

WHEAT LEAF RUST IN NORTH DAKOTA

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Rust nurseries were planted at five locations throughout North Dakota to determine resistance of hard red spring wheat and durum cultivars to the natural *Puccinia recondita tritici* population. Cultivars were evaluated for leaf rust severity and reaction type. Severity and reaction type data were combined to obtain a coefficient of infection value for each cultivar. Growers' fields were surveyed and evaluated for leaf rust occurrence. The hard red spring wheat cultivars Olaf, Butte, Kitt, and Wared should provide the best protection from the natural leaf rust population. Many of the other commercially available hard red spring wheats have susceptible reaction types with low severities. All durum cultivars tested should provide adequate protection. Most commercially available winter wheats are susceptible to leaf rust.

INTRODUCTION

Leaf rust of wheat is a disease of major importance to North Dakota growers. Caused by the fungus *Puccinia recondita* Rob. ex. Desm. f. sp. *tritici*, the disease has the potential to significantly reduce yields (2, 11). Recent epidemics of leaf rust were responsible for estimated losses of 10% in Kansas (1956) (4), 20% on Selkirk spring wheat in Canada (1965) (8), and for the loss of production from thousands of hectares in Mexico (1977) (6). Epidemics also occur in North Dakota, with an estimated loss in 1965 of 6.8% or 13,125,000 bushels (7).

Uredospores of *P. recondita tritici* can overwinter in North Dakota or are carried northward by the wind from the wheat-producing states to the south. Leaf rust can usually be found in eastern North Dakota in early June and will increase throughout the summer if factors are favorable for development. An epidemic is likely to occur if a very heavy spore load contacts large acreages of susceptible wheat and adequate moisture is available. Factors such as insufficient inoculum, low night time temperatures (below 60°F), lack of moisture, or resistant varieties can slow leaf rust development.

The most efficient leaf rust control method is planting resistance cultivars. Most major wheat varieties grown in North Dakota exhibit good resistance to leaf rust, however some commercial varieties have susceptible reaction types with low severities. Should the severities increase, losses could be substantial, as losses of up to 60% have been reported for very susceptible cultivars (9).

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At any given time the leaf rust population consists of a mixture of races. The most prevalent race or races are those which can reproduce on the available host plants, i.e., the most commonly grown varieties. Growing large acreages of the same cultivar or cultivars with similar resistance may result in the eventual selection of rust races which are virulent on those cultivars (3). As a result it is necessary to constantly produce new leaf rust resistant varieties. There are numerous examples of previously resistant cultivars displaying susceptible reaction types and increased severities. Since Marquis was grown in the early 1900's not one major variety of wheat has been popular for more than seven years. Smith (10) reports that although agronomic characteristics are considered, the major changes in leading varieties in North Dakota have been due to changing leaf and stem rust pathogenicity over a period of years.

MATERIALS AND METHODS

Rust nurseries were established at five North Dakota locations to observe the relative resistance of commonly grown hard red spring wheat and durum to the natural leaf rust population.

Adult wheat plants were evaluated for leaf rust severity and for reaction type. Severity as percentage infection was estimated according to the modified Cobb scale (5) (Fig. 1). The modified system described by Mains and Jackson (3) was used to determine host reaction (Fig. 2). To simplify the data, the rust severities and reactions were combined to obtain the coefficient of infection. Reactions were converted to numerical values (VR & R = 0.2, MR = 0.4, MS = 0.8, and S = 1.0), multiplied by percentage severity and by 100. Data from four locations

in 1977 (the rust nursery at Carrington, North Dakota, suffered extensive hail damage in 1977) and from five locations in 1978 were combined to obtain the average coefficient of infection values.

In addition numerous growers' fields throughout North Dakota were surveyed and evaluated for leaf rust severity.

Figure 1. Per Cent Severity

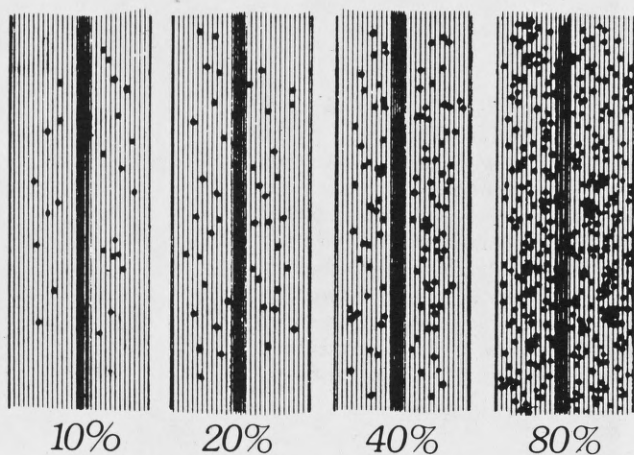
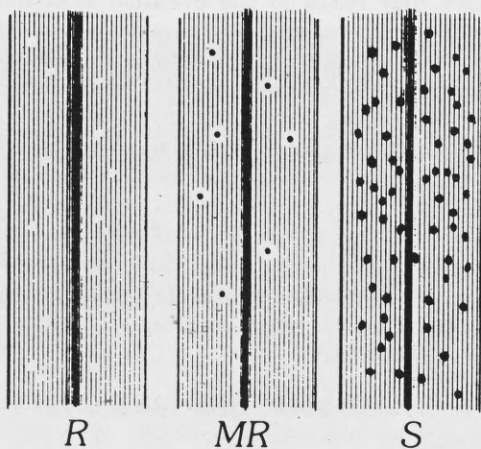


Figure 2. Rust Reaction Types

R = Resistant, MR = Moderately Resistant, S = Susceptible



RESULTS

The major hard red spring wheat cultivars grown in North Dakota in 1978 in order of decreasing acreage are Olaf, Waldron, Ellar, Butte, Kitt, Era, Prodx, and Wared. (Table 1). The resistance of these cultivars to the natural leaf rust population is indicated by their coefficient of infection values. Cultivars displaying consistently low coefficient of infection values are more resistant than those with high values. The values may change from year to year due to changing virulence in the rust population or environmental conditions. The cultivars

Waldron, Ellar, and Tioga displayed their highest coefficient of infection values in 1976 but the values have decreased since (12). Two of the cultivars tested, Prodx and Tioga, had unusually high values for one year, indicating that rust severities could become high enough under proper conditions to create yield losses. The other test cultivars displayed stable coefficient of infection values with only slight fluctuations over the last four years. The cultivars Olaf, Butte, Kitt and Wared are very resistant to the natural leaf rust population as indicated by low coefficient of infection values and will provide the best protection. Waldron, Ellar, Profit 75, Era, Chris and most other commercially grown cultivars have susceptible reaction types with low severities. Thatcher and Manitou exhibited high coefficient of infection values but are not widely grown in North Dakota.

The leading durum wheat cultivars by acreage in North Dakota for 1978 are Ward, Rugby, Crosby, Cando, Rolette, and Botno. Rolette had the highest coefficient of infection value of the durums grown in the nursery. We previously reported that rust develops more slowly on Rolette than on susceptible hard red spring wheats and yields were not reduced on Rolette. Based on these data leaf rust is probably not reducing the yields in the durum cultivars. However, most durums exhibit an MS-MR reaction and higher severities could result in yield losses. Ward, Rugby, Crosby, Coulter, Calvin, and Edmore provide the best protection against the current leaf rust population.

The major winter wheat cultivars grown in North Dakota are, in order of decreasing acreage, Froid, Roughrider, Winoka, Bronze, Winalta, and Minter (1). Virtually all of the major winter wheat varieties are very susceptible to leaf rust with only Bronze, Centurk, and Gent displaying any resistance.

Observations of growers' fields for the two-year period indicated that many of the cultivars planted were highly resistant to leaf rust. Half of the hard red spring wheat and durum fields surveyed in 1977 and 1978 had a trace to no rust and most of the others displayed a trace to 5%. Should these severities increase significantly, yield losses could result. One field of hard red spring wheat in 1977 had a high of 40% severity and several surveyed in 1978 had 10-15%. Several winter wheat fields surveyed in 1978 had a trace to 30% severity.

Leaf rust develops almost every year when susceptible varieties are planted in the eastern third of the state and whenever conditions are favorable in the west. A fungicide spray program can provide protection from leaf rust and is recommended whenever susceptible varieties are planted.

In summary, the hard red spring wheat cultivars Olaf, Butte, Kitt, and Wared should provide good protection against the natural leaf rust population. Many other commercial cultivars grown in North Dakota have susceptible reaction types with low severities. The occurrence of higher severities on these cultivars could result in yield losses. The durum cultivars currently grown in North Dakota will provide adequate protection from leaf rust as long as they continue to rust slowly and the leaf rust population does not change dramatically. The winter wheat cultivars are virtually all very susceptible to leaf rust and may require fungicide protection.

TABLE 1. Average Coefficient of Infection of *Puccinia recondita tritici* for Adult Wheat Cultivars at 5 North Dakota Locations and per cent North Dakota Acreage 1978.

CULTIVAR	% North Dakota Acreage 1978	Average Coefficient of Infection			
		1975	1976	1977	1978
Spring Wheat					
Olaf	35.0	2.2	0.9	0.6	0.8
Waldron	28.3	4.6	13.6	5.8	2.2
Ellar	7.3	4.9	11.4	2.8	3.0
Butte	5.0	1.0	0.4	1.3	0.4
Kitt	4.5	0.6	1.8	3.3	0.5
Era	3.9	4.1	3.0	1.5	0.8
Prodax	3.3	5.4	5.8	14.5	7.8
Wared	2.3	1.7	0.3	0.6	0.7
Profit 75	1.4	2.0	0.5	1.5	0.8
Chris	1.1	4.6	3.4	1.5	1.5
Bounty 208	<1	2.9	4.2	—	1.4
WS 1809	<1	5.3	5.6	—	1.3
Manitou	<1	24.0	35.6	12.0*	—
Tioga	<1	17.6	35.0	18.3	11.4
Sinton	<1	—	5.4	2.3	0.8
Coteau	<1	0.8	0.1	1.0	0.3
Thatcher	<1	68.0	78.0	72.5	64.0
Durum					
Ward	45.0	1.7	1.2	1.0	1.0
Rugby	13.2	1.8	1.4	4.0	0.6
Crosby	10.0	1.7	1.2	2.0	1.4
Cando	8.8	4.4	2.8	2.3	1.2
Rolette	8.8	9.6	6.4	1.4	1.8
Botno	4.0	4.4	4.6	3.3	1.3
Wells	3.2	1.8	1.4	1.0*	4.0*
Leeds	3.1	3.2	—	—	4.0*
Coulter	<1	—	—	2.0*	1.0
Calvin	<1	5.0	0.0	2.0	1.4
Edmore	<1	3.7	0.0	1.4	1.0

The following values for reaction types multiplied by percentage severity VR and R = 0.2, MR = 0.4, MS = 0.8, S = 1.0.

*Data collected from one location only, selection not included in nursery.

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