OCCURRENCE IN WESTERN CANADA OF COLLECTIONS OF LOOSE SMUT, USTILAGO AVENAE, VIRULENT ON OAT VARIETIES WITH RESISTANCE FROM VICTORIA"

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Many widely grown Canadian varieties of oats have been resistant to loose smut and covered smut caused by Ustilago avenae (Pers.) Rostr. and U. kolleri Wille. Resistance in these varieties was derived from the variety Victoria (C.I. 2401), which comes from Argentina and was first used in the 1920s because of its resistance to rust. Later it was realized that it also carried resistance to all known races of the loose and covered smut fungi, and for decades Victoria and its derivatives were used as sources of resistance to smut in the breeding of improved oats. This resistance is based on one or two dominant genes (Murphy and Coffman 1961; Cherewick and McKenzie 1969).

In 1942 Reed and Stanton reported the first collection of loose smut with virulence on Victoria. By 1966 this virulence had been found in 15 states of the U.S.A., and races of this type predominated in the South Central. and South Atlantic states (Holton 1967a).

Another common source of resistance to smut was the variety Clinton (C.I. 3971). Again, extensive use over a wide area screened the population of the parasite effectively for virulence on Clinton. Finally races of loose smut were found in the North Central region of the U.S.A. that are virulent on both Victoria and Clinton (Holton 1967b).

With the gradual spread of races of these types in the U.S.A. it was apparent that it would be only a matter of time until the natural spread of inoculum or the importation of infected seed would bring them to Canada. Annual surveys in Manitoba and eastern Saskatchewan and virulence tests of field collections did not reveal virulence on Victoria or Clinton until 1969. In 1970, 225 fields of oats were inspected (McDonald et al. 1971) and 6 fields were found to have a trace infection of smut, one of covered smut and five of loose smut. Spores collected from these fields were used to inoculate by the standard partial vacuum method seed of the variety Kelsey, which has the Victoria resistance. Three of the collections, all of loose smut, were found to infect Kelsey; percentage infection of Kelsey for the three samples was 48, 63, and 76%.

Spores of collection 04–70 (originally collected at Buchanan, Sask.) were taken from Kelsey and used to inoculate the standard differential varieties (numbers 1–10, Holton and Murphy 1966), supplemented with three varieties (numbers 11–13) that had been added by Cherewick (1958) and with the variety Markton (number 14). In this set of differentials Atlantic possesses the Victoria resistance, and Clintland possesses the Clinton resistance. The reaction of these differentials to collection 04–70 is presented in Table 1.

In 1971 trace amounts of loose smut were detected in 4 of 123 fields of oats surveyed in Manitoba (Hagborg et al., in preparation). Spores collected from the four fields were tested for virulence on Kelsey. One of the collections, 02–71, had a low level of virulence with 2% infection. This type of virulence has been found previously in Western Canada (Cherewick 1958, and unpublished data). The other three collections were highly virulent on Kelsey with 81, 84, and 72% infection. Spores from Kelsey of collection 04–71 (originally collected at Binscarth, Man.) were used to inoculate the differential varieties. The pattern of virulence was found to be identical with that of the 1970 collection 04–70 (Table 1).

Table 1. Reaction of differential varieties to two collections of loose smut

Differential variety	% infection after inoculation with collection: 04–70	04–71
1 Anthony	81	92
2 Black Diamond	0	4
3 Victory	63	56
4 Gothland	0	0
5 Monarch	0	0
6 Camas	0	0
7 Black Mesdag	0	0
8 Atlantic	73	80
9 Fulghum	0	5
10 Clintland	74	24
11 Nicol	0	0
12 Beacon	79	52
13 Mabel	0	0
14 Markton	0	0

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The origin of this race with Victoria and Clinton virulence is unknown since its pattern of virulence on the differentials has not been reported before. A relationship with the race that was accidentally introduced at the Experimental Farm at Regina, Sask., in 1967 with a sample of Lodi oats from Wisconsin has to be ruled out. That race was virulent on 12 of the differential varieties (Cherewick and McKenzie 1969, and unpublished data), whereas the present race is virulent on only five. Natural hybridization could not have brought about such a discrepancy within this short time.

At present, provincial recommendations of varieties of oats for Manitoba and Saskatchewan list varieties with Victoria resistance (Fraser, Garry, Harmon, Kelsey, Rodney, Russell, and Sioux) as "resistant" to smuts. If the level and incidence of infection in fields increase these recommendations will have to be changed and periodic seed treatment of these varieties recommended. A prediction that this will in fact happen would be rather uncertain at the present time. Under similar circumstances, it was predicted that there would be an increase in area and intensity of infection by a race of loose smut of wheat with virulence on Thatcher and its derivatives (Nielsen 1969). Surveys of the last 3 years confirmed that the area in which this race occurs did in fact increase, but the level of infection is still only a trace. This example illustrates that tests of the reaction of varieties to smut by artificial inoculation will reveal the maximum infection physiologically possible. It does not take into account any field resistance by morphological characteristics nor the influence of climatic conditions on host or parasite. In the present case, it is interesting to note the prevalence of Victoria virulence in the South Central and South Atlantic regions of the U.S.A. (Holton 1967a). Holton explains this by the predominance there of varieties with Victoria resistance. It may well be! however, that some genotypes of the parasite may be better adapted than others to certain environmental conditions.

Considering the possible spread of virulence on Victoria and Clinton in Canada the breeder will ask what to use in future as a source of resistance to the smuts. The list published by Holton and Murphy (1966) shows that 'there is ample potential for the development of smut resistant varieties for all areas of adaptation." Varieties with Markton background appear particularly promising.

The author would very much appreciate receiving field collections of smuts of oats. to keep a continued vigilance for new, potentially threatening genes for virulence.

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