

OAT STEM RUST AND OTHER CEREAL RUSTS IN EASTERN ONTARIO  
IN 1961<sup>1</sup>

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Abstract

In the last week of July, 1961, an area in eastern Ontario between Kingston, Hawkesbury, and Lancaster was surveyed for the incidence of cereal rusts. Oats were severely infected by stem rust (Puccinia graminis Pers. f. sp. avenae Erikss. & Henn.) only in the vicinity of barberry. Traces of crown rust (P. coronata Cda.) were observed in most oat fields and, in the vicinity of buckthorn, infections were much heavier. Wheat, generally, had moderate infections of leaf rust (P. recondita Rob, ex Desm.) and stem rust (P. graminis Pers. f. sp. tritici Erikss. & Henn.) but the infections caused little damage.

Physiologic races 4A, 6, 6A, 8A, 10A and 13A of oat stem rust were identified in various localities in the area. The "A" races in this group, which do not occur in Western Canada, are capable of parasitizing the widely grown varieties Rodney and Garry. The races of crown rust identified from collections made on this survey are similar to those found in other parts of Canada. Most of them attack the commonly grown varieties including Rodney and Garry. Race 56 of wheat stem rust predominated in the area as it did in Western Canada. The importance of barberry and buckthorn in the area is discussed.

Introduction

New and dangerous races of oat stem rust (Puccinia graminis Pers. f. sp. avenae Erikss. & Henn.) were found in Eastern Canada in 1957 (2) and soon seemed to predominate in eastern Ontario and parts of Quebec (2). The rust collections from these areas that were used for race identifications were obtained by co-operators, usually in and around their experiment plots. Some of the plots were located where barberry occurs. It would be expected that races originating on barberry close to these sites would predominate in the collections. Wind-borne inoculum from distant areas is of little consequence because the local varieties are resistant to the races of stem rust prevalent in other parts of North America. Consequently, the results of physiologic race surveys may have been biased in favor of the races originating locally on barberry and the dangerous new races may not have been as prevalent as the survey results indicated.

In 1961, an attempt was made to determine whether the results of earlier physiologic race surveys had been biased. In the last week of July,

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the area between Kingston, Hawkesbury, and Lancaster in eastern Ontario was surveyed to obtain collections of the cereal rusts truly representative of the rust population of the area and to determine the severity of rust infection. This area was selected because the dangerous races found in former years occurred commonly in an area south-west of Ottawa in the vicinity of Appleton and Merrickville and because the presence of common barberry has been reported in several localities in the area (5). Several circumstances prevented the full realization of the objectives. The oat varieties Garry, and especially Rodney, occupy most of the oat acreage in eastern Ontario. In other parts of North America Garry is resistant to all of the stem rust races found and Rodney is susceptible only to race 7A. Rust inoculum carried into the district by air currents is not likely to infect them and no host variety or species susceptible to races of stem rust avirulent on Rodney and Garry was commonly found. Consequently, there was not much chance of collecting races from other regions, even though they were carried into the area. The chances of finding widespread stem rust infection on oats was reduced further by the scarcity of this rust in central North America. Little inoculum was available for movement into the eastern area. It is likely, therefore, that nearly all the stem rust collected during the survey originated on barberry bushes near the collection site. The survey served to identify the races that originated on barberry in different localities in the area but an unbiased estimate of the races represented in the primary inoculum of the area was probably not obtained and it is unlikely that such an estimate can be obtained.

Comparatively few wheat fields were found in the district. The winter wheat varieties cultivated are susceptible to both stem rust (*P. graminis* Pers. f. sp. *tritici* Erikss. & Henn.) and leaf rust (*P. recondita* Rob. ex Desm.).

Conditions for rust development in eastern Ontario were not unfavorable. The cool moist season had delayed crops, giving added time for rust development.

### Results

Stem rust of oats (Table 1) occurred in important amounts in a few localities (Appleton, Merrickville, Kemptville, and Sunbury) where barberry is common (5). Elsewhere it was absent or scarce. Even where trace amounts of stem rust were found one would suspect that barberry occurred in the locality. Stem rust losses for the area were small in total but some fields in the vicinity of barberry were severely damaged.

Trace amounts of crown rust of oats were found in nearly all localities (Table 1) indicating that air-borne inoculum from other regions, probably to the south-west, was distributed throughout the area. The alternate host of crown rust, European buckthorn (*Rhamnus cathartica* L.), occurs commonly in some localities in the area (5) and inoculum from buckthorn caused epiphytotic of varying severity in a number of these localities. Although losses were small in general, some fields in the vicinity of buckthorn were damaged.

This survey confirmed the implication of local barberry as a major source of stem rust races. The same or similar races were identified in the various barberry localities (Table 1) and races able to attack Rodney and Garry predominated. Although the occurrence of the same races in different barberry areas was not anticipated it is not surprising. The widespread cultivation of resistant varieties exerts strong selective pressure favoring races capable of

Table 1. Incidence of stem-rust and crown-rust of oats in eastern Ontario July 24 to 26, 1961,  
and physiologic races identified.

| Locality                 | Variety <sup>1/</sup> | Stem rust         |             |                              | Crown Rust      |             |                              |
|--------------------------|-----------------------|-------------------|-------------|------------------------------|-----------------|-------------|------------------------------|
|                          |                       | % Plants Affected | % Infection | Races Isolated <sup>2/</sup> | Plants affected | % Infection | Races Isolated <sup>2/</sup> |
| South March              | Rodney                | Tr <sup>2/</sup>  | Tr          | 6A(1)                        | Tr              | Tr          | --                           |
| Carp                     | Rodney                | 0                 | --          | --                           | Tr              | Tr          | 209(1)                       |
| Kinburn                  | Rodney                | 0                 | --          | --                           | 100             | Tr          | 284(1)                       |
| Almonte                  | Rodney                | Tr                | Tr          | 6A(1), 4A(1)                 | 100             | 10-20       | 210(2), 211(1), 228(1)       |
| Appleton                 | --                    | 100               | 60          | 6(1), 6A(5), 10A(1)          | --              | --          | --                           |
| Smiths Falls             | Rodney                | 0                 | --          | --                           | Tr              | Tr          | 210(1)                       |
| Merrickville             | Garry                 | 100               | 80          | 6A(5), 13A(1)                | 100             | 60          | 284(2)                       |
| Kemptville               | Russell               | 50                | Tr          | 6A(4), 8A(1), 13A(2)         | 50              | Tr-10       | 210(1), 229(1)               |
| Kemptville               | Rodney                | 0                 | --          | --                           | 100             | Tr-10       | --                           |
| North Gower              | Rodney                | Tr                | Tr          | 6A(1)                        | --              | --          | --                           |
| North Gower              | Rodney                | Tr                | Tr          | 6A(1)                        | --              | --          | --                           |
| North Gower              | --                    | 5                 | Tr          | --                           | --              | --          | --                           |
| Ashton                   | Rodney                | Tr                | Tr          | --                           | Tr              | Tr          | 284(1)                       |
| Innisville               | --                    | Tr                | Tr          | --                           | Tr              | Tr          | --                           |
| Perth                    | Rodney                | 0                 | --          | --                           | 100             | 30          | --                           |
| Perth                    | Rodney                | 0                 | --          | --                           | 90              | Tr-5        | --                           |
| Lombardy                 | --                    | 0                 | --          | --                           | 50              | Tr          | --                           |
| Portland                 | --                    | 0                 | --          | --                           | 100             | 20          | --                           |
| Crosby                   | --                    | 0                 | --          | --                           | Tr              | Tr          | --                           |
| Sunbury 4E <sup>4/</sup> | Rodney                | Tr                | Tr          | --                           | 100             | Tr          | --                           |
| Sunbury 1 1/2E           | Rodney                | 50                | Tr          | 6A(1), 10A(1)                | 100             | Tr-30       | 210(1), 283(1)               |
| Sunbury 1 1/4E           | --                    | 50                | Tr          | --                           | 100             | Tr          | --                           |
| Sunbury 1E               | Rodney                | 5                 | Tr          | --                           | --              | --          | --                           |
| Sunbury 1/2E             | Rodney                | 5                 | Tr          | --                           | --              | --          | --                           |
| Sunbury 1S               | Rodney                | 100               | 20-30       | --                           | Tr              | Tr          | --                           |
| Sunbury 3S               | --                    | 0                 | --          | --                           | Tr              | Tr          | --                           |
| Kingston 5W              | --                    | 0                 | --          | --                           | Tr              | Tr          | --                           |
| Lansdowne                | --                    | 0                 | --          | --                           | Tr              | Tr          | --                           |
| Brockville (3 fields)    | Rodney                | 0                 | --          | --                           | Tr              | Tr          | --                           |
| Spencerville (2 fields)  | Rodney                | 0                 | --          | --                           | Tr              | Tr          | --                           |
| Alfred (2 fields)        | Rodney                | 0                 | --          | --                           | Tr              | Tr          | 210(1)                       |
| Hawkesbury               | Garry                 | 0                 | --          | --                           | Tr              | Tr          | 210(1), 230(1), 272(2)       |
| Vankleek Hill            | Rodney                | Tr                | Tr          | --                           | --              | --          | --                           |
| Vankleek Hill            | --                    | 0                 | --          | --                           | 0               | --          | --                           |
| Vankleek Hill            | Russell               | 0                 | --          | --                           | 0               | --          | --                           |
| Alexandria               | --                    | 0                 | --          | --                           | 0               | --          | --                           |
| Williamstown             | --                    | 0                 | --          | --                           | Tr              | Tr          | 203(1), 284(1)               |
| Williamsburg             | Clintland?            | Tr                | Tr          | 6(1)                         | 100             | 10          | --                           |

<sup>1/</sup> Varieties were identified, in nearly all instances, by field appearance. A dash signifies that no identification was made.

<sup>2/</sup> Tr = Trace.

<sup>3/</sup> Number of isolates in brackets.

<sup>4/</sup> Miles east, south, or west of location shown.

parasitizing these varieties. These races are important from the practical standpoint because most of them can attack all of the commercial varieties of oats available today.

The identification of physiologic races of oat crown rust in eastern Ontario (Table 1) did not demonstrate conclusively that many races originated locally in buckthorn. The races of crown rust found in western Canada in earlier years were as varied as those of the eastern area in 1961, and many races have been found in both areas. But, despite the lack of evidence from race identifications, the circumstantial evidence clearly indicates that in some localities much of the primary inoculum originated locally on buckthorn.

Wheat stem rust was common but not damaging in nearly all the wheat fields examined (Table 2). Traces of stem rust were observed in the few barley fields examined and moderate infections were found on spring rye in the rust nurseries at Appleton and Merrickville.

The races of wheat stem rust found throughout the eastern Ontario area (Table 2) occurred also in other parts of Canada. The well-known race 56 predominated in eastern Ontario as it did in western Canada and presumably was carried into the eastern area by air currents. Races 11 and 15B-1L (Can.) have been found in western Canada for several years and probably were carried into eastern Ontario. Race 38 was more common in the eastern area than elsewhere in Canada but this race was common in the United States in 1961 and may also have been carried into the area.

The results discussed above indicate that barberry did not play an important part in the development of wheat stem rust in eastern Ontario in 1961. Similar results were obtained (3) in an earlier study of the varieties of stem rust occurring on barberry in eastern Canada. The small part played by barberry in the epidemiology of wheat stem rust in the area can be attributed to the relatively small acreage of wheat grown.

The rust on rye in the rust nurseries at Appleton and Merrickville probably originated on nearby barberry bushes. Rye stem rust (*P. graminis* Pers. f. sp. *secalis* Erikss. & Henn.) is common on the widely distributed *Agropyron repens* L. and has been isolated frequently from barberry in eastern Canada (3).

### Discussion

The evidence presented indicates that barberry is an important local factor in the epidemiology of oat stem rust in eastern Ontario. The pre-dominance of oats as a field crop throughout the area assures that barberry, where it exists, will be infected by oat stem rust. The spread of rust to the young oat crop seems inevitable and severe local damage can be anticipated whenever conditions favor rust development.

The responsibility of barberry in the production and perpetuation from year to year of new and dangerous physiologic races in eastern Ontario can scarcely be questioned in view of the evidence presented here and elsewhere (2). The pathogenic capacity of the races found since 1957 raises the question of the future of oat production in the area if barberry is not controlled. Oat improvement programs could prove ineffective if new races of stem rust soon offset increased rust resistance in new varieties and rust losses reduce the effects of other improvements in new varieties.

The resistance of the predominant varieties appears to be an important factor influencing the races produced on barberry. The varieties Rodney

Table 2. Incidence of stem rust on wheat, barley, and rye in eastern Ontario July 24 to 26, 1961, and the physiologic races identified.

| Locality                       | Crop         | % Plants Affected | % Infection | Races Identified <sup>3/</sup>           |
|--------------------------------|--------------|-------------------|-------------|--|
| Carp<br>Appleton <sup>1/</sup> | Winter Wheat | 100               | 5-20        | 15B-1L(1), 56(1)                         |
|                                | Spring Wheat | 100               | 10          | 17(1), 56(5)                             |
|                                | Barley       | 100               | 1-5         |  |
| Merrickville <sup>1/</sup>     | Rye.         | 100               | 10          |  |
|                                | Spring Wheat | 100               | 20          | 11(1), 15B-1L(1),<br>17(1), 38(1), 56(8) |
|                                | Barley       | 100               | 1           |  |
| Kemptville                     | Rye          | 100               | 40          |  |
|                                | Winter Wheat | 100               | 10          | 11(1), 15B-1L(1),<br>17(1), 38(3), 56(5) |
|                                | Barley       | Tr <sup>2/</sup>  | Tr          |  |
| Vankleek Hill<br>Williams,town | Winter Wheat | 100               | 5-10        | 56(1)                                    |
|                                | Barley       | Tr                | Tr          | 56(1)                                    |
| Perth                          | Winter Wheat | 100               | 20-30       | --                                       |
|                                | Winter Rye   | 5                 | 5           | --                                       |
| Kingston                       | Winter Wheat | 100               | 20          | 11(1), 56(1)                             |
| Ganonoque                      | Winter Wheat | 100               | 20          | 56(1)                                    |
| Brockville                     | Winter Wheat | 100               | 5           | 56(1)                                    |
| Crosby                         | Barley       | 50                | Tr          | --                                       |
| Sunbury                        | Barley       | 50                | Tr          | --                                       |

<sup>1/</sup> Susceptible spring varieties sown in rust nurseries,

<sup>2/</sup> Tr = Trace.

<sup>3/</sup> Number of isolates in brackets.

and Garry were first distributed in quantity in Ontario in 1955. They met with immediate and widespread farmer acceptance and by 1957 were grown on over 65 per cent of the farms in Ontario (1). The results of the present survey indicate that they continued to increase in popularity after 1957. The first races found that could attack both Rodney and Garry (8A and 13A) were discovered in 1957 and along with other races able to attack these varieties soon became predominant in the barberry areas. The rapid increase of these races can be attributed largely to the selective effect of the resistance of the predominant oat varieties operating in conjunction with hybridization of the rust on barberry.

The potential economic importance of barberry in eastern Canada has been recognized for many years. In 1938 Newton (6) stated (p. 125) "In both eastern Canada and British Columbia the common barberry is present and undoubtedly plays a part in the introduction of new races of stem rust" and also (p. 138) "In eastern Canada and British Columbia some (barberries) are present, but up to the present no exhaustive survey has been made to ascertain how numerous and widely distributed they are. Consequently their importance in perpetuating stem rust from year to year has not been appraised. In these

areas, although cereal production is not so important as in the Prairie Provinces, there is little doubt that eradication of barberry is justifiable".

The distribution of barberry in Ontario has been investigated more recently and its commercial importance discussed (4, 5). Both investigators state that at the time of their surveys barberry eradication seemed feasible and should be undertaken, but to be successful an eradication program must be executed with great persistence.

The distribution of buckthorn in eastern Ontario was investigated by Mulligan (5) who discussed its economic importance. In some localities buckthorn probably constitutes a greater hazard than any known concentration of barberry. In these areas the number of buckthorn bushes is so great that eradication might be difficult (5).

In 1961 the spread of rust from barberry and buckthorn in eastern Ontario was confined to certain localities and although losses were small in aggregate, some fields in these localities were severely damaged. An expansion of the barberry and buckthorn localities seems likely. Indeed, Lindsay (4) states that a barberry area in western Ontario is expanding rapidly. If barberry and buckthorn are not soon checked they may become so numerous as to be uncontrollable and, given time, will jeopardize oats and other cereal crops throughout eastern Canada.

#### Acknowledgements

The authors wish to acknowledge the technical assistance given by Mr. J.H. Campbell in the identification of physiologic races of the stem rusts and by Mr. W. Ostapyk in the identification of physiologic races of crown rust.

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