoba. Many of the plants were infected part way up the stem or even on the pods, indicating that ascospore infections were involved. In previous years (1, 2) stem blight was present in only trace to slight severity and infections were always at the base of the plant. Stem blight has been more common in rape than in turnip rape (Table 1), and in 1973 premature ripening caused by the disease was very evident. Severity was greatest in heavy stands of both rape and turnip rape.

Other diseases

In 1974, root rot was found in a trace level in one field of turnip rape and at a moderate level in a field of rape; trace amounts of aster yellows were present in 24% of the turnip rape and in 9% of the rape fields; trace levels of ringspot [*Mycosphaerella brassicicola* (Duby) Oud.] were found in 35% of the turnip rape fields surveyed.

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Table 1. Disease ratings in fields* of turnip rape (*Brassica campestris*) and rape (*Brassica napus*) surveyed in Manitoba in 1973 and 1974; ratings indicate % of fields in each severity category

	Turnip rape			Rape		
Severity category	Staghead	Black spot	Stem blight	Staghead	Black spot	Stem blight
			1973			
Trace	60	80	30	0	71	50
Slight	30	20	0	0	0	11
Moderate	10	0	0	0	0	0
Severe	0	0	0	0	0	6
% fields affected	100	100	30	0	71	67
			1974			
Trace	53	23	6	0	73	9
Slight	41	6	18	0	0	9
Moderate	6	0	0	0	0	0
Severe	0	0	0	0	0	0
% fields affected	100	29	24	0	73	18

* No. fields examined in 1973 and 1974, respectively: turnip rape 10, 17; rape 18, 11.

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