

# 1988 Wheat Disease Survey Results

M.P. McMullen, D.R. Nelson, T.L. Werk, and G.D. Statler

Wheat diseases have the potential to significantly reduce crop yield and quality, resulting in reduced income to farmers. North Dakota wheat crops have been severely damaged by fungal leaf and head diseases in recent years. Head scab, leaf spots and leaf rust were common in many areas of the state in 1986 (2). A survey of wheat in 1987 revealed that, of the leaf diseases present, tan spot had the greatest economic impact statewide, followed by *Septoria* leaf diseases and leaf rust (3). Head scab was present in the northeast and glume blotch was present in the northeast and northcentral districts. Wheat diseases caused by bacterial and viral infections were generally of low severity in most fields in 1987.

The fungi that cause tan spot, *Septoria* leaf blotches, scab and *Septoria* glume blotch overwinter in North Dakota on infected residue. The widespread occurrence of these diseases in 1986 and 1987 resulted in an abundance of diseased wheat residue that could serve as a source of infection for

the 1988 wheat crops. The occurrence and severity of these diseases in 1988 would depend on favorable environment for their infection and spread. A wheat disease survey was done in 1988 to assess the presence, distribution, incidence and severity of diseases caused by leaf and head disease organisms.

## METHODS OF SURVEY

The 1988 disease survey examined 223 wheat fields, from May through July, in 35 counties (Figure 1). Survey efforts were concentrated in five districts. The northwest district of North Dakota was not surveyed in 1988. Winter, hard red spring and durum wheats were surveyed.

Data collected for each field visited included: date, county, legal description, wheat class, growth stage, diseases observed, disease incidence (percent tillers or percent heads

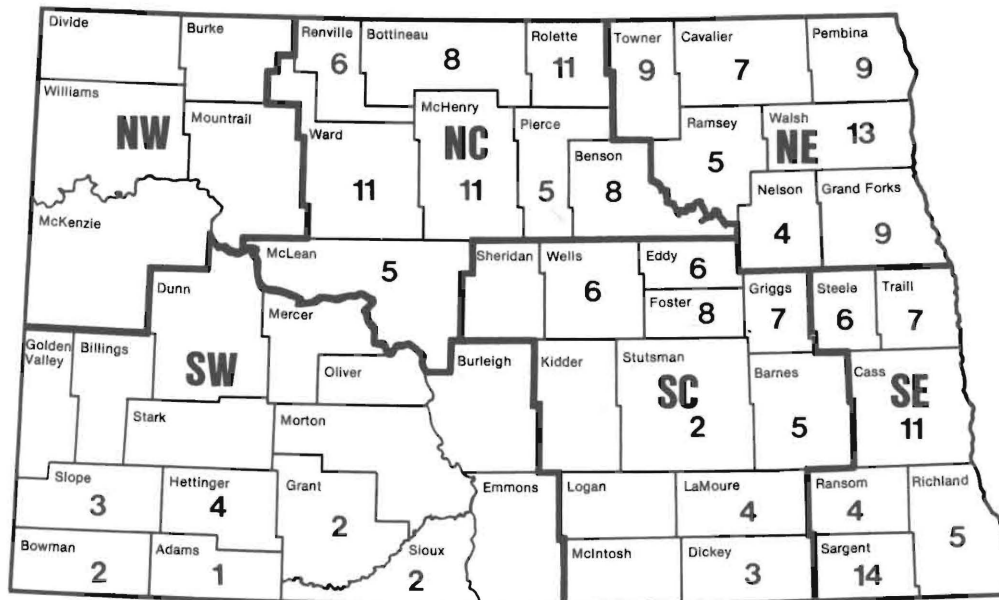


Figure 1. Number of Wheat Fields Surveyed by County, 1988.

McMullen is plant pathologist, NDSU Extension Service, Nelson is survey entomologist, North Dakota Department of Agriculture, Werk is NDSU undergraduate student, Crop and Weed Science, and Statler is professor, Department of Plant Pathology.

affected), disease severity (for fungal leaf spots the percent leaf area affected on most diseased green leaf; for head diseases the percent head area affected; for viral diseases the percent of leaves showing symptoms), highest leaf affected, and rust reactions. When possible, the variety, previous crop and tillage method also were recorded.

Laboratory diagnoses of diseases were made when diagnosis was not possible in the field. Fungal diseases were diagnosed using microscopic and cultural methods. Serological methods were used to confirm many viral diagnoses.

Disease diagnoses in the field were made by T.L. Werk or M.P. McMullen; laboratory diagnosis of leaf spots was made by M.P. McMullen. Serological tests were done in the laboratory of Dr. Michael Edwards, USDA/ARS plant virologist, Fargo. Some leaf rust survey work was done under the supervision of G.D. Statler. D.R. Nelson developed techniques for survey recording, computer storage and compilation of the data.

## 1988 RESULTS

The growing season was unusually hot and dry, with record high temperatures and low precipitation over most of the state in June and July (1). Despite the very dry growing season, 15 separate leaf and head diseases were detected; 11 of these were observed in more than 1 percent of the fields surveyed, but only four (leaf rust, spot blotch, wheat streak mosaic and loose smut) were found in more than 10 percent of the fields surveyed (Table 1). The percentage of fields infected with certain diseases varied considerably from results observed in the 1987 wheat disease survey (Table 1). Fungal leaf spot diseases and head diseases generally were much more prevalent in 1987 than in 1988, while wheat streak mosaic virus disease was much more common in 1988 than in 1987. Most fungal leaf spots and the viral diseases were found in all three wheat classes (Table 2). The average severities of leaf spot diseases were very low in 1988, while the average severities of viral leaf diseases in some districts were high.

The incidence and severity values are both important in describing disease situations, therefore a disease index value (DI) defined as

$$DI = (\text{Incidence} \times \text{Severity}) / 100$$

was calculated for each disease. DI values range from 0 (no disease present) to 100 (all tillers affected and 100 percent of evaluated leaf area affected). District average DI values were calculated for infected fields (to give an indication of the relative occurrence of each disease within infected fields) and across all fields (to give a more general indication of the occurrence of a disease within a district). These values were calculated from stages early boot to flowering and from early kernel development (berry) to maturity (Table 3).

**Leaf rust** - Leaf rust, caused by *Puccinia recondita*, was the most frequently observed disease, with 48 percent of all fields surveyed infected (Table 1) and occurrence on all three wheat crops (Table 2). However, leaf rust levels remained low. From early boot to flowering the disease index value of leaf rust was very low in all districts, both in infected fields and across all fields (Table 3). Disease index values were slightly higher in fields surveyed from flowering to maturity (Table 3), especially in the northeast district where crops were somewhat later in maturing.

**Table 1. Percentage of Surveyed Fields Infected - 1987, 1988.**

	1987	1988
<b>Leafspot Diseases</b>		
Leaf rust	55.7	48.0
Tanspot	59.8	5.8
Spot blotch	21.9	22.0
Septoria species combined	40.2	12.1
<i>Septoria avenae</i> f. sp. <i>tritici</i>	12.7	2.2
<i>Septoria nodorum</i>	17.7	6.7
<i>Septoria tritici</i>	7.9	0.5
Undetermined <i>Septoria</i> spp.	1.9	2.7
Stem rust	0.3	0.9
Powdery mildew	3.8	4.0
Bacterial leaf blight	2.2	0.5
<b>Head Diseases<sup>1</sup></b>		
Glume blotch	7.9	8.2
Scab	9.9	0
Loose smut	5.8	13.3
Black chaff	0.4	1.4
Black point	0	0.7
<b>Viral Diseases</b>		
Wheat streak mosaic	2.9	37.2
Barley yellow dwarf	7.0	6.3

<sup>1</sup> Head emergence and beyond (Zadoks stage 59 and beyond)

**Table 2. Percentage of Surveyed Fields Infected by Wheat Class, Crop, 1989.**

	Durum	Spring	Winter
<b>Leafspot diseases</b>			
Leaf rust	39.6	50.8	49.0
Tanspot	6.3	7.3	2.0
Spot blotch	18.8	24.2	19.6
Septoria species combined	17.0	9.0	16.0
<i>Septoria nodorum</i>	10.4	6.5	3.9
<i>S. avenae</i> f. sp. <i>triticea</i>	6.3	1.6	0.0
<i>S. tritici</i>	0.0	0.0	2.0
Undetermined <i>Septoria</i>	0.0	0.8	9.8
<b>Head Diseases</b>			
Glume blotch	0.0	12.5	0.0
Loose smut	6.1	18.2	7.1
<b>Viral Diseases</b>			
Wheat streak mosaic	45.8	24.2	58.8
Barley yellow dwarf	6.3	8.1	2.0

**Wheat streak mosaic virus (WSMV)** - WSMV was the second most frequently observed disease over all crops in 1988 (Table 1) and the most common disease found in durum and winter wheat fields (Table 2). Severe WSMV was found in early growth stages in the southwest and southeast districts. From early boot to flowering, the highest disease index values for WSMV were from the southwest and southeast districts and these values were higher than all other leaf diseases combined in these two districts. The disease index values for WSMV were lower in fields surveyed following flowering than from boot to flowering because

**Table 3. Average Disease Index (DI) in Infected Fields and Across All Fields.**

EARLY BOOT TO FLOWERING															
District						Infected Fields					All Fields				
	NC	NE	SC	SE	SW	NC	NE	SC	SE	SW	NC	NE	SC	SE	SW
# Fields Sampled	40	25	18	30	8										
	Percent Fields Infected					DI	DI	DI	DI	DI <sup>1</sup>	DI	DI	DI	DI	DI
Leaf rust	25	64	72	60	1	0.1	0.6	1.0	0.3	0.5	T <sup>2</sup>	0.4	0.7	0.2	0.1
Tan spot	3	8	0	7	0	1.6	0.3	0.0	10.5	0.0	T	T	0.0	0.7	0.0
Spot blotch	23	32	39	27	1	0.1	2.3	0.1	0.8	0.5	T	0.7	T	0.2	0.1
Septoria leaf spots	3	16	17	13	0	10.0	4.5	0.3	4.7	0.0	0.3	0.7	0.1	0.6	0.0
WSMV <sup>3</sup>	63	8	33	30	88	7.4	0.6	0.3	28.2	86.6	4.6	T	0.1	8.5	75.7

EARLY KERNEL DEVELOPMENT TO MATURITY															
District						Infected Fields					All Fields				
	NC	NE	SC	SE	SW	NC	NE	SC	SE	SW	NC	NE	SC	SE	SW
# Fields Sampled	19	20	20	10	0										
	Percent Fields Infected					DI	DI	DI	DI		DI	DI	DI	DI	DI
Leaf rust	47	90	55	60	—	0.6	3.7	2.4	1.0	—	0.3	3.3	1.3	0.6	—
Tan spot	5	10	5	30	—	0.1	0.7	0.1	0.1	—	T <sup>2</sup>	0.1	T	T	—
Spot blotch	11	15	25	30	—	5.3	0.1	0.1	0.7	—	0.6	T	T	0.2	—
Septoria leaf spots	53	15	5	0	—	6.1	0.7	0.1	0	—	3.2	0.1	T	0.0	—
WSMV <sup>3</sup>	37	0	25	40	—	6.9	0.0	2.4	2.5	—	2.5	0.0	0.6	1.0	—

<sup>1</sup> DI = Disease Index = (Incidence x Severity) / 100  
 Incidence = Percentage Tillers Affected  
 Severity = Percentage Leaf Area Affected on Most Severely Affected Green Leaf  
 (This was generally the 3rd leaf from the top during growth stages early boot to flowering and the 2nd leaf from the top during growth stages flowering through maturity)

<sup>2</sup> T = trace (< 0.1%)

<sup>3</sup> WSMV = Wheat Streak Mosaic Virus

severely infected fields had either been turned under or leaf tissue had been destroyed by a combination of disease and heat stress. More complete information on WSMV occurrence, severity and economic loss will be provided in an accompanying report (4).

**Spot blotch** - Spot blotch, caused by *Helminthosporium sativum*, was the most frequently observed fungal leaf spot disease in 1988, recorded in 22 percent of all fields surveyed, the same level of occurrence as in 1987 (Table 1). Although this disease was observed often, severity levels were low and disease index values were very low from early boot to maturity (Table 3). In post-flowering fields, the northcentral district had the greatest level of spot blotch (Table 3).

**Tanspot** - Tanspot, caused by *Pyrenophora tritici-repentis*, was recorded in only 5.8 percent of the fields surveyed, compared to 60 percent of surveyed fields in 1987 (Table 1). Severity of tanspot was low in 1988, with average disease index values generally as low or lower than those for leaf rust and spot blotch across all fields (Table 3). However, several fields surveyed in the southeast district from early boot to flowering had leaf severities ranging from 1 percent to 12 percent, and this resulted in a relatively high disease index value for infected fields in the southeast (Table 3).

**Septoria complex** - Three species of the *Septoria* fungus are known to cause leaf diseases of wheat in North Dakota (2,3). All three were observed on wheat in 1988. *Septoria*

*nodorum* was present in 6.7 percent of the fields surveyed, *S. tritici* was observed in 0.5 percent of fields surveyed, and *S. avenae triticea* was observed in 2.2 percent of the fields surveyed (Table 1). Occurrence of these *Septoria* infections was considerably less in 1988 than in 1987 (Table 1). Like the other fungal leaf diseases, *Septoria* leafspots, when grouped together, were low in incidence and severity, with low disease index values across all fields (Table 3). The highest disease index values in infected fields occurred in the northcentral district (Table 3).

**Glume blotch** - Glume blotch is caused by the fungus *Septoria nodorum*, a fungus which causes both a leaf blotch and a glume infection. In both 1987 and 1988 approximately 8 percent of headed fields had some glume blotch infection (Table 1). Field incidence was low in 1988, ranging up to 6 percent compared to 90 percent in 1987. Glume blotch was recorded on spring wheats (Table 2) in the northeast, south central, and southeast districts.

**Barley yellow dwarf virus (BYDV)** - BYDV is transmitted and carried from one cereal crop to another by grain-feeding aphids. This virus disease was observed in 6.2 percent of all fields surveyed in 1988 vs. 7.0 percent in 1987 (Table 1). BYDV was more common in the spring wheats than in winter wheat (Table 2). The average incidence of BYDV in infected fields was 10 percent with district averages ranging from 2 percent to 39 percent. Leaf severities were typically quite high in those plants where infection was apparent.

**Other diseases observed** - A few other leaf and head diseases were observed on wheat crops in 1988 (Table 1).

A low incidence of seed-borne loose smut was found in 13.3 percent of all fields surveyed, primarily in spring wheat.

Powdery mildew was found in 17.6 percent of the winter wheat fields surveyed, but not in the other two classes of wheat. Severity of powdery mildew averaged only 1 percent.

Bacterial leaf blight, stem rust, black chaff and black point infections were seen in less than 1 percent of fields surveyed.

Head scab was not observed during this survey.

## SUMMARY

Wheat leaf spots and leaf rust were detected in all classes of wheat surveyed in 1988, but their levels were very low and overall they caused little damage to the 1988 wheat crop. Growing season temperatures were too high and humidity levels too low for spore release and subsequent infection. Low levels of leaf spot infections in 1988 should result in a relatively small amount of overwintering fungi in the 1988 crop residue. However, a few fields surveyed in 1988 had substantial levels of leaf spot disease; these infections may have been due to isolated rain showers and previous crop and field disease history. Disease development for leaf spots in 1989 will depend upon the occurrence of favorable weather for spore production and infection. Leaf rust development in 1989 will depend on if the disease develops in states to the south; if rust spores are carried into North Dakota by prevailing winds; if susceptible varieties are planted; and if optimum dew or precipitation occurs.

Wheat streak mosaic was the most damaging wheat disease in 1988. The warm, dry weather that inhibited leaf spot

diseases favored wheat streak because it favored reproduction and movement of the wheat curl mite, the organism that transmits the virus and carries it from plant to plant. Increased mite activity resulted in increased spread of wheat streak mosaic into areas of the state where it had not previously been recorded. A more complete account of this disease is given in an accompanying report (4).

## SURVEY PLANS - 1989

Wheat disease survey work will continue in 1989. Three individuals stationed at Minot, Carrington and Fargo will survey for wheat pests. Survey efforts will be coordinated through Extension Service area agronomists at Minot and Carrington and through the North Dakota survey entomologist and extension plant pathologist at Fargo.

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