PHYSIOLOGIC RACES OF CEREAL RUSTS IN CANADA IN 1951

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This report (January 1952) presents the results of the survey for the distribution, in Canada, of the physiologic races of several cereal rusts. Race identification was carried out for wheat stem rust (Puccinia graminis var. tritici), leaf rust of wheat (P. triticina), oat stem rust (P. graminis var. avenae), oat crown rust (P. coronata var. avenae), and leaf rust of barley (P. hordei). Collections of stem rust from barley, Hordeum jubatum and Agropyron spp. were analysed for the presence of wheat stem rust and rye stem rust (P. graminis var. secalis), but no attempt was made to determine the physiologic races of the latter rust. The original report contained tables showing the distribution of the physiologic races of the respective rusts by provinces, but these are here omitted. Cereal rust development in Canada has already been discussed in the report of the Rust Nurseries (q. v.).

Puccinia graminis var. tritici

The 178 isolates of wheat stem rust from wheat, barley and wild barley were identified as the following races (the number of isolates of each race in brackets): 1 (2); 2 (2); 11 (1); 15B (85); 16 (1); 17 (5); 38 (5); 48 (3); 49 (1); 56 (71); 69 (1); C. 51-2 (1). As only 11 of the isolates came from east of Manitoba, this year's stem rust survey is largely confined to Western Canada.

Race 15B appears to have been the predominant race in the Prairie Provinces in 1951, followed closely by race 56. It is probable, however, that the prevalence of race 15B is considerably exaggerated by the fact that many collectors who sent in rust specimens for identification collected these from wheat varieties that had proved resistant to stem rust in former years. Rust collected from such varieties was almost exclusively race 15B. There is, nevertheless, little doubt that this race was the predominant one in western Man. and eastern Sask. In other areas it was less prevalent than race 56, the most common race for many years. There appears to be a close relationship between the major concentration of race 15B and that of the wheat varieties Thatcher, Regent and Redman. In Alberta, where a number of other wheats are grown race 56 was much more common.

Some comment is called for in connection with race distribution in southern Alta. and the Creston area of southeastern B. C. In this region certain races occurred (races 1, 2, 11, 16 and 48 and an apparently new race designated as C. 51-2) that were not found in other parts of the Prairie Provinces. The occurrence of races 2 and 48 on both sides of the Rocky Mountains suggests that spore dispersal may take place across the mountains in southernmost Alberta or in the adjacent United States. The fact that six races were identified from the 13 isolates from the neighborhood of Creston, B. C. suggests a considerable variety in the physiologic-race population of that locality. It may also be remarked that the two isolates of race 2 though identified as that race, bear a rather close resemblance to race 59B, which was found in the Creston area in 1950. The race designated as C. 51-2 gave rise to the following infection types on the differential hosts:-

L. C.	Ma.	Rel.	Ko.	Arn.	Mnd.	Spm.	Kub.	Ac.	Enk.	Ver.	Kpl.	Lee
4	4	2-	3=	3	0;	0;	1	3	1	0;	1	1-

All collections of stem rust from barley and wild barley, Hordeum jubatum, were analysed for the presence of wheat stem rust and rye stem rust. In 60 collections from barley (18 from Eastern Canada and 42 from Western Canada), 47 isolates of rye stem rust and 29 of wheat stem rust were obtained. In the 18 collections from Eastern Canada, only rye stem rust could be found. In the 42 collections from Western Canada, wheat stem rust and rye stem rust were present in about equal proportions - 29 isolates of each being obtained. It is worth noting that 14 collections made on the stem-rust resistant varieties Peatland, Vantage, H-106, Moore, and U. M. 43-1020 produced only rye stem rust.

Twenty-two collections of stem rust on wild barley were made in the Prairie Provinces. From these were obtained 13 isolates of wheat stem rust and 12 of rye stem rust.

Despite the frequent occurrence of rye stem rust on barley varieties generally regarded as stem-rust resistant, the cultures of rye stem rust thus far studied do not appear to be highly virulent to these varieties in the seedling stage. All of the 59 isolates from barley and wild barley, as well as several from rye and Agropyron and Elymus species, were inoculated to seedling leaves of the wheat-stem-rust susceptible variety Montcalm and the resistant variety Vantage. Montcalm proved, in general, to be moderately susceptible while Vantage showed rather high resistance to all cultures as did also the varieties Peatland, Chevron, Feebar and Kindred in tests with a number of cultures. In view of the apparent field susceptibility of some of these varieties to rye stem rust it appears that the reliability of seedling reaction as a criterion of the resistance of barley varieties to this rust needs further study.

Puccinia triticina

All rust collections were originally inoculated to the susceptible wheat Little Club and a "screening set" composed of the varieties Exchange, Lee, Gabo, and Frontana. From the infections on Little Club two single-pustule isolates were established for each collection. In cases where large rust pustules were produced on any of the screening varieties cultures were established to determine the race or races responsible for them.

As in the two preceding reports the races are designated according to the "Unified Numeration" of the key agreed on, in 1948, by American and Canadian investigators of this rust. The old racenumbers corresponding with the new ones are also given.

Races bearing the suffix "a", as 1a, 15a, are virulent on seedlings of Hope and most Hope and H44 derivatives.

The 372 isolates studied were identified as follows (number of isolates in brackets): UN 1 = races 1 (35), 1a (24); UN 2 = races 15 (5), 15a (82); UN 3 = race 58 (69); UN 5 = race 5 (82); UN 6 = race 126 (47); UN 9 = race 9 (3); UN 10 = races 11 (18), 38 (2); UN 11 = race 93 (3); UN 14 = race 128 (2); and UN 17 = race C-2 (2). Race C-2 originally described by Brown and Johnson (Can. Jour. Res. C, 27:191-202. 1949). produces the following infection types on the standard differential hosts:

Mal.	Car.	Brev.	Web.	Lor.	Med.	Huss.	Dem.
0	2	2	3	3	3	1	3

The distribution of leaf rust races is not greatly different from that of the two preceding years. UN 2 (race 15), UN 5 (race 5) and UN 6 (race 126) were the predominant races in the Prairie Provinces except for southern Alta. where UN 1 (race 1) and UN 10 (race 11) were collected more commonly than any other races. The two last-mentioned races were also the predominant ones in southeastern B. C. (the Creston area).

UN 3 (race 58) accounted for more than 60 per cent of isolates from collections made in Eastern Canada where it has been the prevailing race for a number of years.

Biotypes virulent towards Hope, H-44 and their derivatives were very much more common in Man., Sask., and northern Alta., than the less virulent races.

Puccinia graminis var. avenae

The following ten races were identified in a study of 102 isolates of oat stem rust (number of isolates of each race in brackets): 2 (10); 3 (1); 4 (1); 5 (2); 6 (2); 7 (9); 8 (37); 10 (27); 11 (12); and 13 (1).

One feature of this year's survey is the sharp decline in the prevalence of the races in race-group 1-2-5 which declined from 38.1% in 1950 to 11.8% in 1951. This decline appears to be highly significant as these races constituted 31.6% of oat stem rust isolates in 1949, 54.6% in 1948, and 50.5% in 1947. A simultaneous rise has taken place in the prevalence of the races of race-group 8-10-11 which rose from 44.1% in 1950 to 74.6% in 1951. Previous figures for this race group were 62.0% in 1949, 43.4% in 1948, and 49.5% in 1947.

Race 7, which became widespread for the first time in 1950, was found again this year but only in Man. and Sask. and constituted only 8.2% of all isolates. One culture of the closely related race 3 was isolated from Que.

The occurrence in this year's survey of four isolates of races in race group 4-6-13 suggests the possibility that these races may be gaining wider distribution than heretofore. Races of this group were found in trace quantities every year from 1925 to 1930 but were collected thereafter only in 1935 and 1937 until 1944; since then, they have been found, though rarely, each year except in 1947 and 1948. Wide distribution of these races would be a matter of concern as they are capable of attacking all the varieties of oats now cultivated in North America.

Puccinia coronata var. avenae

Thirteen physiologic races were isolated from 126 uredinial collections of crown rust obtained from widely separated localities in Eastern Canada and the Prairie Provinces.

Races 2 and 3 were the most prevalent races in Eastern Canada where they comprised 79.6% of all isolates identified. Both these races were also present in the Prairie Provinces. There they comprised 25% of all isolates. Six of the races (34, 45, 57, 1946-1, 1947-1 and 1948-1) attack Bond and its derivatives. These six races were quite prevalent in the Prairie Provinces, comprising 68.7% of the isolates in that area. In Eastern Canada they formed only an insignificant part of the isolates. Although races 34, 45 and 57 were relatively less prevalent in the Prairie Provinces in 1951, then in 1950, the difference in relative prevalence of these races in the two years was probably not significant. However, in Eastern Canada, these races were significantly less prevalent in relation to other races identified in 1951 than in 1950. In Eastern Canada, the crown rust inoculum that initiates crown rust infections on oats in the spring may arise either from aeciospores from buckthorn bushes in Eastern Canada and adjacent states of the U.S.A., or from windborne urediniospores from oat fields in the corn belt of the United States. Therefore, the relative prevalence of the races that occur each year would be influenced by the relative amounts of inoculum arising from these two sources. Oat varieties susceptible to races 34, 45 and 57 and immune to races 2 and 3 predominate in the U.S. corn belt, while in Eastern Canada much of the oat acreage is grown to varieties susceptible to races 2, 3, 34, 45 and 57. Furthermore, it has been shown in previous surveys that races 2 and 3 occur much more frequently on buckthorns in Eastern Canada than the other races mentioned. It may then be inferred that, in 1950, when races 34, 45 and 57 predominated in Eastern Canada, the larger part of the inoculum initiating spring infections came from infection centers in the United States where these races predominate. In 1951, on the other hand, it appears that much of the inoculum initiating infections in 1951 came from buckthorn bushes in Eastern Canada.

No races were isolated that can appreciably attack the varieties Trispernia, Victoria, Landhafer or Santa Fe, all of which are currently being used by Canadian plant breeders to confer crown-rust resistance on new hybrid varieties.

Puccinia hordei

The dwarf leaf rust of barley, Puccinia hordei was collected in both Eastern and Western Canada in 1951. Most of the collections were made on the varieties Montcalm and Vantage, but none of the collections indicated that this rust occurred in more than trace amounts.

A number of isolates were cultured on the standard differential hosts, but only race 4 was identified. The isolates of this race were distributed as follows (number of isolates in brackets): N.S. (2), Que. (4), Ont. (7), Man. (5), and B.C. (1). No collections were made in N.B., Sask. or Alta.

Race 4 of this rust is known to occur in the Eastern United States, where it has caused considerable reduction in barley yields, especially in 1950. According to Dr. C. W. Roane, Agr. Expt. Station, Blacksburg, Virginia, this rust is capable of overwintering in that area in the uredinial stage. This condition might, in part, explain the heavy infestation that occurred on barley in Que. and Ont. in 1950, as barley crops in these provinces would undoubtedly be exposed to wind-borne urediniospores, originating on barley crops south of the international border.