CEREAL RUSTS IN CANADA IN 1957

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Cereal rusts caused insignificant losses in Western Canada in 1957. Probably the most important factor restricting rust increase was the large acreage sown to rust resistant wheat and oat varieties in Man., e. Sask., and adjacent areas in the U.S.A. Stem rust development was restricted further by cool early spring weather in s. U.S.A. which reduced the amount of stem rust inoculum. Air-borne inoculum was not carried northwards into Western Canada until rather late in the season. A very light shower of leaf rust spores occurred on 10-12 June but appreciable numbers did not appear in spore-traps until early July. Stem rust spores were found rarely on slides before 22 July. The number of spores caught was much the same as for 1956; much lower than for several years previous to 1956. The late spore movement, along with a comparatively early harvest, left little time for rust development. The rather large amount of rust on susceptible varieties in experimental plots at the end of the season indicated that a considerable quantity of inoculum reached Western Canada before harvest.

Wheat Stem Rust was first observed on 2 July on winter wheat near Winnipeg but it was not found on spring wheat until 12 July. This rust appeared much earlier in 1955 and 1956 when it was found first on 13 and 22 June respectively.

In Man., where nearly all the wheat was Selkirk, only a trace of stem rust was found in farmers' fields. However, the severity of infection in a field of Marquis wheat near Winnipeg was 35%. The scarcity of rust in farmers' fields can be attributed largely to the resistance of the varieties grown. A trace of stem rust was found west to Regina and Saskatoon. Infection was not seen in Sask. but a trace of rust occurred on susceptible varieties in Alta. In n. Alta. the only record of the presence of stem rust was a trace on barley at Fallis, west of Edmonton.

Leaf Rust of Wheat was first observed on 2 July, 1957, about two weeks later than usual. This was by far the most common of the cereal rusts. In Man. where the wheat crop was almost entirely composed of the variety Selkirk, infections were mostly of a moderately resistant type and ranged up to about 20% in severity at harvest time in the southern part of the province. In the more northerly areas infection was considerably lighter. In e. Sask. infection was generally light or a trace though rather severe infection was

reported on susceptible varieties in the east central area (e.g. Kamsack, Kelliher, Quinton). Infection extended at least as far north as a line from Tisdale west to Battleford but there only a trace of the rust was found. The amount of infection diminished westwards through Sask. to trace on all plants, as at Rosetown, or trace on about 10% of the plants, as at Kindersley. In Alta. light infection was found as far north as Lacombe and Camrose but only a trace occurred at Edmonton.

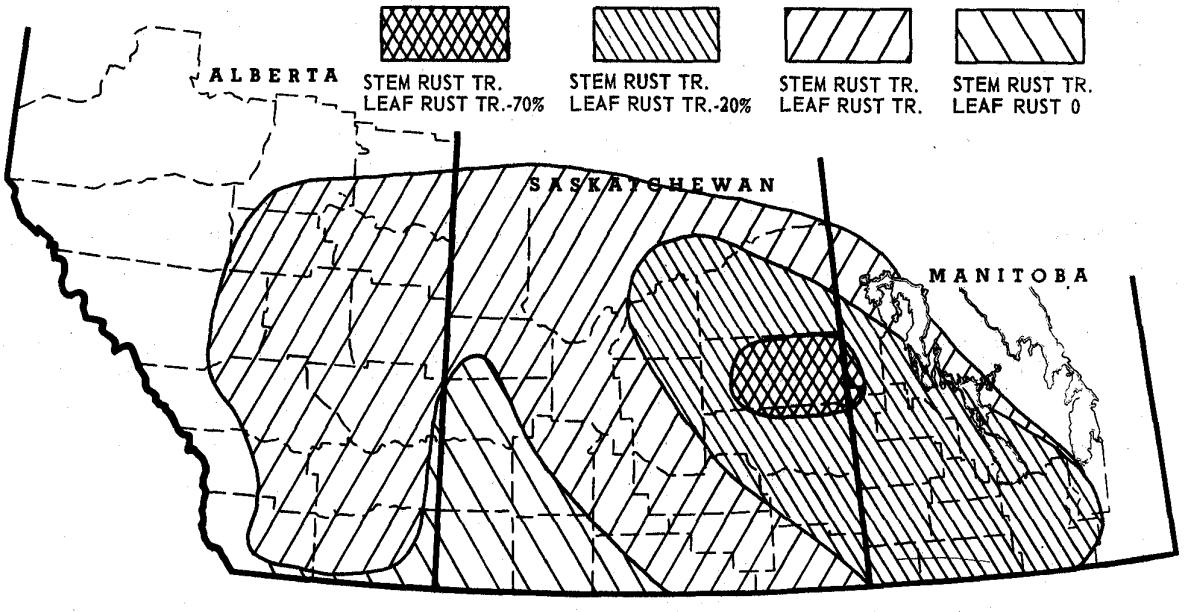

Fig.1 Map of the Prairie Provinces showing approximate intensities of stem and leaf rust in 1957 on susceptible common wheat.

In 1957, Oat Stem Rust was first observed in Man. on 25 July. Only a trace of oat stem rust occurred in farmers' fields in Man., where the varieties Rodney and Garry predominated, but the rust was fairly common on wild oats at the time of harvest. In Sask. this rust occurred in trace amounts in the south-eastern part as far west as Indian Head and was found also in the Canora-Kamsack area in the east-central part of the province. No reports of this rust were received from Alta.

Crown Rust of Oats was first observed in 1957 on 15 July at Christie, Man. Its distribution was practically coextensive with that of oat stem rust.

It was found throughout the agricultural area of Man. and as far west as Indian Head and Melfort, Sask. Infection was generally heavier than that of oat stem rust. Many of the infections were of a susceptible type and it is possible that some late-sown fields sustained damage.

Leaf Rust of Barley was found only in s. e. Man., in the Red River Valley and areas just west of it. Only a trace of infection was found. Rye stem rust had a scanty distribution throughout the agricultural areas of the Prairie Provinces; a trace was found at Edmonton, Alta., and it was observed in the rust nurseries in Man. and at Indian Head, Sask. Light infection of leaf rust of rye occurred in Man. and northwest as far as Preeceville, near Canora, Sask.

Cereal Rusts and Other Diseases in the Rust Nurseries

In 1957, the uniform rust nurseries were grown at 36 locations in Canada. A summary of the disease observations made on the varieties of wheat, oats and barley grown at these locations appears in Table 3.

The varieties grown in the rust nurseries are: Wheat: McMurachy, Lee, Kenya Farmer, Little Club, Marquis, Mindum, Thatcher, Selkirk, Redman, Exchange, Frontana, Ramsey, R. L. 3254. Oats: Bond, Trispernia, Exeter, Garry, Clinton, Landhafer, Rodney, R. L. 2278. Barley: Montcalm, Parkland, Vantage, Feebar. Rye: Prolific.

Wheat Stem Rust

Wheat stem rust failed to develop abundantly in the rust nurseries in 1957. In Western Canada the nurseries at Creston, B. C., Melfort, Sask., Brandon, Man., and Winnipeg, Man. were the most severely infected. Much less rust occurred at Indian Head, Sask., and Morden, Man., and there was no stem rust in seven of the western nurseries. Stem rust was present at all locations in Ont. and Que. except Appleton and Williamstown in Ont., but considerable infection occurred only at Mindemoya, Ont., and L'Assomption, Que. The nurseries in the Atlantic Provinces were free from stem rust except at Fredericton, N. B. where there was a moderate amount of rust. It seems likely that the delayed northward movement of a restricted quantity of stem rust spores helped to limit stem rust development on susceptible varieties in 1957.

Only the very susceptible varieties Little Club, Marquis, Mindum, and Exchange showed over 10% stem rust at any location. The 15B resistant variety McMurachy was most heavily rusted (10%) at Mindemoya, Ont. Evidently race 48A, the only race isolated from McMurachy at Mindemoya, caused most of this infection. The small amount of rust on the varieties Lee,

Thatcher and Redman indicates that there was not much race 15B in any nursery. Kenya Farmer, Selkirk and R. L. 3254 showed only traces of rust.

Wheat Leaf Rust

Heavy leaf rust infections occurred in nurseries in all provinces except Sask. and Alta. The absence or scarcity of leaf rust in the nurseries at Pictou and Lower South River in N. S. and Doyles and St. John's West in Nfld., may have resulted from the poor condition of the plants rather than from the absence of rust inoculum. Other nurseries in the Atlantic Provinces were heavily infected. The scarcity of rust in the Sask. and Alta. nurseries may have resulted from dry conditions and a lack of air-borne inoculum. Severe infections at Morden, Brandon and Winnipeg showed that an abundance of inoculum was present in Man. Possibly the large acreage of Selkirk wheat in Man. acted as a barrier preventing a large-scale rust movement westward into areas where leaf-rust-susceptible varieties are grown.

The leaf rust reaction of the varieties in the nurseries varied little from the expected. The rather high percentage of rust on Lee at Morden and Brandon in Man., and on Selkirk at Morden and Winnipeg in Man., does not necessarily mean that the resistance of these varieties is now altogether ineffective. It seems more likely that much of this infection was produced under conditions favorable to rust development by races to which these varieties are moderately resistant. These varieties had only half as much rust at these locations as the susceptible variety Little Club. Evidence from physiologic race identifications indicates that although biotypes in a number of races can attack Lee, there are no biotypes very virulent on Selkirk. The variety Redman was severely infected at Morden and Winnipeg, Man., Fort William, and Guelph, Ont., but was lightly infected elsewhere. Redman has performed in this matter for a number of years. It is susceptible in areas where races such as 15a and 5a predominate but it is resistant where other races such as 58 predominate. In 1957, races 5a and 15a were most common in Man. and Ont., and in these provinces Redman was severely attacked. This variety was resistant in Sask. and Alta., where it is usually susceptible, presumably because races 1 and 11, which do not attack it, suddenly became predominant there in 1957. Exchange and Frontana were resistant at all locations.

Oat Stem Rust

Oat stem rust was absent or produced only light infections in all nurseries except those at Winnipeg, Man., Kemptville, Ont., Lennoxville, Que., and Kentville, N.S. All nurseries west of Indian Head, Sask., were free from this rust except at Agassiz, B. C. Race identification demonstrated that the light infection on the variety Rodney at Kemptville, Ont., was caused

by race 7A. It is likely that the rust on Rodney at Lower South River, N.S., was this same race but races were not identified from this material. The variety Garry was resistant at all locations.

Oat Crown Rust

Crown rust infections were not severe at many locations in 1957. No crown rust was present in nurseries west of Melfort, Sask., and it occurred sporadically in nurseries in other parts of the country. The relatively large amount of crown rust on the varieties Garry and Rodney, as compared with former years, indicates a rapid increase in the prevalence of races able to attack these varieties. R.L. 2278 was considerably more resistant than either of these varieties.

Rusts on Barley and Rye

Barley was attacked heavily by stem rust only at Creston, B.C. Since Prolific rye in the same nursery was free from stem rust most of the rust on the barley varieties was evidently wheat stem rust. The same situation occurred at Creston last year.

Leaf rust of barley was present in most nurseries in Ontario and Quebec. It occurred also at Fredericton, N.B., Morden, Man., and Creston, B.C. This rust was more widespread and caused somewhat heavier infections than in 1956. Severe infection of rye by stem rust occurred only at Fredericton, N.B., although it was present in appreciable amounts at Guelph, Merrickville, and Mindemoya, Ont., and Kentville, N.S. as well. Leaf rust of rye was widely distributed, being present in nurseries in all provinces except Alta. and Nfld.

Diseases other than Rusts

A summary of the incidence of pathogenic fungi in the rust nurseries is presented in Table 3. Septoria spp. were observed on wheat in nurseries in every province. Mildew of wheat occurred sporadically in all provinces except Man. and Sask. Septoria avenae f. sp. avenae occurred on oats in nearly all the nurseries except those in Sask. and Alta. Its appearance in Man. nurseries for the second consecutive year indicates that it may now be established in the Prairie Provinces. Only light infections have been encountered in these two years but the disease appeared to increase over 1956. Severe infections of barley mildew occurred in B.C. and Que. Septoria passerinii occurred sporadically at locations from B.C. to P.E.I. The heaviest infections were at Morden, Man., and Normandin, Que.; somewhat lighter infections occurred at Ottawa, Ont., Lennoxville, and L'Assomption, Que.

Table 3. Incidence of certain pathogenic fungi on wheat, oats, barley and rye at 36 locations in Canada in 1957 [1/]

Locality	WHEAT				OATS			BARLEY				RYE	
	P. gr. tritici	P. recondita	Erysiphe graminis	Septoria spp.	P. gr. avenae	P. cor. avenae	S. avenae f. sp. avenae	P. graminis	P. hordei	Erysiphe graminis	S. passerinii	P. gr. secalis	P. secalina
Saanichton, B. C.	0	4	2	2	0	0	4	1	0	4	2	0	1
Agassiz, B. C.	0	4	0	3	1	0	3	0	0	4	0	1	4
Creston, B. C.	4	4	2	0	0	0	0	2	2	4	0	0	4
Beaverlodge, Alta.	0	1	0	3	0	0	0	0	0	0	0	0	0
Edmonton, Alta.	0	0	-*	-	0	0	-	0	0	-	-	0	0
Lethbridge, Alta.	0	1	3	0	0	0	0	0	0	2	0	0	0
Lacombe, Alta.	0	2	1	0	0	0	0	0	0	0	2	0	0
Scott, Sask.	0	2	0	1	0	0	0	0	0	0	1	0	0
Melfort, Sask.	3	2	0	3	0	1	0	0	0	0	2	0	1
Indian Head, Sask.	2	2	0	3	1	0	0	1	0	0	1	1	1
Brandon, Man.	3	4	0	4	2	2	2	1	-	0	-	1	3
Morden, Man.	2	4	0	2	2	3	2	1	1	0	4	1	3
Winnipeg, Man.	3	4	0	3	3	4	2	1	-	-	-	1	4
Fort William, Ont.	3	4	0	3	2	3	3	1	2	0	0	0	4
Kapuskasing, Ont.	2	4	0	0	1	0	2	1	0	0	0	0	2
St. Catharines, Ont.	1	3	2	1	0	1	0	0	1	4	0	0	3
Guelph, Ont.	1	4	4	4**	2	3	3	0	3	4	2	2	4
Kemptville, Ont.	2	4	3	1	3	0	0	1	2	4	0	1	4
Ottawa, Ont.	2	4	1	1	2	4	4	1	4	4	3	0	4
Merrickville, Ont.	1	4	4	1	1	4	4	2	2	4	1	2	4
Mindemoya, Ont.	4	4	1	1	2	4	1	1	4	3	0	2	4
Appleton, Ont.	0	3	-	-	2	1	-	2	0	-	-	1	2
Williamstown, Ont.	0	4	0	1	0	4	1	0	2	0	1	0	3
Macdonald College, Que.	2	4	0	0	2	3	1	1	3	3	0	1	3
Lennoxville, Que.	1	4	1	3	4	0	3	1	1	0	3	1	3
Ste. Anne de la Poc., Que.	2	4	0	3	1	0	3	0	1	-	1	0	2
Normandin, Que.	1	4	0	4	1	1	4	0	0	0	4	0	2
L'Assomption, Que.	4	4	-	3	2	2	4	0	1	0	3	0	2
Fredericton, N. B.	3	4	-	4	2	3	3	1	2	0	0	4	3
Kentville, N. S.	0	3	4	1	4	1	4	1	0	0	0	3	3
Pictou, N. S.	0	0	0	1	2	2	2	0	0	1	0	0	0
Lower South River, N. S.	0	0	0	4	2	2	4	0	0	0	1	1	0
Nappan, N. S.	0	4	2	3	1	2	4	0	0	0	0	0	2
Charlottetown, P. E. I.	0	3	0	2	2	1	4	0	0	1	1	0	2
Doyles, Nfld.	0	1	0	0	0	0	3	0	0	0	2	0	0
St. John's West, Nfld.	0	0	-	-	0	0	-	0	0	-	-	0	0

* A dash signifies that no observation was made.

** Septoria nodorum.

1/ 1 = trace, 2 = light, 3 = moderate, 4 = heavy. For the rusts 1 = tr. - 1%, 2 = 2 - 20%, 3 = 25 - 50%, 4 = above 50%.

In addition to the diseases shown in Table 3 the nurseries were examined for the presence on barley of Helminthosporium teres, Rhynchosporium secalis, and H. sativum. H. teres was found in the nurseries from Scott, Melfort, and Indian Head in Sask., and from Morden, Man. R. secalis was present in nurseries from Beaverlodge, Alta., Scott and Melfort, Sask., Morden, Man., and Kapuskasing, Ont. H. sativum occurred at Creston, B.C., Indian Head, Sask., Fort William and Kapuskasing, Ont., Lennoxville, Que., Kentville, Pictou, Lower South River and Nappan, N.S., Charlottetown, P.E.I. and Doyles, Nfld.

Distribution of Physiologic Races

Puccinia graminis f. sp. tritici

Nineteen races and subraces of wheat stem rust were identified in the 1957 physiologic race survey. The number of isolates obtained (186) was smaller than for several years because there was little stem rust in Canada this year. The races isolated (number of isolates in brackets) are: 1(6), 2(3), 10(1), 11(10), 11-1(Can.)(8), 15(2), 15B-1(Can.)(20), 15B-1L(Can.)(14), 15B-4(Can.)(27), 29-1(Can.)(4), 29-2(Can.)(5), 32(3), 34(6), 38(1), 48(2), 48A(7), 56(57), 59(6), 87-2(Can.)(1), 139(1), 140(1) and 152(1).

Physiologic races were identified by the same method used in 1956. The supplementary differential host varieties Lee, Golden Ball, Selkirk, Bowie, McMurachy and Yuma were useful in distinguishing subraces. The other supplementary varieties used were Kenya Farmer, Mayo 54, Frontana-K58-Newthatch II-50-17, Mida-McMurachy-Exchange II-47-26 and Kenya 117A. These five varieties were resistant to all isolates excepting Mayo 54 which was moderately susceptible to race 32.

No dangerous new race was isolated in 1957, but there was a marked change in the prevalence of some known races. Race 15B (33% of the isolates) declined in prevalence for the third consecutive year. A subrace of 15B which was reported but not named in 1956 has been called, tentatively, race 15B-1L (Can.). This subrace is like 15B-1 (Can.) except that it is virulent to the durum wheat varieties Yuma and Langdon. Race 15B-4 (Can.), which can attack the durum wheat varieties Ramsey and Towner, comprised over 14% of the isolates. The well-known race 56 increased in prevalence, comprising 31% of the isolates in 1957 as against 21% in 1956. Many of the wheat varieties are highly resistant to race 56. If only the races isolated from the susceptible wheat varieties Marquis and Little Club and the susceptible H. jubatum in Man. and Sask. are considered, it seems more likely that race 56 comprised over 60% of the rust inoculum reaching these two provinces. The only races which have moderate virulence to Selkirk wheat are races 29-1 (Can.), 29-2 (Can.), 32 and 87-2 (Can.). In spite of the large acreage of Selkirk in Man. and e. Sask. these races did not increase in prevalence in 1957.

More rust collections from the area around Creston, B. C. were analysed than for many years. The race distribution in that area is very different from other regions in Canada. For example, races 1, 10,48 and 140 were found only in collections from the Creston area and the similar races 2 and 59 were common in B. C. but rare elsewhere. These races are much like those found in the states of Oregon and Washington. The race distribution indicates that B.C., Oregon and Washington constitute an ecological region quite distinct from the cereal producing area east of the mountains.

Several years ago American and Canadian workers who identify physiologic races of wheat stem rust agreed that a common source of differential host seed would improve the uniformity and reliability of race identification. The United States Department of Agriculture undertook to increase and care for pure seed stocks of the differential host varieties. Lines of the differential varieties Marquis, Reliance, Kota, Mindum, Spelmar and Acme, derived from single plant selections, were established. They have been tested to selected races in the United States and at Winnipeg and undesirable lines have been discarded. Wheat stem rust races are now being identified at Winnipeg on the provisionally purified differential hosts supplied by the United States Department of Agriculture.

It was agreed at the International Rust Conference in Mexico City in 1956 that certain varieties would be tested to evaluate them as possible supplementary differential hosts. This work, begun in 1956, was carried on in 1957. The varieties Triticum timopheevi R. L. 1312, Illinois-Chinese[2] X T. timopheevi R. L. 2537, Marquillo, Mentana-Rhodesian, Ramsey, Langdon, Yuma, Thatcher[6] X Kenya Farmer and Lee[6] X Kenya Farmer reacted differentially to some of the races used. However, only Ramsey and Yuma or Langdon appear to have value as differential hosts for Western Canada at present.

Stem Rust on Barley and Wild Barley

Rye stem rust was isolated more frequently from barley and wild barley in 1957 than in any year since 1951. One hundred and thirty one collections of stem rust were obtained from Alta., Sask., Man. and Ont. Of 57 collections from barley or wild barley 42 were wholly or partly rye stem rust. Although rye stem rust is more virulent to most rust-resistant barley varieties than wheat stem rust, barley was not harmed to any appreciable extent in 1957.

Puccinia recondita

In 1957, as in previous years, each rust collection was initially increased on Little Club and two single pustule isolates were established and

used for race identification. The remainder of each original culture on Little Club was used to inoculate a "screening" set composed of the varieties Exchange, Frontana, Selkirk, Klein Titan, Mindum, Stewart, Ramsey, Rio Negro, Colotana, Mida-McMurachy-Exchange and Maria Escobar-H-44-Marquis. Wheat leaf rust races were usually identified on the five standard differential host varieties Malakof, Brevit, Webster, Loros and Mediterranean, and on the accessory host varieties Renown and Lee. The complete set of eight standard differential hosts was used in the identification of 146 cultures. Altogether 402 isolates were studied and 11 races were identified. These races are (number of isolates in brackets): 1(44), 5(24), 9(12), 11(78), 15(118), 28(24), 35(15), 58(63), 68(2), 126(19), 140(3).

In 1956, race 15 was the most prevalent race in Man., Sask. and Alta. Race 15 was again the most prevalent race in Man. in 1957 but in Sask. and Alta. races 1 and 11 were predominant. These races are characteristic of the Western Coastal areas and were presumably carried into the Prairies by unusual wind movements. This resulted in a distribution of leaf rust races on the Prairies which is in marked contrast to that of last year. The situation in other parts of the country was relatively unchanged although race 15 was isolated more frequently than in 1956. Race 28 was identified in 24 cultures. This race is very similar to race 126 differing only in the reaction on Hussar. The separation of UN 6 into races 28 and 126 is of doubtful value and was not done in 1956.

The majority of isolates of races 1 and 11 were not virulent to Renown and Lee. The marked decline in cultures virulent on Lee and Renown is due to the predominance of races 1 and 11 in Sask. and Alta. Lee was most susceptible to isolates of race 15 and UN 6. A few isolates in other races were virulent to that variety as well. It was highly resistant to all cultures of races 35, 68 and 140.

The durum wheat varieties in the screening set were moderately susceptible to some isolates, particularly to those of race 58 and race 11. Ramsey was consistently more resistant than were Stewart and Mindum. However, adult plants of these last two varieties were resistant to all the isolates with which they were inoculated.

Rio Negro and Colotana were highly resistant to most isolates. Rio Negro produced a mesothetic reaction with races 28 and 126 and was somewhat susceptible to race 9. Maria Escobar -H-44 - Marquis, a highly resistant variety, was mesothetic in reaction to races 28 and 126. Mida-McMurachy - Exchange and Frontana showed mesothetic reactions with many isolates.

Although most isolates produced a (1) to (2) type reaction on Selkirk, more (2)+ type or (2) to (3) type were recorded in 1957 than in 1956. It is doubtful that this slight change in type of reaction represents a real increase in virulence.

Puccinia graminis f. sp. avenae

In the 1957 physiologic race survey of oat stem rust the 90 isolates obtained were separated into 13 races. The races identified (number of isolates in brackets) are: 1(1), 2(1), 3(1), 4(3), 5(3), 6(5), 7(30), 7A(13), 8(15), 8A(1), 10(1), 12(2), 13(13), 13A(1). Physiologic races were identified by much the same method used in past years. The only change was the addition of the variety Saia to the supplementary hosts Garry and Rodney.

There were some distinct changes in the prevalence of known races in 1957 as compared with the past few years. Race 7 remained the most prevalent race but its predominance diminished sharply from over 60% of the isolates in 1956 to less than 34% in 1957. Race 8 was again second in prevalence to race 7. The number of isolates of race 7A increased from less than 3% of the total in 1956 to over 14% in 1957. This race is important because it can attack the variety Rodney which was released to farmers a few years ago. The distribution of this race was much the same as in 1956. Nearly all the isolates came from Man. where Rodney is a popular variety. In Eastern Canada, races 4, 6, and 13, which are quite similar, increased in prevalence from less than 6% of the isolates in 1956 to over 23% in 1957. These races were not found in Western Canada. They are important because they can attack both the White Russian and Richland types of resistance which are present in many commercial oat varieties.

Two new and important races were discovered in 1957. These races tentatively identified as races 8A, and 13A can attack both of the new varieties Garry and Rodney. They were isolated only from rust collected at Ste. Anne de la Pocatiere, Que.

Puccinia coronata var. avenae

Thirty-three races and sub-races of oat crown rust were isolated from collections received from Sask., Man., Ont., Que. and the Atlantic Provinces. The races isolated (number of isolates in brackets) are: 201(8), 202(10), 203(5), 205(1), 209(9), 210(5), 211(7), 212(12), 213(14), 216(13), 227(1), 229(1), 231(1), 234(1), 239(4), 240(1), 264(2), 274(23), 276(2), 279(14), 280(1), 284(3), 293(2), 1957-1(4).

Races 213, 216, 274 and 279 comprised 44.4% of all isolates and were about equally prevalent in Eastern and Western Canada. In 1956 these four races comprised only 3% of all the isolates. They are pathogenic to all the commercial oat varieties grown in Canada. Three races, 264, 293 and one tentatively designated 1957-1, were isolated in Canada for the first time in 1957.

Four of the races isolated have pathogenic properties of great interest to plant breeders. Race 264 can attack the varieties Sante Fe, Landhafer, Bond and Victoria, and races 276, 293 and 1957-1 can attack all of these varieties except Victoria. These four varieties have been important sources of crown rust resistance for a number of years.

Isolates from aecia collected on Rhamnus cathartica in 1957

Aecial collections were obtained on R. cathartica from P. E. I., Ont. and Man., in 1957. Several grass hosts, which can differentiate between the various varieties of crown rust were inoculated with spores from these collections.

The same three crown rust varieties that were found last year were isolated again this summer. They were the varieties avenae, secalis and festucae. Of these the variety avenae was by far the most prevalent. Ten physiologic races of the variety avenae were identified from the aecial material. All of the races identified from these collections, except race 237, were isolated this year from uredial collections on oats.