

RUST NURSERIES IN CANADA IN 1954

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In Report 8, issued by the Plant Pathology Laboratory, Winnipeg, Man., December 1954, are recorded the observations on the occurrence of rusts and several other diseases on varieties of wheat, oats, barley, rye and flax grown in 34 places in Canada in 1954. The incidence of the various diseases on the different varieties is presented in eight tables with a summary of the data in a ninth, which alone is here reproduced (Table 2).

Twelve varieties of wheat, eight of oats, five of barley, one of rye and three of flax were grown in the nurseries. The varieties were: wheat - McMurachy, Lee, Kenya Farmer, Little Club, Marquis, Minidum, Thatcher, Selkirk, Norka, Redman, Exchange, and Frontana; oats - Bond, Trispermia, Ajax, Vanguard, Garry, Clinton, Landhafer, and Rodney; barley - Montcalm, Black Hulless, Vantage, Peatland, and Feebar; rye - Prolific; and flax - Rocket, Bison, and Dakota.

A review of the incidence and development of cereal rusts in Western Canada is published in the original report, but a slightly expanded account is included below.

Cereal Rusts in the Prairie Provinces in 1954

In 1954, much of the wheat-growing area of the United States and Canada experienced a most widespread and destructive cereal rust epidemic.

This epidemic had its beginnings in centres in Northern Mexico and southern Texas where the red spores of stem rust survived the winter of 1953-54. Stem rust was increasing on wheat in southern Texas in late February. At that time stem-rust spores were caught on slides exposed in central Texas and by mid-March stem-rust infection was also observed in the region. Rust development occurred earlier in these southern areas in 1954 than in 1953 when stem rust did not appear until early April. Leaf rust of wheat likewise developed earlier there than in 1953 with the result that this rust was general throughout the whole of Texas by the end of March.

However, rust development was severely checked in Texas by drought in April and no further spread of any consequence occurred until rains came late in that month. By the middle of May slight amounts of stem rust were present in southern Oklahoma, and a trace had appeared in Southern Kansas. By 1 June leaf and stem rust of wheat had become quite prevalent in northern Texas and the southern half of Kansas and had spread in small amounts northwards into Nebraska.

Stem and leaf rust spores in small numbers began to appear on slides exposed in southern Manitoba during late May. Towards the end of the first week in June conditions were very favourable for the north-

ward spread of rust spores and a heavy leaf and stem rust spore shower occurred over Man. and Sask. The concentration of stem and leaf rust spores appeared to be greater in eastern Sask. at that time than in Man. During the period over 200 spores of leaf and stem rust per square inch of slide were deposited on spore-trap slides exposed at Regina, Sask., while only a small fraction of that number was deposited on the slides exposed in central and eastern Man. There is no record of the spores occurring in the air over parts of Sask. north and west of Regina as no spore traps were located there. However, the tremendous number of spores which occurred on slides exposed at Regina in early June indicates that spores in substantial numbers were carried at that time far to the north and west of this point. That this occurred was shown by the fact that stem-rust and leaf-rust infections appeared almost simultaneously on wheat throughout the area from eastern Man. northwestward to North Battleford in Sask. about 10 days after the advent of this spore shower.

Stem Rust of Wheat

This year, wheat stem rust (*Puccinia graminis* var. *tritici*) was first found at Morden, Man., on 17 June, a day later than in 1953. That same week stem and leaf rust of wheat were found throughout the area extending northwestwards from s. e. Man. to beyond North Battleford in n. w. Sask. The heavier infections occurred in the central and n. w. parts of Sask. On 26 June about 40% of the wheat plants in some localities showed stem rust pustules. At that time a trace of leaf rust occurred on 80% of wheat plants in some fields in central and n. w. Sask. During the next two weeks stem rust spread westward into Alta. but in smaller amounts.

Moisture conditions were extremely favourable for rust development throughout the whole of Western Canada during the entire growing season of 1954 and stem rust became heavy on Thatcher, Redman, Lee and other varieties susceptible to race 15B, the predominant race of wheat stem rust in the area. The heaviest rust infection extended in a wide strip northwestwards from Morden, Man. through Man. to beyond North Battleford, Sask. (See Fig. 1). Within this heavy rust area the average stem-rust infection on the above named varieties ranged from 30% to 70% with the most severe infections occurring in the area from Regina to North Battleford. In n. e. Sask. stem rust infection was less severe and in s. w. Sask. rust was light. In e. Man., rust infection was much less severe than in the heavy rust areas of central Sask. Before the end of the season stem rust spread westward across Alta. However, in that province severe infection was confined largely to the east central part of the province. Thatcher, Redman and Lee carried about equal amounts of stem rust but trace amounts only occurred on Selkirk.

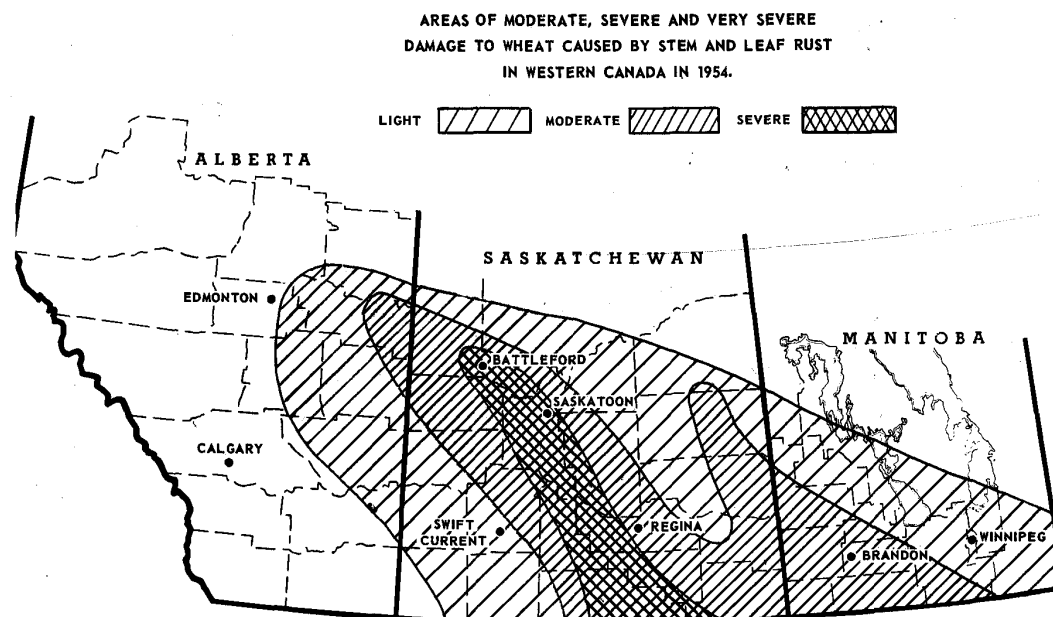


Fig. 1. Map showing relative severity of the damage caused by rust in Western Canada in 1954.

Durum wheat throughout the rust area of Western Canada carried an appreciably heavier infection than the bread wheats. Infections in much of the durum ranged as high as 80%.

Leaf Rust of Wheat

Leaf rust of wheat (*Puccinia triticina*) was first found in Western Canada, in 1954, at Winnipeg, Man., on 16 June. Next day it was found at Morden. On 21 June traces were found at Dauphin and on 22 June it appeared in trace amounts on Thatcher wheat at Saskatoon, Sask. On 26 June leaf rust was found at North Battleford and shortly thereafter had spread into Alta. Leaf rust was coextensive with stem rust and in most areas infections were much heavier than those of stem rust. It was heavy throughout Man., Sask., and e. Alta. Generally, average infections ranged from 60% to 80% on Thatcher and Redman with the heavier infections occurring on Thatcher. These varieties in most fields in Western Canada were completely defoliated by leaf rust two to three weeks before the plants ripened. Leaf rust also occurred on Selkirk wheat but in relatively light amounts. The leaf rust infection appeared on Selkirk considerably later than on Thatcher and Redman. When the first leaf rust infections were observed on Selkirk the intensity of infection on Thatcher and Redman had reached 30-50%. In the most severely leaf-rusted fields Selkirk carried infections averaging 25-40%. Some leaf rust occurred on Lee wheat but in negligible amounts. Durum

wheats were only slightly affected by leaf rust.

Stem Rust of Oats

In 1954, stem rust of oats (Puccinia graminis var. avenae) was first observed on oats, in trace amounts, on 6 July in south-central Man. and on 11 July in e. Sask. Like stem rust of wheat, oat stem rust extended considerably farther west than usual. It was fairly prevalent throughout much of Man. and Sask. and extended westward into Alta. to some distance n. w. of Edmonton. However, in that province severe infections were confined to the extreme eastern part of the mid-central area. It was quite severe throughout the rust area of Sask. and Man., particularly on varieties such as Victory and Banner that are susceptible to race 7, the most prevalent race in Western Canada in 1954. Infections were much lighter on the varieties Vanguard, Fortune, Ajax, and Exeter all of which are resistant to race 7. However, certain other races (8, 10, and 11) to which these varieties are susceptible were also present and in late fields these varieties became heavily infected. No stem rust was found anywhere on Garry oats but trace amounts were present in some fields of Rodney.

Crown Rust of Oats

Crown rust (Puccinia coronata var. avenae) appeared considerably later than the rusts on wheat. The first traces of crown rust were observed in Man. on 6 July. From that date it spread rapidly northwards and westwards across the prairies to a point just beyond Edmonton, Alta. There are no previous records of crown rust reaching so far north and west. In fact, crown rust has seldom been found west of central Sask. This rust became very heavy in late stands of oats throughout Man. and eastern Sask. In Alta. crown rust occurred mostly in trace amounts. However, a few fairly heavy infections were observed in the eastern part of central Alta. Vanguard, Ajax, Victory, Banner, Fortune and several other varieties, which are susceptible to all races of crown rust, were severely attacked by this rust in many areas in Man. and Sask. Crown rust infections on these varieties in later stands ranged from 60 to 80%. Garry and Rodney, which are resistant to about half of the races that occur in Western Canada, were less affected than the other varieties mentioned. These two varieties carried infections averaging 20-40% in areas where the crown rust infection averaged upwards of 70% on the susceptible varieties. Throughout the rust area these varieties substantially outyielded the susceptible ones.

Other Cereal Rusts

Sl. to mod. amounts of leaf rust (Puccinia hordei) occurred on barley in Man. and eastern Sask. It was not observed anywhere in damaging amounts.

Traces of stem rust (*Puccinia graminis* var. *secalis*) and leaf rust (*Puccinia secalina*) were found in a few fields of rye in southern Man. (B. Peturson and G. J. Green).

Influence of Weather on Cereal Rusts in 1954

Weather conditions throughout much of Western Canada were quite favourable for the development of rusts during most of the 1954 growing season.

Temperatures were below normal in April and May, (10°-15° F. in April and 4°-8° F. in May). As a consequence seeding was delayed in many districts and in areas where seeding was possible germination was greatly retarded. Excessive rains throughout the prairies during the last ten days in May also delayed seeding operations. As a result of this unseasonable weather seeding operations in all three prairie provinces were delayed by from two to three weeks. This delayed seeding was one of the major causes contributing to the 1954 rust epidemic. Precipitation was much above normal throughout Sask. during nearly all of the growing season. Precipitation exceeded the normal rainfall by 100, 50, and 100% respectively in June, July and August. This high rainfall greatly favoured germination of rust spores. In fact, there was during this period hardly a day when conditions were unfavourable for spore germination. In both Man. and Alta. precipitation also appreciably exceeded the normal for the whole season although there were some periods during parts of July when precipitation was below normal in certain areas of these provinces. Precipitation was also below normal in Man. in August.

June temperatures were from 2° below to 1° F. above normal over most of grain-growing areas of the prairie provinces, except for an area in s. w. Sask. and s. e. Alta. where temperatures were 4° F. below normal. For July temperatures were above 1° F. above normal over Man. and Sask. except the southwest corner. There and in Alta. the temperature was 2° below normal. August temperatures were about 1° F. above normal for Man. and 2° below normal for Sask. and Alta.

Although temperatures were generally slightly below normal in Western Canada during the period of rust development they were high enough for rapid rust development. The correctness of this view was demonstrated in rust culture experiments carried out at the Plant Pathology Laboratory, Winnipeg. These experiments showed that the incubation period of stem rust of wheat under outside conditions varied from 7 to 9 days during June, July and August. Moisture conditions on the prairies were ideal for spore germination, particularly in Sask. during the whole growing period. As a result of these favourable conditions for rust initiation and development in the prairie provinces very severe rust epidemics, particularly of leaf rust of and stem rust of wheat, occurred throughout Man. and Sask. and in parts of Alta. (B. Peturson).

Damage Caused by Cereal Rusts in 1954

This year, cereal rusts, particularly stem and leaf rust of wheat, caused greater reductions in yield and quality of cereal crops in Western Canada than in any previous year. As stated earlier, much the heaviest stem-rust infection occurred on durum wheat; a lighter, but severe, stem rust infection of unprecedented severity occurred on the predominant wheat varieties, Thatcher and Redman, and a much less severe rust infection occurred on oats. The damage caused to the various cereal crops was in direct proportion to the amount of rust present.

A wheat crop that at the beginning of August 1954 gave promise of an average yield of at least 21 bushels per acre for all of Man. and Sask. was so severely reduced by rust, excessive moisture, hail, and frost that the actual yield amounted to only about 10 and 14 bushels per acre respectively for Sask. and Man. This reduction of some 180 million bushels in expected yield was due more to the ravages of rust than to adverse weather.

As a comparison of the yield performance of a resistant and a susceptible variety under rust epidemic conditions gives a measure of rust effect an attempt to compare the yields of Selkirk (a highly resistant variety) with the yields of the prevalent susceptible varieties was made to measure the effect of rust on yield in 1954. Through the kindness of the United Grain Growers Company, which made available the results of a questionnaire sent to their elevator agents on the yields of Selkirk and Thatcher wheat, and through other data on comparative yields of Selkirk, Thatcher, Redman, and Lee obtained through a questionnaire sent to contract seed growers, yield data were obtained from about 300 points in Man. and Sask. In nearly every instance comparison was made between pairs of fields of Selkirk and a susceptible variety sown on summerfallow and seeded about the same date. In Man. the average yields per acre were as follows: Selkirk 35 bu., Lee 21 bu., Redman 17 bu., and Thatcher 14 bu.; while those for Sask. were: Selkirk 31 bu., and Thatcher 13 bu. The poor performance of the susceptible varieties may be attributed mainly to the effect of rust, and the superiority of Lee over Thatcher and Redman was, no doubt, due to its very high leaf rust resistance. Although final estimates of rust losses to wheat in the Prairie Provinces have not yet been reached it is considered probable that these losses were not less than 135 million bushels.

Durum varieties were more severely affected by rust than bread wheats. In Man. and Sask. they yielded about 7 bu. per acre, i. e. about one half that of Thatcher. Late oat fields were severely rusted and the yield materially reduced. However, the main oat crop was much less severely rusted than the wheat and oat yields in both Man. and Sask. equalled or slightly exceeded the long time average. (B. Peturson).

Table 2. Incidence of certain pathogenic fungi on wheat, oats barley and rye grown at 34 locations in Canada in 1954.

Locality	WHEAT			OATS		BARLEY					RYE			
	<u>P. graminis tritici</u>	<u>P. triticina</u>	<u>Erysiphe graminis</u>	<u>P. graminis avenae</u>	<u>P. coronata avenae</u>	<u>P. graminis</u>	<u>P. hordei</u>	<u>Erysiphe graminis</u>	<u>Septoria passerinii</u>	<u>Rhynchosporium secalis</u>	<u>Helminthosporium sativum</u>	<u>Helminthosporium teres</u>	<u>P. graminis secalis</u>	<u>P. secalina</u>
Saanichton, B. C.	0	1	3	0	0	0	0	4	3	0	0	0	0	0
Agassiz, B. C.	-	2	2	-	0	-	0	4	-	-	-	-	-	2
Creston, B. C.	4	4	1	1	0	2	0	0	0	0	4	0	2	2
Beaverlodge, Alta.	1	2	0	0	0	0	0	0	0	4	0	0	0	0
Edmonton, Alta.	1	4	0	1	1	1	0	0	1	4	0	0	0	1
Lacombe, Alta.	1	1	0	0	0	0	0	0	0	4	0	0	0	2
Lethbridge, Alta.	3	3	0	1	0	3	0	0	0	1	0	0	1	0
Scott, Sask.	2	4	0	1	1	2	0	0	0	4	0	0	1	1
Melfort, Sask.	2	3	0	3	1	1	2	0	1	3	0	0	1	1
Indian Head, Sask.	4	4	0	4	4	3	0	0	4	0	0	0	1	2
Brandon, Man.	4	4	0	4	4	3	2	0	0	0	0	2	2	4
Morden, Man.	4	4	0	4	3	4	1	0	2	0	0	2	1	3
Winnipeg, Man.	4	4	0	4	4	2	1	0	1	0	0	4	2	2
Fort William, Ont.	4	3	0	4	1	3	2	0	0	1	0	1	2	2
Kapuskasing, Ont.	4	4	0	2	1	1	0	0	3	0	0	0	0	0
Mindemoya, Ont.	4	4	0	4	4	2	3	0	0	0	1	0	2	4
Guelph, Ont.	4	3	3	2	2	2	2	4	-	-	-	-	3	3
St. Catharines, Ont.	4	4	1	3	2	3	2	1	-	-	-	-	1	2
Appleton, Ont.	1	0	0	4	4	2	0	0	0	0	1	0	2	-
Ottawa, Ont.	4	3	0	2	4	1	2	3	-	-	-	-	4	2
Merrickville, Ont.	1	3	1	3	-	0	2	0	-	-	-	-	2	1
Kemptville, Ont.	1	1	4	2	-	1	1	4	0	0	4	0	2	0
Williamstown, Ont.	2	2	0	4	3	-	1	0	-	-	-	-	2	1
Macdonald College, Que.	2	4	1	2	4	1	4	1	2	0	3	0	1	3
L'Assomption, Que.	3	3	0	2	2	2	3	1	2	0	2	0	2	-
Lennoxville, Que.	4	4	0	3	4	-	-	0	-	-	-	-	3	3
Normandin, Que.	2	2	0	1	1	1	1	0	0	0	3	0	0	0
Ste. Anne de la Poc., Que.	2	3	1	1	2	0	2	1	0	2	0	0	1	1
Fredericton, N. B.	3	4	0	2	4	2	4	-	0	0	2	0	3	3
Kentville, N. S.	1	3	0	4	2	0	2	0	-	-	-	-	1	2
Nappan, N. S.	0	2	3	1	1	1	2	0	0	0	1	0	0	3
Pictou, N. S.	0	-	-	2	4	-	-	-	-	-	-	-	0	0
Charlottetown, P. E. I.	0	1	0	1	1	0	1	0	0	0	4	0	0	2
St. John's West, Nfld.	0	0	-	0	0	0	0	-	-	-	-	-	0	0

Note: - = no observations made; 1 = trace; 2 = light; 3 = moderate; 4 = heavy.

Cereal Rusts in the Rust Nurseries

The incidence of wheat stem rust in the rust nurseries is summarized in Table 2. The level of infection on the varieties Lee, Mindum, Thatcher, and Redman is an indication of the geographical distribution and prevalence of race 15B. This race was present in most eastern nurseries and predominated in all western nurseries except in B. C. At many locations in Eastern Canada heavy infections occurred on the 15B-resistant McMurchy for the first time since it was included in the rust nurseries. Light infections were also found on this variety at Morden and Brandon in Man. The races isolated from McMurchy were 29 and 48 in Man., Ont. and Que. and 139 in N. B. The isolates of race 48 differ from those of this race obtained in previous years in their ability to attack McMurchy. The isolation of race 139 from McMurchy was not unexpected as 1953 isolates of this race could attack it. The race identified as 29 is a biotype, rather virulent to Selkirk and McMurchy, which was isolated once in 1953 from a collection made at Winnipeg. In the rust nurseries, generally, Selkirk (McMurchy × Exchange) × Redman³) was more resistant than McMurchy, the heaviest infection recorded on the former being 5% at Morden. The variety Kenya Farmer was highly resistant in all nurseries.

Wheat leaf rust (Table 2) was present in all nurseries. Heavy infections occurred generally in Man. and Sask. and in several nurseries in Eastern Canada. The new variety Selkirk was much less severely affected than varieties such as Redman and Thatcher but moderate infections occurred at several locations. Kenya Farmer, which is resistant to leaf rust except certain isolates of races 5, 15, 58 and 126, was heavily infected only at Macdonald College, Lee, Exchange and Frontana were highly resistant in all nurseries.

Moderate to heavy infections of oat stem rust (Table 2) were present from Sask. to western Que. Very light infections occurred east and west of this region. Race 7 was probably responsible for most of the heavy infection on Clinton, and no doubt predominated in the nurseries as it did in 1953. The somewhat lighter infections on Ajax and Vanguard were probably caused by races 8, 10 and 11, with race 8 being the most common. The variety Rodney was highly resistant in all nurseries except at Brandon where it was attacked by race 7A, the only race known to be capable of attacking it. Garry was highly resistant in all nurseries.

Crown rust (Table 2) was very prevalent in many of the nurseries in Eastern Canada. In Western Canada it was very abundant in all the nurseries in Man. and eastern Sask. It occurred in trace amounts in the Scott nursery in western Sask. and in the Edmonton nursery in Alta. No crown rust was found in the nurseries in B. C. and Nfld. This year crown rust spread farther north and west than in any year since rust nurseries were established in 1926. In almost all nurseries where crown rust occurred, Garry and Rodney carried about equal amounts of rust, about half as much as Bond, Clinton, Ajax and Vanguard. No rust, or trace amounts only, occurred on Trispermia and Landhafer except at

Pictou, where infections of 15% and 35% respectively were present. This rust was in the telial stage and the physiologic race responsible for the infection could not be identified.

The distribution of stem rust on barley (Table 2) was similar to that on wheat. However, the relatively heavy infection on the wheat stem rust resistant variety Vantage and the very light infection on the rye stem rust resistant variety Black Hulless at Fredericton, indicated that much of the rust there was rye stem rust. Nevertheless the available evidence indicates that the infection (20%) on Vantage at Lethbridge was wheat stem rust. Leaf rust of barley was prevalent in Eastern Canada but only light infections occurred in the west.

Leaf rust and stem rust of rye (Table 2) were prevalent in most nurseries.

Other Diseases

The incidence of certain other diseases in the nurseries is also given in Table 2. Powdery mildew of wheat and barley occurred only in B. C. at some locations in Eastern Canada. Powdery mildew of oats and rye was not observed in any nursery. Speckled leaf blotch of barley (Septoria passerinii) was present at several widely separated locations, moderate or heavy infections occurring at Saanichton, B. C., Indian Head, Sask., and Kapuskasing, Ont. Heavy infections of scald (Rhynchosporium secalis) were noted at Beaverlodge, Edmonton, and Lacombe, Alta., and at Scott and Melfort, Sask. Most nurseries in Eastern Canada showed spot blotch (Helminthosporium sativum) but in the west the disease was present only at Creston, B. C. New blotch (H. teres) was found in all Man. nurseries and at Fort William, Ont.

Flax rust occurred in small amounts in seven of the western nurseries: Beaverlodge, Lethbridge, Scott, Indian Head, Brandon, Morden and Winnipeg. It also occurred in trace amounts in the nursery at Ottawa. No rust was found on Rocket in any of these nurseries. Rust occurred on Bison at all of the eight nurseries listed above and on Dakota at all except the nurseries at Ottawa and Beaverlodge. At Winnipeg the rust on Bison and Dakota averaged 20% and at the other nurseries where these varieties became infected the infection ranged from trace to 5%. At the other 24 nurseries no rust was found on the varieties, Bison, Dakota and Rocket.

PHYSIOLOGIC RACES OF CEREAL RUSTS IN CANADA IN 1954

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In Report 9 issued by the Plant Pathology Laboratory, Winnipeg, Man., January 1955, an account is given of cereal rust development in Western Canada in 1954 and the distribution in Canada is recorded of the physiologic races of the rusts: wheat stem rust (*Puccinia graminis* var. *tritici*), wheat leaf rust (*P. triticina*), oat stem rust (*P. graminis* var. *avenae*) and oat crown rust (*P. coronata*). Isolations from collections of aecia from barberry and buckthorn are also recorded.

Cereal rust development in Western Canada has already been covered in Report 8, on the Rust Nurseries. The other two sections have been summarized below.

Distribution of Physiologic Races

Puccinia graminis var. *tritici*

The 1954 stem-rust survey included 361 isolates. The following races were isolated (the number of isolates of each race given in brackets): race 10 (1); race 11 (1); race 15 (2); race 15B (283) further distinguished as the biotypes 15B (274), 15B-3 (6), and 15B-4 (3); race 29 (30) in the biotypes 29-1 (21), 29-2 (7), and 29-3 (2); race 37 (1); race 38 (5); race 48A (14); race 56 (15); race 59A (1); race 59C (5); race 87 (2) and race 139 (1).

Race 15B was the predominant race in both Eastern Canada and the Prairie Provinces, accounting for 77% of all Canadian isolates. Most of the isolates of this race were of the type widely prevalent since 1950, designated simply as race 15B. Two other biotypes of this race, distinguishable by means of the accessory varieties Golden Ball, Selkirk, and McMurachy, were found in small amounts. Six isolates of the biotype designated 15B-3 were collected in the Prairie Provinces. This biotype is more virulent than the others to Selkirk and McMurachy. Three isolates of 15B-4 (formerly called 15B-2) were collected in Man. This biotype is distinguishable from the others by its greater virulence on Golden Ball. It is now referred to as 15B-4 because the designations 15B-1 and 15B-2 are in use in the United States for biotypes identified at the University of Minnesota. Other strains of the race 15 complex found in 1954 include race 15 found in N. B., near barberry, and race 87 found in Ont. and Man. Race 87 differs from race 15B-3 chiefly by the production of X type of infection instead of 4 type on Mindum, Spelmar and Kubanka.

After race 15B, race 29, accounting for 8% of all isolates, was the next most prevalent. In this race, three biotypes were distinguished by means of accessory varieties: race 29-1 virulent on Golden Ball, Selkirk and McMurachy; race 29-2 non-virulent on Golden Ball but virulent on Selkirk and McMurachy; and race 29-3 virulent on