Wheat Streak Mosaic Severe in 1988

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DISTRIBUTION AND SEVERITY IN 1988

Wheat streak mosaic virus disease was confirmed in small grain crops in 35 counties in North Dakota in 1988, including six counties along the Canadian border (Figure 1). The disease was diagnosed by the presence of characteristic symptoms and the presence of the virus vector, the wheat curl mite, along with periodic confirmation through ELISA serological testing done by Dr. Michael Edwards, USDA/ARS virologist. Occurrence in these counties was determined either through field surveys or through submission of plant samples to the plant pest diagnostic laboratory at NDSU. Additional counties may have had the disease present but were not surveyed or sampled.

Volunteer plants of winter wheat, hard red spring wheat and durum wheat in the southeast area of the state exhibited wheat streak mosaic symptoms and wheat curl mite populations in late August and early September of 1987. Winter wheat crops from this area showed wheat streak mosaic symptoms on September 30, 1987. Winter wheat samples from southwestern counties were confirmed to have wheat streak mosaic as early as March 4, 1988, and by May 25, severe infections were present.

A growing season survey of wheat fields showed that wheat streak mosaic was present in 37 percent of 223 fields surveyed (Table 1). The northeast area had the smallest percentage of surveyed fields infected with wheat streak, while the southwest had the greatest percentage of surveyed fields infected (Table 1). This disease was present in all classes of wheat. Winter wheat fields had the highest percentage of plants infected (incidence) and had high percentage of leaf showing symptoms (severity), resulting in a

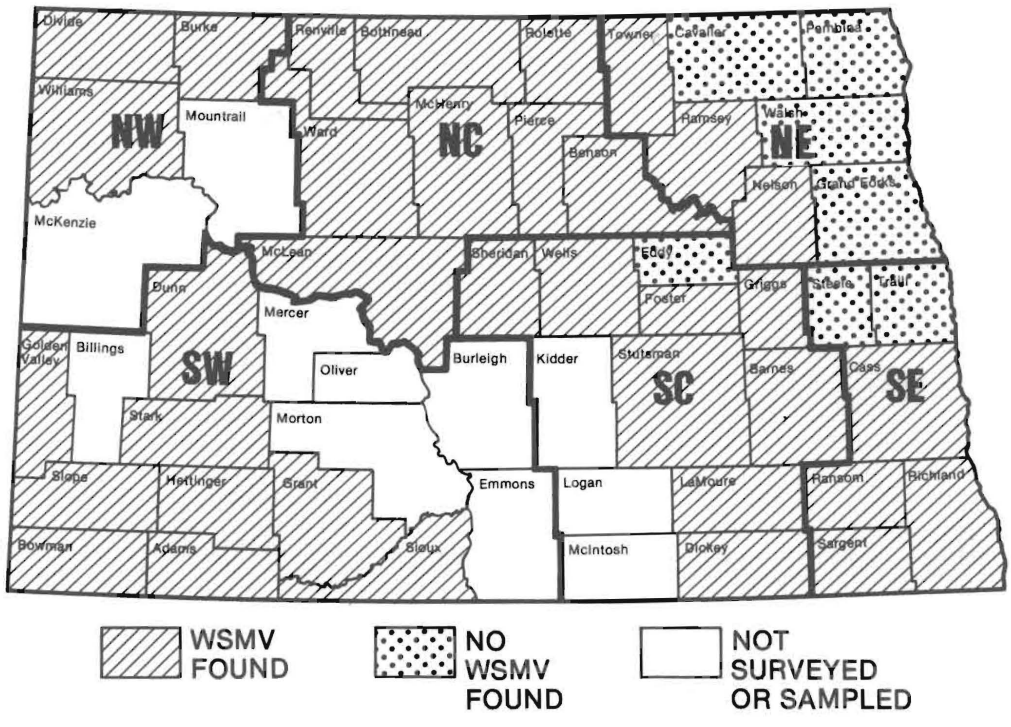

Figure 1. Wheat Streak Mosaic Virus (WSMV) Detected in 1988

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relatively high disease index value (Table 2). Winter wheat acreage was greatest in the southwest, southeast and south-central counties.

LOSSES DUE TO WHEAT STREAK MOSAIC IN 1988

Survey information on incidence and severity and percent yield loss information provided by NDSU Extension Service area agronomists and county agents allowed for estimation of yield losses caused by the wheat streak mosaic disease in the three classes of wheat. These losses were over and above those due to the 1988 drought, based on comparisons of yields of infected vs non-infected fields. Statewide, estimated losses amounted to approximately $40.1 million dollars, based on October 1988 prices (Table 3). Highest yield losses were in the winter wheat crops, but because of the much greater acreage of hard red spring wheat (6.2 million vs 250,000), total losses in spring wheat were greater (Table 3). The southwest area of the state was hardest hit with the disease, where winter wheat losses were estimated at 80 percent and spring wheat and durum losses were estimated at 5 percent each (Table 3). In contrast, the statewide level of wheat streak mosaic from May to July in 1987 was quite low in all classes of wheat (McMullen et al., 1988).

Wheat varieties were not evaluated in field plots in 1988 for differences in response to wheat streak mosaic virus infection. Differences in variety response among durums and hard red spring wheats in North Dakota previously have been documented (Edwards and McMullen, 1988), while differences in winter wheats have been reported from other states (Willis and Brooks, 1988).

REASONS FOR WHEAT STREAK MOSAIC EPIDEMIC IN 1988

Wheat streak mosaic was very severe in 1988 due to several factors:

Rainfall in the late summer of 1987 encouraged growth of wheat volunteers which served as 'green bridges' on which the wheat curl mite could survive until emergence of winter wheat crops. Wheat volunteers are the host which allows for greatest mite reproduction and virus replication. Other green hosts include some native and introduced grasses and green corn.

Some winter wheat fields were planted very early in 1987, prior to the recommended planting dates of September 10 to 15. This allowed early increase of the mite population and disease spread in the winter wheat crops prior to winter freeze-up.

The fall of 1987 was very warm and dry into December, conditions which are ideal for wheat curl mite reproduction and dispersal. Also, the volunteer wheats and the winter wheat crops were under moisture stress and this may have stimulated the mites to exhibit more dispersal behavior, thus vectoring the disease to more plants. Mite movement and dispersal has been found to be directly correlated with air temperatures, wind speeds, and plant stress conditions (Nault and Styer, 1969).

Warm, dry weather and strong winds during the spring and summer of 1988 were ideal for wheat curl mite movement and reproduction.

Table 1. Percent Surveyed Wheat Fields Infected with Wheat Streak Mosaic, North Dakota, 1988.

	District					
	NC	NE	SE	SC	SW	Total
# Fields Surveyed	63	58	41	47	14	223
% Fields Infected	54	5	34	40	93	37

	Wheat Class		
	Durum	HRS	Winter
# Fields Surveyed	48	124	51
% Field Infected	46	24	59

Table 2. Average Incidence and Severity of Wheat Streak Mosaic within Infected Fields, North Dakota, 1988.

Wheat Class	Incidence[1]	Severity[2]	Disease Index[3]
Durum	4.7	99.0	4.70
HRS	16.1	75.5	12.16
Winter	50.5	76.8	38.78

[1] Incidence = Percent of plants within a field showing symptoms
[2] Severity = Percent of leaf area showing symptoms
[3] Disease index = (Incidence x Severity)/100

Table 3. Estimated Losses in North Dakota due to Wheat Streak Mosaic Virus, 1988.

	Est. % Yield Losses			Dollar Loss
District	Winter	HRS	Durum	(millions)
NE	50%	1%	1%	$ 4.1
NW + NC	10%	3%	3%	$ 6.7
SC	17%	5.4%	1.3%	$ 7.3
SW	80%	5%	5%	$12.5
SE	27%	5%	7%	$ 9.5
Dollar loss (millions)	$7.5	$23.1	$9.5	$40.1

CORN AS A RESERVOIR OF THE DISEASE; SURVEY RESULTS 1985, 1988

Corn has been documented as a host for the wheat mite curl and the wheat streak virus (Slykhuis, 1955). To determine the importance in North Dakota of corn as a reservoir of the mite and virus, two surveys of corn were made, one in 1985 and one in 1988. In 1985, approximately 20 ears from each of 26 corn fields in southeastern North Dakota were sampled after small grain harvest but prior to corn maturation. Ear leaf and husk tissue was analyzed with ELISA serological testing procedures for the presence of wheat streak mosaic virus. The percentage of fields infected with the virus ranged from 0 percent to 75 percent per county could (Table 4). The percentage of ears within each field infected with the virus ranged from 0 percent to 6.3 percent per county (Table 4). D.R. Nelson also examined the ears for wheat curl mites by washing the ears in soapy water and

examining the wash water with a stereoscopic microscope. The percentage of ears in any one field showing some mites present ranged from 5 percent to 100 percent. The highest mite incidence on corn was in Sargent County.

In 1988, five ears from 61 corn fields in 15 North Dakota counties were collected in mid to late August and examined for the presence of wheat curl mites. Wheat curl mites were detected in every corn field sampled, including fields in two counties (Steele and Traill) which had no confirmed cases of WSMV in wheat in 1988 (Table 5). Green corn ears appeared to give a greater recovery of mites than ears that were approaching physiological maturity; presumably the mites left the corn ears as the ears matured.

The information provided by the 1985 and 1988 corn surveys indicates that corn is an important summer reservoir of the mites and virus in North Dakota. Winter wheat planted next to corn that is still green could be at risk, with mites dispersing from the corn as it matures and is carried by the wind to nearby winter wheat crops or wheat volunteers. High temperatures and dry conditions (Enz et al., 1988) that occurred in the growing season of 1988 were not sufficiently severe to eliminate the mite populations, because they were still detectable in corn in late August.

GRASS HOSTS

Various grasses have been tested at North Dakota State University for the presence of wheat streak mosaic virus. In 1988 a few late-planted barley and oat crops were confirmed to be infected with wheat streak along with several common grasses (Table 6). Certain grasses have been reported as reservoirs for the mite or virus (Somsen and Sill, 1970). Common perennial grasses may be important reservoirs of the mite and the virus in the absence of overwintering wheat hosts. However, most epidemics of wheat streak have apparently had their origin in volunteer wheats, while other grasses have more frequently accounted for localized movement into a field (Somsen and Sill, 1970).

POTENTIAL FOR 1989

The very dry summer and fall of 1988 restricted development of wheat volunteers. Winter wheat acreage planted in 1988 also was reduced because of poor soil moisture availability at planting time. Thus, the overwintering hosts for the wheat curl mite and the virus were less abundant than in previous years. While corn provided a host during the late summer, much of the corn had reached maturity well before any winter wheat was planted or wheat volunteers emerged, and consequently harbored lower mite populations to potentially infest any volunteers or commercial plantings that may have been available.

Table 4. Corn tested for Presence of Wheat Streak Mosaic, North Dakota, 1985.

County	# Fields Tested	% Fields Positive[1]	# Ears Tested	% Ears Positive[1]
Barnes	4	75.0	80	6.3
Dickey	6	16.7	117	0.8
LaMoure	2	0	40	0
Ransom	4	75.0	74	6.8
Richland	3	0	53	0
Sargent	7	57.1	135	5.9
Totals	26	42.3	499	3.8

[1] Virus confirmed by ELISA serological tests.

Table 5. Presence of Wheat Curl Mites in Corn, August 1988, North Dakota.

County	District	# Fields Sampled	Average # Mites/Ear (5 ears/field)
Cass	SE	8	31
Ransom	SE	6	41
Richland	SE	4	34
Sargent	SE	6	92
Steele	SE	4	40
Traill	SE	6	75
Barnes	SC	5	125
Dickey	SC	3	90
Foster	SC	1	3
Griggs	SC	5	131
LaMoure	SC	3	99
Stutsman	SC	4	18
Hettinger	SW	4	44
Slope	SW	1	8
Stark	SW	1	5

Table 6. Grasses Serologically Tested for Wheat Streak Mosaic in North Dakota, 1988.

Grass	Reaction
Wheat, all classes	+
Barley	+
Oats	+
Smooth Brome	+
Wild Barley	+
Winter Rye	—
Reed Canary	—
Western Wheat Grass	—
Quackgrass	—
Japanese Brome	—

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