PHYSIOLOGIC RACES OF CEREAL RUSTS IN CANADA IN 1950

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The complete report, mimeographed separately in January, 1951, contains tables in which are presented the data derived from the surveys of the distribution, in Canada, of physiologic races of the following rusts of cereals: Puccinia graminis var. tritici, P. triticina, P. graminis var. avenae, P. coronata var avenae, and P. hordei. Only Table 2 of the original report is here reproduced as Table 3.

For cereal rust development in Canada in 1950, the report on the Rust Nurseries may be consulted.

Distribution of Physiologic Races of the Cereal Rusts

The 147 isolates of wheat stem rust (Puccinia graminis var. tritici) comprising the physiologic race survey were resolved into the following 10 races (number of isolates of each in brackets): 15B (82); 17 (2); 19 (1); 29 (3); 38 (1); 56 (53); 59 (2); 69 (1); 113 (1); 140 (1). Two of these, races 69 and 140, had not previously been found in Canada.

A striking feature of the survey is the widespread distribution of race 15B which had been collected only once in Canada prior to this year, viz., from Killarney, Man., in 1946. Infection by this race was concentrated in Man. and eastern Sask. but the limits of its distribution extended eastwards to the province of Quebec and westwards to the Rocky Mountains.

Although infection by race 15B was heavy in many places, especially in Man., where 58 isolates of this race were identified from 69 isolates collected, it probably did not occur as frequently in comparison with other races as this figure would indicate. Its exaggerated frequency is to be found in the large number of rust collections taken from durum wheat and from rust resistant common wheat varieties, such as Thatcher, Redman, Regent, and Mida. Such collections are almost exclusively composed of race 15B. Of the isolates from barley, in Man. and Sask., race 15B accounted for almost two-thirds. In the same area, less than half the isolates from susceptible common wheat and only one-quarter of those from Hordeum jubatum were identified as race 15B. It is therefore probable that race 15B composed less than half of the wheat stem rust present in the eastern prairie region where it was most prevalent.

The apparent scarcity of the formerly common races 17 and 29 is no doubt partly due to difficulties in detecting these races when they and race 15B are present in the same collection of rust. It is almost certain that these races occurred more frequently than is suggested by the survey data.

Table 3. Isolates of race 15 of wheat stem rust obtained from cereals and grasses in Canada 1919-1950.

Year	Province						Total no. isolates race 15	Total no. isolates studied (all races)	Race 15 as % of total isolates
	N.S.	Que.	Ont.	Man.	Sask.	Alta.			
1919	-	-	-	-	1	-	1	28	3.6
	no isolates 1920-1925						0	426	0.0
1926	-	-	-	1	1	-	2	378	0.5
1927	-	-	-	4	3	1	8	450	1.8
1928	2	2	1	11	5	-	21	391	5.4
1929	-	-	1	-	-	-	1	306	0.3
	no isolates 1930-31						0	387	0.0
1932	-	-	-	1	-	-	1	129	0.8
	no isolates 1933-36						0	612	0.0
1937	-	-	-	1	-	-	1	184	0.5
1938	-	-	-	1	1	-	2	291	0.7
1939	-	-	1	-	-	-	1	156	0.6
1940	-	1	-	-	-	-	1	234	0.4
1941	-	-	-	1	-	-	1	215	0.5
1942	-	-	-	1	-	-	1	99	1.0
	no isolates 1943-45						0	340	0.0
1946	-	1	-	1*	1	-	3	145	2.1
1947	-	1	2	-	1	-	4	123	3.3
1948	-	-	-	1	-	-	1	132	0.8
	no isolates 1949						0	100	0.0
Total 1919 1949	2	5	5	23	13	1	49	5126	1.0
1950	0	1*	5*	58*	16*	2*	82	147	55.8

*Isolates identified as race 15B

In view of this year's outbreak of race 15B it may be of interest to review the previous known distribution of race 15 in Canada. Table 3 summarizes the known distribution of race 15 on cereals and grasses since race surveys were first undertaken in 1919. It is evident that there were at least three periods 1926-1929, 1937-1942, and 1946-1948 in which race 15 had considerable distribution. Possibly the reason why it did not increase to the point of becoming a predominant race in the two earlier periods was the absence of cereal varieties that would exercise on it a preferential selection. It was during the second period, 1937-1942, that race 15B was first recognized as a distinct strain (biotype) of greater virulence than the general run of race 15. The fact that none of the isolates of race 15 found in Canada during this period are designated as race 15B does not prove that this biotype did not occur in the period 1937-1942, since the differential varieties now employed to distinguish it were not then in use.

Whatever the relation of barberry to the origin of race 15 (and there is abundant evidence that it is one of the races most commonly isolated from barberry) it is clear that it has had sufficient distribution on cereals and grasses in the Great Plains area to permit its rise to predominance if and when circumstances become favourable. Possibly one of the favourable circumstances is the incorporation into common and durum wheats of emmer "blood". Emmers like Yaroslav and Vernal are more or less susceptible to race 15 and particularly so to its biotype 15B. The existence of this biotype coincident with the growing of great acreages of Carleton and Stewart (derived from Vernal) and of many Hope and H44 derivatives (derived from Yaroslav) appears to have been one of the primary causes of the rust epidemic of 1950 (T. Johnson and G.J. Green).

Identification of races of Puccinia triticina was carried out by use of the full set of leaf rust differential hosts plus the variety Hope, which has been used for several years as a supplementary host to determine the virulence of rust isolates towards Hope and H44 derivatives. Hope is fully susceptible in the seedling stage only to those races or biotypes that are particularly virulent to the above-mentioned wheats. Races possessing this virulence are designated by the letter "a".

Each rust collection, after increase on the susceptible wheat Little Club, was inoculated to a "screening set" of four accessory hosts: Exchange, Lee, Gabo, and Frontana. Any large pustules noted, particularly on Exchange and Lee, were used for the establishment of further isolates to determine the race or races involved. The majority of the isolates studied, however, were randomly selected, two single-pustule isolates per collection being established from the first rust increase on Little Club. The survey as a whole therefore represents an attempt to combine the two objectives of discovering races potentially dangerous to present breeding material and of determining what races are predominantly present in the rust collections gathered.

The races were tabulated in accordance with the "Unified Numeration" of the key agreed on, in 1948, by American and Canadian workers with leaf rust. The old race numbers corresponding with the new ones are also given.

The 275 isolates were identified as follows (number of isolates in brackets): UN 1 = race 1 or 1a (23); UN 2 = race 15 or 15a (51); UN 3 = races 3 and 58 (50); UN 5 = race 5a (66); UN 6 = race 126 or 126a (60); UN 10 = race 11 (8); UN 11 = race 93 (2); UN 14 = race 128a (2); UN 16 = race 33 (10); UN 23 = race 124 (3).

The distribution of the races in 1950 was very similar to that of the preceding year. UN 3 (race 58) was the predominating race in Eastern Canada. In Man. and Sask., the bulk of the rust consisted of UN 2 (race 15a or 15); UN 5 (race 5a); and UN 6 (race 126 or 126a). As in the preceding year, the race distribution in Alta., particularly in the southern part of the province, was different from that in the other two prairie provinces. The predominant races in Alta. were UN 1 (race 1 or 1a), UN 16 (race 33) and UN 10 (race 11). The variety of races was greater here than elsewhere in the prairie region. The 40 isolates from Alta. consisted of 8 races whereas the 132 isolates from Man. and Sask. consisted of only 5 races. The race distribution in the B.C. collections (mostly from Creston in eastern B.C. and Agassiz in the Fraser Valley) was rather similar to that of Alta.

The race distribution in Man. and Sask. is evidently influenced by the Hope and H44 derivatives grown there and in the adjacent United States. In these two provinces 86% of the isolates were virulent to Hope wheat as against 37% in Eastern Canada and 20% in the Alta. and B.C. collections. The tendency that Hope or H44 derivatives have to select out certain races is shown by the fact that 32 of the 34 isolates from Redman wheat consisted of the Hope-virulent races 5a, 15a, 126a and 128a whereas only 14 of the 28 isolates from Thatcher wheat were virulent to Hope (T. Johnson and G.J. Green).

A study of 152 isolates of oat stem rust (Puccinia graminis var. avenae) resulted in the identification of the following races (number of isolates of each in brackets:) 1 (5), 2 (44), 4 (2), 5 (9), 6 (1), 7 (24), 8 (33), 10 (18), and 11 (16).

The chief feature of the physiologic-race survey is the widespread distribution of race 7, which, in previous years, was rarely collected on oats. This race, which made up 16% of the oat stem rust isolates, was common in the oat-growing areas from Sask. to eastern Ont., and was collected as far east as Ste. Anne de la Pocatière, Que. Its emergence as a common race is not a serious threat to most of the oat varieties now grown in Canada. It appears to be no more virulent than races 1, 2, and 5 to the older susceptible oat varieties or to the newer varieties Vanguard, Ajax, Exeter, Beacon, and Beaver that possess the so-called Richland type of stem rust resistance, which is highly effective against these races. Race 7, however, constitutes a threat to a number of oat varieties possessing the White Tartar type of resistance. Several varieties (e.g. Clinton, Mindo, Bonda, Zephyr) have been produced recently in the United States as a countermove to the increasing menace of races 8, 10, and 11. These varieties are likely to rust considerably if race 7 increases in prevalence.

The distribution of races in this survey is somewhat biased owing to the fact that many of the rust collections studied came from Ajax, Vanguard, and other varieties that are rusted chiefly by races 8, 10, and 11. This bias may be largely corrected by considering only collections made on Avena fatua and varieties susceptible to all races. Calculations made on this basis indicate that the race group 1, 2, 5 makes up 56.7% of the rust instead of 37.1% of the uncorrected totals and race group 8, 10, 11 26.7% instead of 44.1%. The figure for race 7 remains virtually unchanged at 15.0% instead of 15.8% (T. Johnson).

The following physiologic races of crown rust (Puccinia coronata var. avenae) were identified (number of isolates of each in brackets): 1 (2); 2 (20); 3 (15); 4 (6); 5 (2); 34 (64); 45 (39); 57 (8); 1948-1 (1).

A further increase has occurred in the relative prevalence of crown rust races that attack varieties possessing the Bond type of crown rust resistance (races 34, 45 and 57). Prior to 1947, these three races comprised only a negligible percentage of the crown rust isolates that were identified in Canada. However, since 1947, they have increased year by year until they now have become the predominant races of crown rust present in Canada. For the years 1947, 1948, 1949 and 1950 these races comprised 4, 20, 48 and 71 per cent, respectively, of all isolates identified in each of these years. These races were relatively more prevalent in 1950 in the Prairie Provinces, where they comprised 90 per cent of all isolates of crown rust identified, than in Eastern Canada, where they comprised 58 per cent of all isolates (B. Peturson).

Infestation of barley by leaf rust (Puccinia hordei) was more pronounced in Canada in 1950 than it had been in the previous three or four years. This condition might have been influenced by the late, comparatively cool season that retarded plant development thereby providing favourable conditions for the development of the rust.

In Eastern Canada and at Winnipeg, Man., leaf rust was particularly noticeable on the varieties Montcalm, Vantage, Goldfoil, and Peatland, in the Uniform Rust Nurseries. No leaf rust occurred on these varieties grown in Sask. and Alta., but at Agassiz and Creston, B.C., they were lightly infected. At Saskatoon, Sask., rust developed on the variety Charlottetown 80, although no rust was noted on any other variety grown in the same plot.

Wisconsin H. 106, grown at 33 stations throughout Canada was free from leaf rust, except at Williamstown, Ont., and L'Assomption, Que., where trace amounts of rust occurred on it.

A total of 37 collections of leaf rust were cultured on the standard differential hosts, and six physiologic races were isolated. These races were distributed provincially as follows (number of isolates in brackets): N.S., race 4 (2); Que., races 1 (1), 2 (1), 4 (6), 16 (4), 44 (3), 53 (2); Ont., races 4 (3), 44 (1); Man., races 4 (10), 44 (1); Sask., race 4 (1); B.C., race 4 (2).

Race 4, which has been common in previous years, predominated in 1950, while race 44, previously collected in Que., occurred this year in Ont. and Man.

All of the six races identified occurred in Que. Why there should be more races of this rust present in Que. is difficult to explain. In previous years new races have from time to time been isolated from rust collected on barley in this province, a condition that suggests the sexual reproduction of this rust. Within recent years the aecial stage of P. hordei was encountered in nature in England, on Ornithogalum spp. and produced experimentally in Portugal, on Dipcadi serotinum (both genera of Liliaceae). In Manual of the Flora of the Northern States and Canada (Britton), species of Ornithogalum are reported to have escaped from gardens in Pennsylvania and other states. Perhaps the aecial stage of this rust also occurs in Eastern North America, but considerable search would be necessary to confirm this assumption (A.M. Brown).