Wheat Leaf Rust in North Dakota In 1972

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Wheat leaf rust caused by the fungus **Puccinia recondita** Rob. ex. Desm. f. sp. **tritici** is potentially one of the most devastating foliar diseases of wheat in North Dakota. Spores responsible for initial disease development may be blown northward from rusted fields in the southern states, or they may overwinter under favorable conditions in North Dakota (3). The virulence of the rust population in relation to the resistance of the commonly grown wheat varieties determine rust severity when climatic conditions are favorable for rust development. Leaf rust may develop into epidemic proportions if susceptible wheat varieties are grown over large acreages and favorable weather conditions prevail. A leaf rust epidemic could seriously reduce the production of the North Dakota wheat crop. Spray trials at Fargo have indicated that yields can be reduced 14 bushels per acre or 30 per cent by severe leaf rust infections (5).

Large yearly losses from leaf rust have been avoided in North Dakota by growing leaf rust resistant varieties and using fungicide sprays. However, due to changes in virulence of the rust population, resistance has not been permanent and losses from leaf rust are frequently encountered.

In order to develop and maintain leaf rust resistant wheat varieties for the North Dakota growers, studies must be conducted each year to determine the specific virulences of the predominant races of rust occurring in the state and to ascertain the reaction of the commonly grown varieties to these races. The following is a report on such studies for 1972.

Materials and Methods

Leaf rust nurseries were grown at six North Dakota locations to determine the relative resistance of the commonly grown wheat varieties, breeding lines and leaf rust differentials to the natural leaf rust population at each location. Percentage rust severity and host-pathogen reaction types (susceptible, moderately susceptible, moderately resistant and resistant) were recorded.

Dr. Statler inocculating wheat plants with rust organisms in the greenhouse.

Uredospore collections were made from hard red spring, durum and winter wheats throughout North Dakota. Single-pustule cultures of these collections were used for race identification (1).

Results and Discussion

Leaf rust was first recorded in 1972 on winter wheat near Fargo on May 31, two weeks earlier than 1971. Due to the unseasonably cool temperatures during June, which were frequently below the minimal for spore germination and infection, rust development and subsequent spread were slow. When conditions conducive for leaf rust development returned in July, rust developed and spread rapidly on the susceptible varieties. Widespread planting of Waldron and other leaf rust resistant varieties was mainly responsible for preventing large scale statewide damage.

Changes in races of the natural leaf rust population force plant pathologists and breeders to constantly check virulence of the fungus and the resistance of our commonly grown varieties. This work is conducted in leaf rust nurseries and in greenhouse tests at NDSU. Leaf rust was more severe in the nurseries at Fargo, Langdon, Carring-

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ton and Minot than at Williston and Dickinson (Table 1). Thatcher, Canthatch, Empire, Manitou and Neepawa were severely rusted at most locations. Selkirk, Fortuna, Colano, Justin, Fletcher and Barton were moderately susceptible. Chris and Polk exhibited more rust at Minot and Dickinson than in previous years. This suggests that a shift in the rust population for increased virulence on these varieties may be occurring at both Minot and Dickinson. Low to moderate severities with susceptible to moderately susceptible reaction types were found on W.S. 1809, Bounty 208, Lark, W.S. 1812, Era and Nordak. Waldron, Red River 68 and Bonanza were highly resistant at all locations.

The durum varieties tested were not severely rusted at most locations except at Fargo where infection occurred late in the season. Hercules, Wascana and Rolette had the highest per cent severities while Leeds, Wells, Ward and Golden Ball had low severities.

Table 1. Percent severity and reaction types of **Puccinia recondita** x adult wheat plant reactions at six North Dakota locations.

Variety	Fargo	Langdon	Carrington	Minot	Williston	Dickinson
Spring Wheat						
Thatcher	70S	60S	80S	80S	50S	60S
Canthatch	70S	60S	80S	80S	40S	60S
Empire	60S	50S	80S	80S	60S	70S
Manitou	60S-tMR	35S-5MR	70S-tMR	60S	15S-tMR	40S-tMR
Neepawa	50S-tMR	30S-5MR	60S	50S-tMR	15S-tMR	20S
Selkirk	50S-10MS	30S-tMR	60S-5MR	30MS-20MR	10MS-5MR	15MS-5MR
Fortuna	20S-tR	30S	40S-tMR	60S	10S-5MR	40S
Colano	20MS	15MS-tMR	30S	20S-10MR	30S-10MR	20S-tMR
Justin	15S	15S	20-25S	40S	5S-2R	10S-5MS
Fletcher	10MS	5S	5S-tMR	40S-5MR	15S-tMR	25S
Barton	30S,tS	10S-1MR	15S	5MS-5MR,40S	40S,10S	5S,5R
Chris	15S	10S-tR	15S-tMR	35S-tMR	10S-tMR	25S-tMR
Polk	15MS	10S-tMR	10S-tMR	40S-tMR	10S-5MR	5MS-5MR
W. S. 1809	2MS	10S-tMR	3MS-tMR	10S	15S	10S-5MR
Bounty 208	15S-tMR	5MS-1MR	5MS	20MS-5MR	5S-tMR	10MS-tMR
Lark	10MS	3MS-tMR	5S	10MS-5MR	10MS	10S-tMR
W. S. 1812	1MS,5S	5S-tMR	tS,5S	15S-tMR	15S-tMR	3MS-tMR
Era	3S	5MS-tMR	2MS-tMR	5S-5MR	5MR-3S	10S-5MR
Nordak	5S	tS	2S	5S	tMS	tS
Red River 68	0	tS	tMR	3MS-tMR	1MS-tMR	3MS
Waldron	tS	0	tMS	tS	tS	tMS
Bonanza	0,5MS	tMR	tMR	tMS-tMR	tMR	tS,5S
Differentials						
Lr1	15S	10MS	10MS-10MR	30S	tMR-tMS	tS
Lr2	10S	3S	5-10S	5S	tS	2S
Lr2D	20S-5MR	10R-5S	50R-5MS	10S-5R	tS	5S-tMR
Lr3	60S	50S	80S	80S	30S	60S
Lr10	70S	40S	80S	80S	20S-tMR	50S
Lr16	30MS-20MR	20S-tMR	50S-tMR	30S-tMR	40MR-10S	10MS-5MR
Lr17	40MR-5MS	20R-3S	10MR-5MS	40MR-10MS	10R-2MS	5MR-3MS
Lr18	40MR-5MS	20R-3S	20R-5S	40MR-5MS	5R-tMR	5R-tMS
Agent	tS	tS	tS	tS	0	tS
Transfer	0	0	tMS	0	0	0
Durum						
Wells	10MR-2MS	tMS-tMR	tS	tMS	tMR-tMS	tMR
Leeds	10MR-5MS	tMS-tMR	tMR-tMS	2MS	tMS	tMR
Hercules	15MS	1MS	2MS	15S	5MS-5MR	tMR
Wascana	10MS-10MR	1MS	2S	15S	5MS	tS-tMR
Rolette	10MS-tMR	tS	3S-tMR	15MS	5MR-tMS	1MS
Golden Ball	tS	tR	tS	tS	tMS	tMS
Ward	10MR-3MS	0	tMS-tMR	tMR-tMS	0	0

Per cent severity precedes reaction type. S equals susceptible; R equals resistant; MR equals moderately resistant; MS equals moderately susceptible; t equals trace. A dash indicates a range in severity or response. A comma separates two distinct rust reactions (segregation).

As was found in the two previous years, most of the winter wheat varieties tested were severely rusted (Table 2). Hume, Scout 66 and Trapper showed the greatest amount of rust. In contrast, Sundance, Winalta and Bezostaia were less severely rusted. A comparison of the 1971 and 1972 trials showed no major differences except for Centurk which had an increase in severity from 10MS to 50S-tMR. In a comparison of the 1970 and 1972 tests, it was found that Kharkof, Hume and Winoka were more severely attacked in 1972. Winalta had much less rust this year than in 1970. These differences suggest changes in the natural leaf rust population.

Table 2. Leaf rust severity and reaction types of winter wheat varieties grown at Casselton, North Dakota in 1972.

Variety	Severity and Reaction	Variety	Severity and Reaction
Hume	70S	Lancer	50S
Scout 66	70S	Centurk	50S-tMR
Trapper	70S	Warrior	40S
Kharkof	60S	Sundance	20S
Winoka	60S	Winalta	5S-tMR
Froid	50S	Bezostaia	tMR-2MS

Changes in the natural leaf rust population were also indicated on the differentials. The single gene host lines **Lr1** and **Lr2** were more severely rusted at Minot and Carrington than in 1971 (5). **Lr2** was less severely rusted at Langdon and Carrington than in 1971. These as well as other changes in severities and reaction types of the differentials suggest changes in virulence of the natural leaf rust population. Agent and Transfer were resistant at all locations as expected; however, several cultures were collected in 1972 which were virulent on seedlings of Agent. Agent has been frequently used as a source of leaf rust resistance in breeding programs. Shaner (4) et al. recently reported a culture in Indiana which was virulent on Transfer.

The 120 leaf rust isolates identified in 1972 were grouped into eight UN races. Races 2 and 3 accounted for over 90 per cent of the isolates identified. A comparison of the race frequencies in 1972 shows a shift away from those in 1971 and toward a population very similar to that of 1970 (Table 3). Of the eight races identified in 1972, seven were the same as those identified in 1970. The frequencies of these races were also very similar both years. A comparison of the 1971 and 1972 collections revealed differences in both the number of races identified and in their frequency. Races 6, 7, 9, 12 and 22 were identified from the 1971 collections, but not from the collections of 1972. Race 2 and 3, although predominating in 1971, did not occur in the same frequency as in 1972 when they comprised over 90 per cent of the races identified. Agent, a cultivar widely used in breeding programs as a source of leaf rust resistance, was susceptible to 10 isolates collected in 1972. None of the 1970 or 1971 isolates were virulent on Agent. This apparent change in the rust population suggests the need for continued cooperation between pathologists and plant breeders in testing, evaluating and screening breeding lines for resistance to both the predominant races as well as isolates from natural populations with unusual or new virulences.

Table 3. Frequency of races of **Puccinia recondita** identified in North Dakota in 1970, 1971 and 1972.

UN Race	Frequency[1] Cultures Identified (%) 1970	1971	1972
1	1.1	0.0	0.8
2	66.1	28.2	63.4
3	24.4	24.2	27.6
5	1.1	12.1	0.8
6	0.0	7.3	0.0
7	1.7	6.5	0.0
9	0.0	0.8	0.0
10	0.6	0.0	0.8
12	0.0	1.6	0.0
13	0.0	11.3	0.8
17	1.1	4.8	5.0
22	0.0	0.8	0.0
25	3.9	2.4	0.8

[1]Percentage based on 180 isolates for 1970, 124 for 1971 and 120 for 1972.

Only through continual cooperation between breeder and pathologist can the losses due to leaf rust in North Dakota be reduced or eliminated.

References

1. Basile, Rita. 1957. *A diagnostic key for the identification of physiologic races of* **Puccinia rubigo-vera tritici** *grouped according to a unified numeration scheme.* Plant Disease Reptr. 41:508-511.
2. Burleigh, J. R., M. G. Eversmeyer, and A. P. Roelfs. 1972. *Development of linear equations for predicting wheat leaf rust.* Phytopathology 62:947-953.
3. Chester, K. Starr. 1946. *The nature and prevention of the cereal rusts as exemplified in the leaf rust of wheat.* Chronica Botanica Co., Waltham, Mass. 269 pp.
4. Shaner, G., J. R. Roberts, and R. E. Finney. 1972. *A culture of* **Puccinia recondita** *virulent to the wheat cultivar Transfer.* Plant Disease Reptr. 56:827-830.
5. Statler, G. D. 1971. *The virulence and potential destructiveness of wheat leaf rusts in North Dakota.* North Dakota Farm Res. 29:2, 7-10.
6. Statler, G. D. 1972. *Distribution of virulence of wheat leaf rust in North Dakota in 1971.* Plant Disease Reptr. 56:77-80.