

## Chloride and Fungicide application study, North Dakota, 2007

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There have been numerous studies examining the effect of chloride on leaf and root diseases, and also the effect of fungicides on leaf and head disease. However, there are few studies examining the combination of chloride nutrition with fungicide for leaf and head disease control. This study was designed to examine whether a synergy exists between chloride nutrition and fungicide application of winter and spring wheat.

This study was conducted at two sites in North Dakota in 2007. The first site was located 7 miles east of **Ellendale** in Dickey County, R62W, T129N, NW ¼ of NW ¼ section 12 on Barnes loam soils (fine-loamy, mixed, Udic Haploborolls). The experimental design was a split block, with two winter wheat varieties as the main blocks and eight fertilizer/fungicide treatments as the split-blocks. The treatments were replicated four times. The two varieties, Falcon, and Millenium, were seeded September 25. Individual plots were 7.5 ft wide and 20 ft long. A 5-ft alleyway was maintained between blocks. Initial fertilizer treatments were applied soon after emergence on October 16. About 0.4 in. rain fell on Oct. 17, with winter freeze-up beginning Nov. 1.

Treatments were applied as follows from fall through the growing season:

<u>Treatment Number</u>	<u>Treatment description</u>
1	Check
2	60 lb/a Cl as KCl (0-0-60) fall applied
3	60 lb/a Cl as CaCl <sub>2</sub> fall applied
4	5 lb/a Cl as CaCl <sub>2</sub> foliar 5-leaf stage
5	Tilt 4 oz/a at 5-leaf stage
6	Tilt 4 oz/a at heading
7	5 lb/a Cl as CaCl <sub>2</sub> at heading
8	<u>Tilt @ 4 oz/a + 5 lb/a Cl as CaCl<sub>2</sub> at heading</u>

Treatments 4 and 5 were applied to both varieties May 9. Wind was 5-10 mph and the application was made between 11AM and noon.

Treatments 6, 7 and 8 were applied to Millenium June 11, and to Falcon June 15, due to differences in heading dates. On June 11, wind speed was 15 mph from the WSW. On June 15, wind was 5 mph from the NNW.

Plots were harvested using a plot combine with a 4-ft head July 24.

Plots were high in P and K, OM about 3% on a loam soil. Chloride tested in the fall about 120 lb/acre, but decreased over winter to about 60 lb/a by April.

Soil tests, Ellendale, 10/2006

Depth	P	K	pH,	OM	Cu
	ppm	ppm		%	ppm
0-6 inch	20	410	6.4	3.5	0.59

Nitrate-N to 2 ft. was high, at 250 lb/a. No additional N was applied. Sulfate-S was also high, averaging 800 lb/a 2-ft

Statistical analysis was conducted using SAS 9.1 for windows, using the PROC MIXED procedure, correcting for spatial relationships not addressed with blocking.

### Results-

<b>Factor</b>	<b>F</b>	<b>P&gt;</b>
Discoloration		
Trt	6.07	0.0003
Variety	11.54	0.045
trtXvar	2.59	0.04
Rust		
Trt	2.94	0.04
Variety	3.67	0.15 NS
trtXvar	1.74	0.15 NS
Leaf Disease		
Trt	4.45	0.002
Variety	12.29	0.04
trtXvar	2.12	0.07 NS
Scab Incidence		
Trt	1.11	0.38 NS
Variety	11.78	0.004
trtXvar	2.09	0.07 NS
Scab severity		
Trt	0.70	0.61 NS
Variety	7.9	0.01
trtXvar	1.53	0.25 NS
Test weight		
Trt	0.41	0.89 NS
Variety	47.1	0.01
trtXvar	0.30	0.95 NS
Yield		
Trt	1.10	0.40 NS
Variety	48.9	0.00001
trtXvar	1.27	0.32 NS
Protein		
Trt	2.20	0.06 NS
Variety	13.9	0.02
trtXvar	1.10	0.39 NS

Since a treatment by variety interaction was only present in the discoloration measurement, results were tabulated as an average of the two varieties.

Ellendale measurements as affected by treatment, over two winter wheat varieties.

Treatment	Discoloration	Rust	Leaf disease	Scab Inc	Scab sev	TW	Yield	Pro
1 ck	49.3 c	9.6 b	38.7 c	12.8	5.0	55.9	59.0	13.4
2 KCl	43.3 c	8.7 b	34.4 bc	9.8	4.1	56.1	59.2	13.7
3 CaCl <sub>2</sub> f*	34.2 b	8.0 ab	26.3 b	11.2	2.6	56.4	60.6	13.5
4 CaCl <sub>2</sub> 5L	33.0 b	8.8 b	24.9 ab	9.9	2.8	56.1	57.2	13.5
5 Tilt 5L	32.5 b	6.8 ab	25.3 b	7.0	3.8	56.6	61.9	13.4
6 Tilt H	21.0 a	5.7 a	15.1 a	4.2	2.0	56.5	60.5	13.8
7 CaCl <sub>2</sub> H	39.1 bc	8.2 ab	31.2 bc	6.2	2.3	56.2	58.4	13.5
8 Tilt + CaCl <sub>2</sub> H	21.8 a	5.8 a	15.5 a	11.0	4.7	56.0	57.3	13.8
LSD 5%	11.0	2.4	10.0	NS	NS	NS	NS	NS

\*f = fall applied, 5L = applied at 5-leaf stage, H = applied at heading

Tilt and calcium chloride at heading and Tilt applied alone at heading produced the least discoloration, rust and leaf disease of any treatments. The addition of chloride did not produce less leaf disease, rust or discoloration compared to Tilt alone. Both calcium chloride and Tilt applied at the 5-leaf stage produced similar reductions in leaf disease, rust and discoloration. The KCl treatment was no better than the check, however, there was an improvement in discoloration of leaves and leaf disease with fall-applied calcium chloride over the check. Dry, hot weather during late June and early July prevented the development of significant scab and also limited yield potential at this site.



Figure 1. Ellendale plots at harvest day.

The second site was located SE of **Valley City** about 5 miles, R57W, T139N, section 6, SE ¼ of NE ¼ on Lanona fine sandy loams (coarse loamy, mixed, Udic Haploborolls).

Treatments were applied April 20 and seeded the same day with a no-till seeder using Glenn spring wheat at 1,000,000 live seeds/acre.

Beginning soil test data were:

Depth	Cl	P, ppm	K, ppm	pH,	OM, %	Cu, ppm
0-6 inch	3.5	24	215	5.8	1.9	0.42
6-24 inch	11.7					

Nitrogen was applied April 13 at a rate of 100 lb N/acre on soybean stubble. Soil test nitrate-N was about 20 lb/a to 2 ft. depth.

Supplemental N and S were applied 5/15 after newly emerged wheat showed signs of S deficiency. 100 lb/a of 21-0-0-24 S was applied with a broadcast dry fertilizer applicator across the plots and in the surrounding sandy soil area where the symptoms had appeared. Wheat was in the 3-leaf stage at this time. The plots received about 1 inch of rain about 5 days after application.

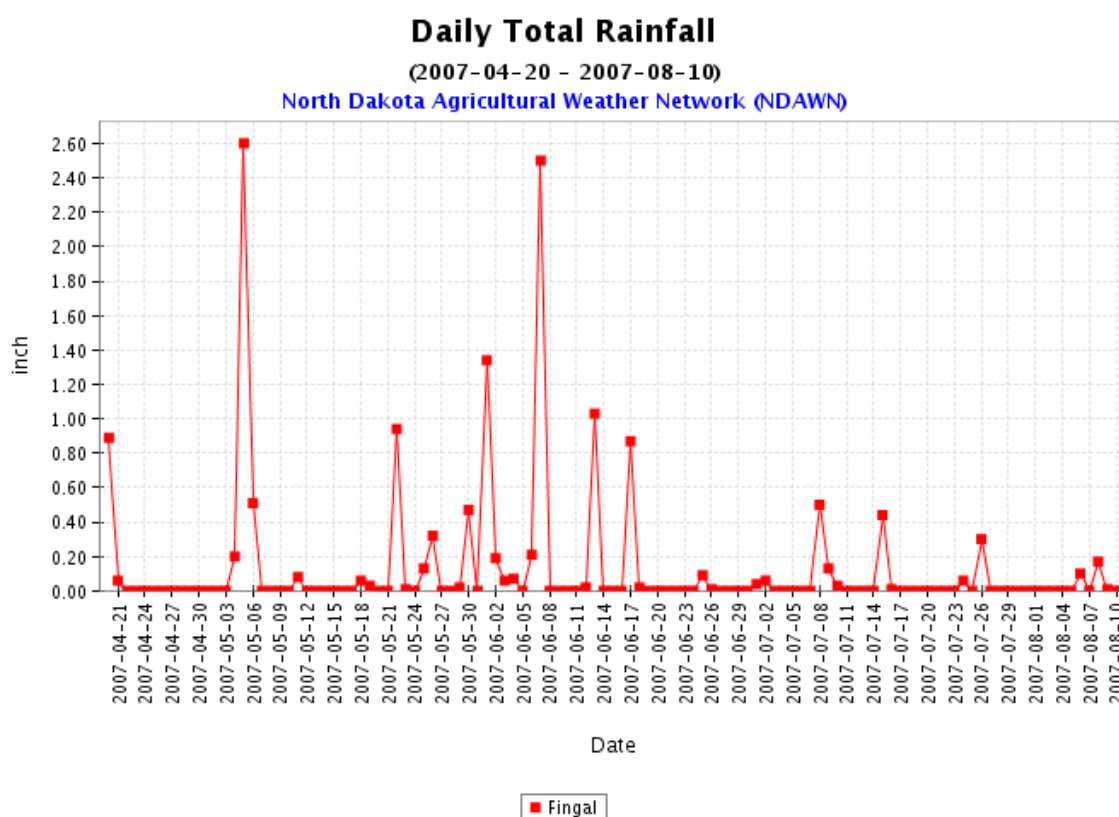


Figure 2. Rainfall Fingall, ND, closest N-DAWN location to the Valley City site.

Experimental design was a randomized complete block with eight treatments and four replications. Analysis was conducted in SAS using the PROC MIXED procedure correcting for spatial relationships not addressed with blocking.

Treatments were applied as follows from fall through the growing season:

**Treatment Number Treatment description**

1	Check
2	60 lb/a Cl as KCl (0-0-60) fall applied
3	60 lb/a Cl as CaCl <sub>2</sub> fall applied
4	Tilt 4 oz/a at 5-leaf stage
5	5 lb/a Cl as CaCl <sub>2</sub> foliar 5-leaf stage
6	Tilt 4 oz/a at heading
7	5 lb/a Cl as CaCl <sub>2</sub> at heading
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The 5-leaf treatments were applied 5/31, a little early, due to impending rainfall expected during the next week, which did occur (Figure 2). The foliar treatments were applied at Feekes 4.5 as a result in a NW wind 10-15 mph using a shielded bicycle sprayer. Treatments were applied using 20 gal water/a at 40 psi with flat-fan spray tips.

### Valley City Results-

There was no scab at Valley City, so no measurements were available.

Valley City measurements as affected by treatment, over two winter wheat varieties.

Treatment	Discoloration	Rust	Leaf disease	TW	Yield	Pro
1 ck	10.0	3.0	7.3	61.0	43.6b	16.4
2 KCl	9.8	2.4	7.3	61.8	44.5b	15.9
3 CaCl <sub>2</sub> f*	7.3	2.8	5.3	62.8	53.1a	15.6
4 Tilt 5L	8.8	2.7	6.8	61.5	43.4b	16.3
5 CaCl <sub>2</sub> 5L	8.3	2.4	6.3	61.6	42.3b	15.6
6 Tilt H	10.0	3.8	7.3	60.6	35.7b	16.7
7 CaCl <sub>2</sub> H	12.5	4.4	8.5	62.1	42.3b	15.8
8 Tilt + CaCl <sub>2</sub> H	11.0	2.9	7.8	62.6	43.4b	15.9
LSD 5%	NS	NS	NS	NS	9.4	NS

\*f = fall applied, 5L = applied at 5-leaf stage, H = applied at heading

Leaf disease incidence was very low. There were no differences between treatments in any leaf discoloration or disease. Calcium chloride applied as a foliar spray at 5 leaf provided the best yield over all other treatments. There were no differences in protein due to treatment.

### Discussion

These studies will be conducted again in 2008. The foliar treatments of chloride will be discontinued in 2008, with only fall treatments considered. Due to analysis of copper treatments on scab and foliar diseases conducted recently and due to be presented soon in a journal article, there will be fall (winter wheat) spring soil copper sulfate treatments applied followed by fungicide at 5-leaf and at heading to consider in addition to the soil chloride treatments.

### Summary

Heading applications of chloride were not effective in affecting scab in winter wheat. Soil application of chloride from calcium chloride reduced leaf diseases at one site. Although calcium chloride increased yield at the spring wheat site, this result may not be credible. Future work will examine both chloride and copper and the interaction with foliar and heading applied fungicide on winter and spring wheat.

### Acknowledgements

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