

Variety responses to intensive fungicide management in the State Variety Trials

New information to use when making variety decisions.

Jochum Wiersma and James Anderson

Objectives

- ★ Evaluate attainable grain yield of HRSW varieties in the State Variety Trials by controlling biotic stresses caused by fungal pathogens and insects with appropriate fungicides and insecticides.
- ★ Determine whether the variety by management interactions are large enough that they result in rank changes of the varieties.

UNIVERSITY OF MINNESOTA

Extension

S E R V I C E

Materials & Methods

★ Locations:

- Morris
- Crookston
- Roseau

★ Experimental design:

- Split-plot design with 3 replications.
- Split plot treatment: HRSW varieties
- Whole plot treatment:
 - ‘Intensive’ - with fungicides and/or insecticides
 - ‘Conventional’ - without

Materials & Methods

★ Fungicide treatments:

- Feekes 5 - 5 fl. oz/A Stratego.
- Feekes 9 - 4 fl. oz/A Tilt.
- Feekes 10.51 - 4 fl. oz/A Folicur.

★ Insecticide treatment:

- Penncap at labeled rate if aphids or other insect pests exceeded economic thresholds.

Data Analysis - 2004

Table 1 P-values of the variety x management interaction term in the analysis of variance of individual locations and the combined across locations.

<i>Trait</i>	<i>Morris</i>	<i>Crookston</i>	<i>Roseau</i>	<i>Combined</i>
Grain Yield	0.002	0.001	0.000	0.000
Test Weight	ns*	0.000	0.019	0.000
Grain Protein	ns	0.001	0.097	ns

* Not significant at $p=0.1$.

Table 2 T-test values of Spearman's rank correlation coefficients.

<i>Trait</i>	<i>Morris</i>	<i>Crookston</i>	<i>Roseau</i>	<i>Combined</i>
Grain Yield	-0.862	1.778	1.542	-0.793
Test Weight	1.851	7.032*	6.812*	6.294*
Grain Protein	1.864	4.524*	7.893*	5.289*

* Significant at $p=0.05$.

Data Analysis - 2005

Table 3 P-values of the variety x management interaction term in the analysis of variance of individual locations and the combined across locations.

<i>Trait</i>	<i>Morris</i>	<i>Crookston</i>	<i>Combined</i>
Grain Yield	0.025	0.001	0.008
Test Weight	0.002	ns	ns
Grain Protein	ns	0.008	0.013

Table 4 T-test values of Spearman's rank correlation coefficients.

<i>Trait</i>	<i>Morris</i>	<i>Crookston</i>	<i>Combined</i>
Grain Yield	0.307	3.677*	4.248*
Test Weight	9.361*	10.684*	8.110*
Grain Protein	5.948*	4.631*	7.333*

* Significant at $p=0.05$.

Variety	Crookston				Morris			
	Conventional		Intensive		Conventional		Intensive	
	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank
	bu/A		bu/A	bu/A		bu/A		bu/A
Alsen	61.3	14	64.4	14	46.2	7	40.8	22
Banton	59.3	19	65.7	10	45.9	8	42.7	19
Briggs	60.4	16	68.1	7	51.5	2	43.4	18
Dapps	59.6	18	57.2	23	38.5	16	39.4	23
Express	51.1	24	55.8	24	39.9	15	21.6	25
Freyr	68.9	5	63.3	16	43.1	11	48.2	12
Glenn	64.1	9	65.3	12	37.8	17	41.6	20
Granger	72.9	2	73.1	4	42.0	13	49.3	9
Granite	67.8	6	68.7	6	35.9	21	48.7	11
Hanna	64.7	8	66.2	9	37.3	19	44.7	15
Knudson	71.9	3	70.2	5	47.9	4	51.2	7
Marshall	56.6	21	74.0	3	21.8	25	46.5	14
Mercury	60.0	17	65.0	13	65.4	1	62.1	1
Norpro	63.0	10	64.3	15	40.9	14	51.4	4
Oklee	67.7	7	62.5	17	37.3	20	48.8	10
Oxen	62.0	11	59.6	20	32.5	24	52.0	3
Parshall	53.5	22	57.9	22	37.7	18	41.3	21
Polaris	76.5	1	84.0	1	33.8	22	51.3	5
Reeder	51.1	25	55.3	25	33.1	23	44.7	16
Saturn	70.0	4	79.9	2	43.5	10	52.7	2
Steele-ND	62.0	12	58.9	21	43.7	9	39.2	24
Trooper	59.0	20	62.4	18	47.9	3	47.3	13
Ulen	60.9	15	65.5	11	42.2	12	44.1	17
Walworth	61.3	13	66.5	8	47.6	5	49.4	8
Mean	62.3		65.4		41.6		46.1	
LSD 0.05	4.0		4.0		9.0		9.0	

UNIVERSITY OF MINNESOTA

Extension

S E R V I C E

Grain Yield (Bu/A)
2004 2005

Variety	Con ¹	Int ¹	Con	Int
Alsen	88	90	53	56
Banton	92	92	53	57
Briggs	94	94	56	59
Dapps	91	86	50	51
Express	–	–	48	43
Freyr	87	92	58	58
Glenn	–	–	51	57
Granger	90	89	59	65
Granite	87	100	56	62
Hanna	81	94	53	59
HJ98	87	100	–	–
Ingot	81	88	–	–
Knudson	93	96	61	64
Marshall	71	96	39	64
Mercury	94	108	63	65
Norpro	83	100	53	60
Oklee	88	94	55	58
Oxen	89	94	48	58
P 2375	89	93	–	–
Parshall	80	93	46	52
Polaris	90	96	57	72
Reeder	88	98	43	52
Saturn	88	92	57	70
Steele-ND	88	87	52	52
Trooper	77	105	54	57
Ulen	–	–	52	58
Verde	90	93		
Walworth	80	96	56	61
Mean	86.6	94.6	53.1	58.7
LSD	6.2	6.2	7.1	7.1

Discussion

★ Yield responses to fungicides:

- 2004 - across locations and varieties 8 bu/A
- 2005 - across locations and varieties 6 bu/A

★ Rank correlation for grain yield:

- In 4 out of 5 environments rank correlation non significant
- Use of fungicides results in rank changes

★ Examples:

- | | |
|------------|------------------------------|
| – Trooper | Powdery mildew in Roseau '04 |
| – Trooper | Stripe rust in Morris '04 |
| – Oxen | Leaf rust in Morris '05 |
| – Marshall | Leaf rust in Morris '05 |

Conclusion

- ★ Trials will be continued.
- ★ Results will be included in Minnesota Variety Trials Bulletin.

UNIVERSITY OF MINNESOTA

Extension

S E R V I C E

Late Season in HRSW



Jochum Wiersma & Albert Sims

The Issues

- ★ Increased cost of N fertilizer.

- ★ Grain protein matters in HRSW.

- ★ Interest in split applications of N.
 - To reduce tillering & lodging
 - To increase grain protein content

UNIVERSITY OF MINNESOTA

Extension

S E R V I C E

Late Season N

- ★ Late season applications of nitrogen have been standard practice for the past two decades in winter wheat production in England, Denmark, the Netherlands and northern Germany.
- ★ The most common practice is application a dry fertilizer just before heading.

UNIVERSITY OF MINNESOTA

Extension

S E R V I C E

Late Season N

- ★ In our region both NDSU and University of Minnesota have done work on late applications of nitrogen to enhance grain quality:
 - Greg Endres and Bill Schatz at the Carrington Experiment Station.
 - John Wiersma at the Northwest Research & Outreach Center.
 - Jochum Wiersma at the Northwest Research & Outreach Center.

Endres & Schatz. (1994)

★ Materials & Methods:

- Crop planted with 100 lb N/A available.
- Foliar nitrogen applied with 1:1 solution of water and UAN at 0, 15 and 30 lbs N/A right after anthesis.
- HRSW - Gus, Grandin, Kulm, 2375, Norm, and Krona.
- Durum - Monroe and Renville.

UNIVERSITY OF MINNESOTA

Extension

S E R V I C E

Agronomic Traits

<i>Rate</i>	<i>Leaf Burn</i>	<i>1000 KWT</i>	<i>Test Weight</i>	<i>Grain Yield</i>	<i>Grain Protein</i>
0	0.0	30.3	58.5	39.5	12.5
15	11.3	30.3	58.1	41.1	13.1
30	21.1	29.8	57.9	39.7	13.7
LSD	5.4	NS	NS	NS	0.6

UNIVERSITY OF MINNESOTA

Extension

S E R V I C E

Leaf Burn

<i>Cultivar</i>	<i>0</i>	<i>15</i>	<i>30</i>
Kulm	0.0	13.0	30.0
Grandin	0.0	20.0	28.8
P2375	0.0	10.8	18.8
Norm	0.0	8.8	17.5
Monroe	0.0	9.5	17.5
Renville	0.0	10.5	20.0

UNIVERSITY OF MINNESOTA

Extension

S E R V I C E

Results

- ★ Significant leaf burning using UAN with differences between cultivars.
- ★ No significant differences between cultivars for response to foliar nitrogen.
- ★ No significant responses for grain yield, test weight, and kernel weight to foliar nitrogen.
- ★ About 30 lbs N/ percentage point protein.

John Wiersma (1993)

★ Materials and Methods:

- Crop planted with 150 lbs N/A available;
- Nitrogen application methods:
 - 30, 60, 90, 120 lbs N/A as urea granules at planting.
 - 30, 60, 90, 120 lbs N/A as urea solution one week after anthesis applied to soil.
 - 30, 60, 90, 120 lbs N/A as urea solution in four applications every four days beginning one week after anthesis applied foliar (22 gal/A).

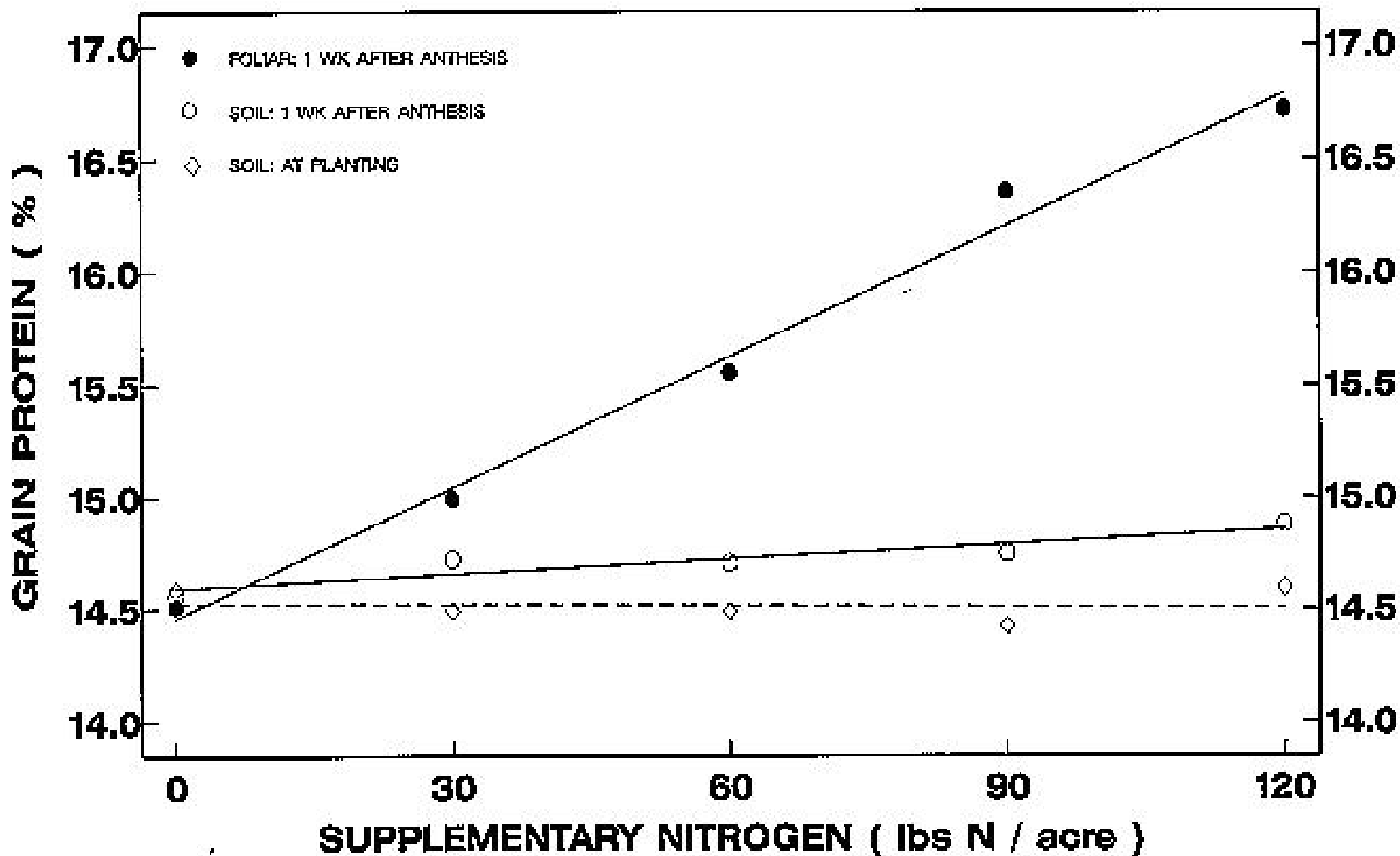


FIG. 1. CHANGES IN GRAIN PROTEIN CONCENTRATION WITH INCREASING N RATE: COMPARISON OF METHODS / TIMING OF N APPLICATION, CROOKSTON, 1993. (N APPLIED IS IN ADDITION TO 150 LBS N FROM SOIL + FALL-APPLIED N).

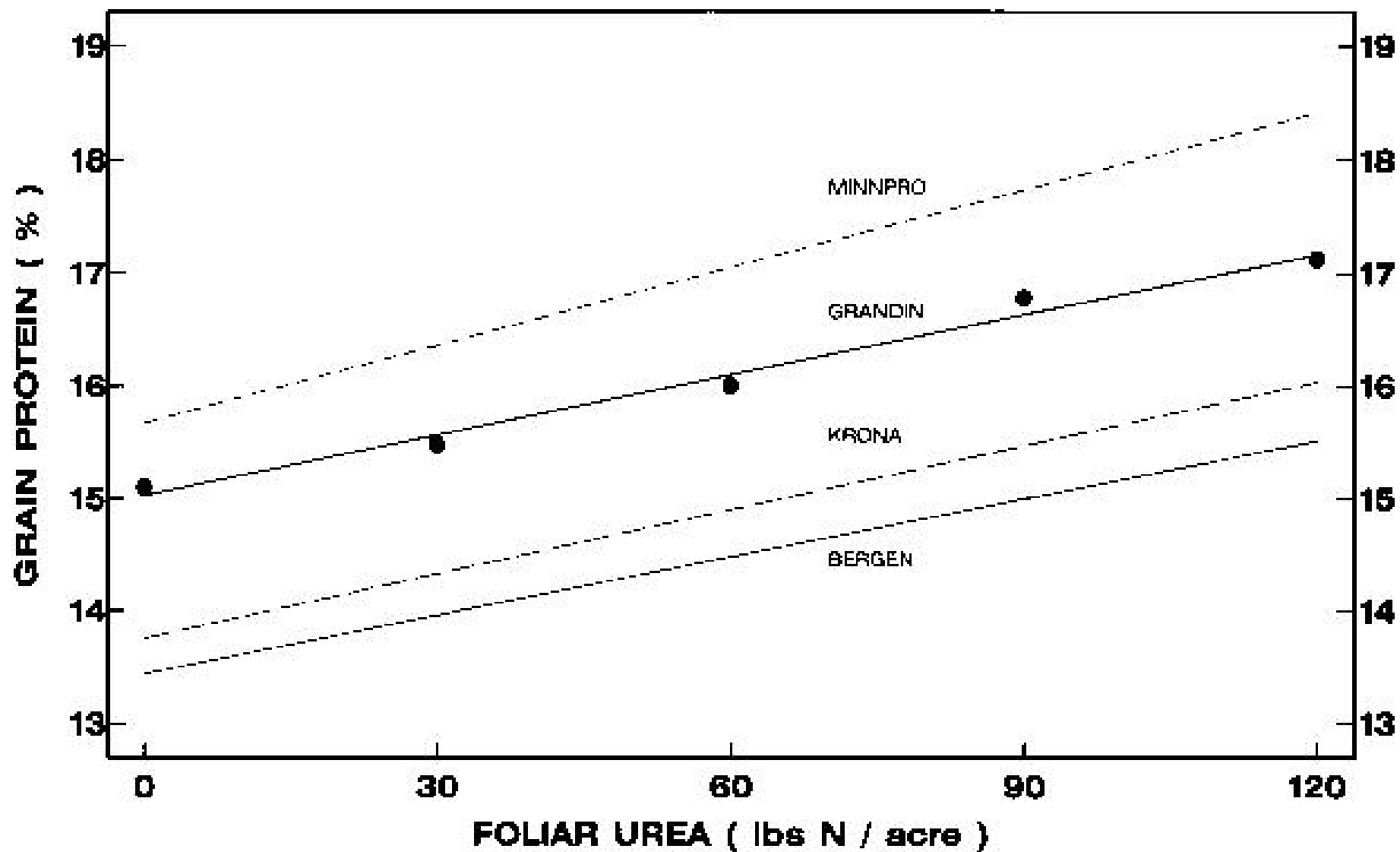


FIG. 3. GRAIN PROTEIN RESPONSES OF FOUR HRSW VARIETIES TO FOLIAR UREA APPLIED SEQUENTIALLY, BEGINNING ABOUT ONE WEEK AFTER ANTHESIS, CROOKSTON, 1993. (N APPLIED IS IN ADDITION TO 160 LBS N FROM SOIL + FALL-APPLIED N).

Results

- ★ No leaf burning.
- ★ No differences between cultivars.
- ★ No response in test weight, kernel weight or grain yield to additional N when applied either at planting or to soil at anthesis.
- ★ Non-protein dry matter decreases as protein dry matter increases whilst kernel weight doesn't change.
- ★ About 60 lbs N/ percentage point protein.

Jochum Wiersma (2005)

★ Materials and Methods:

- RCB with 3 replication (90ft strips across the field)
- Treatments:
 - 1) Control.
 - 2) 30 lbs N/A stream bar at GS 59.
 - 3) 30 lbs N/A foliar at GS 59+7d.
 - 4) 15 lbs N/A SB at GS 59 + 15 lbs N/A foliar at GS 59+7d.
 - 5) 15 lbs N/A foliar at GS 59 +7d + 15 lbs N/A foliar at GS 59+12.
- UAN:water = 1:1 (Ross Farms) or UAN:water = 1:2 (AWG Farms).

Materials & Methods

★ Yield:

- Yield monitors

★ Grain Protein:

- AWG Farms - Zeltec grain protein monitor
- Ross Farms - ‘Stuck in the hopper’



Lo282 2005

Protein

Yield

Trooper

Avg Yield 65.0
Avg Protein 13.8

Lars

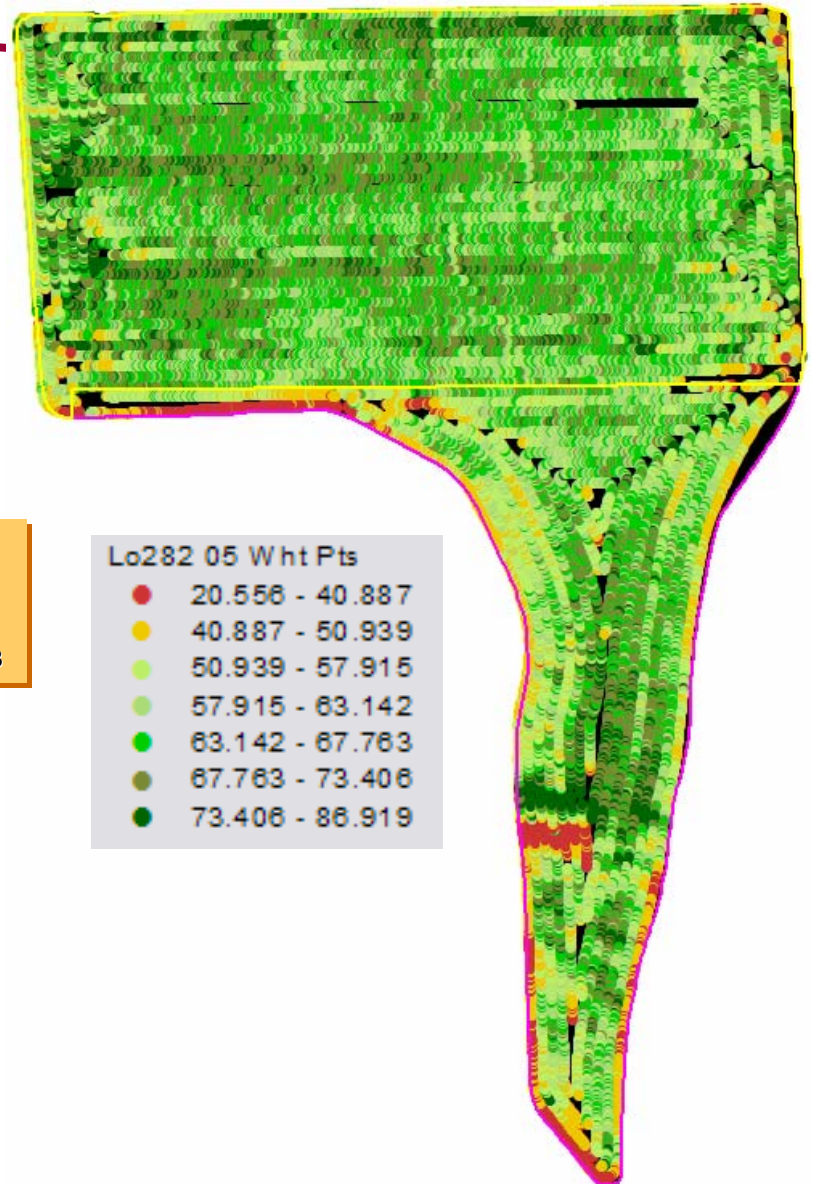
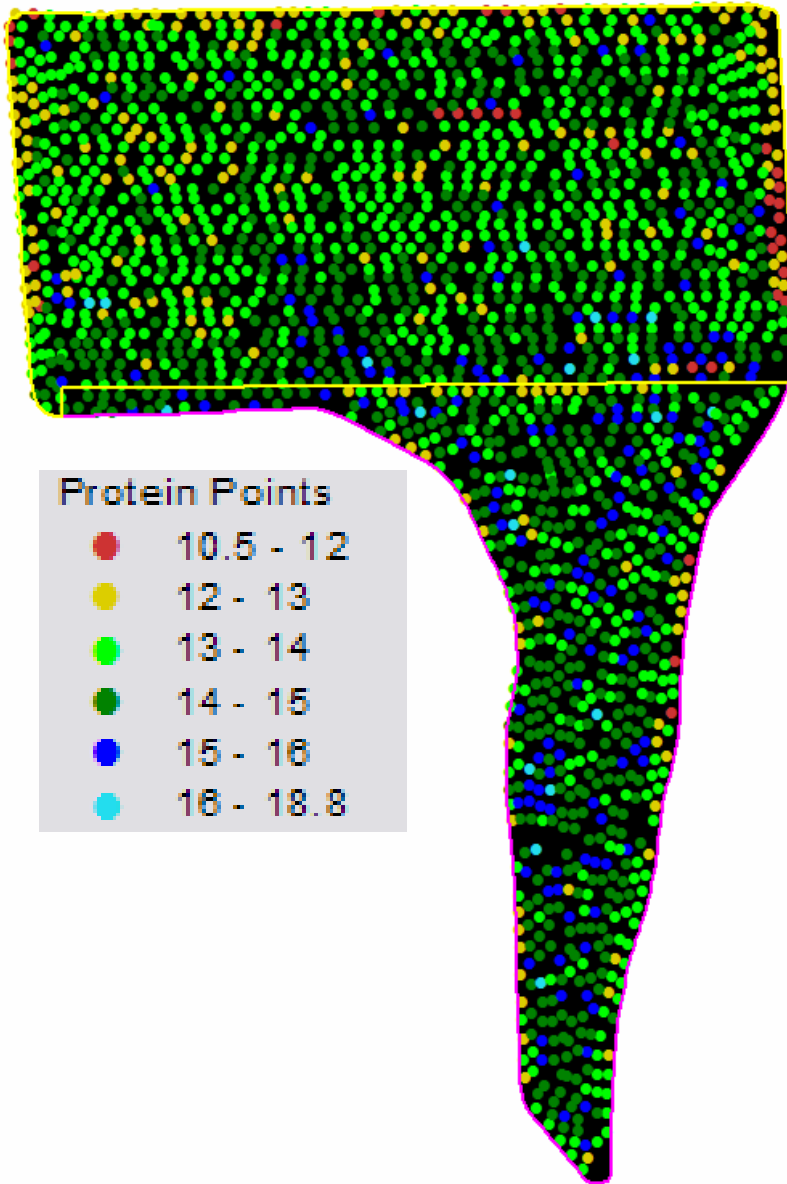
Avg Yield 58.8
Avg Protein 14.3

Protein Points

- 10.5 - 12
- 12 - 13
- 13 - 14
- 14 - 15
- 15 - 16
- 16 - 18.8

Lo282 05 Wht Pts

- 20.556 - 40.887
- 40.887 - 50.939
- 50.939 - 57.915
- 57.915 - 63.142
- 63.142 - 67.763
- 67.763 - 73.406
- 73.406 - 86.919





Lo282 Treatment

30# Foliar

15# S / 15# F

30# Stream

2 x 15# Foliar

Check

2 x 15# Foliar

30# Stream

15# S / 15# F

30# Foliar

Check

15# S / 15# F

Check

30# Foliar

30# Stream

2 x 15# Foliar

Protein

Treatment

Avg Pro

Min Pro

Max Pro St Dev

Frequency

30# Foliar

13.30

11.40

15.30

0.70

107.00

15# S / 15# F

13.80

12.40

15.60

0.70

103.00

30# Stream

13.90

12.30

15.30

0.60

79.00

2 x 15# Foliar

13.90

12.50

15.30

0.60

67.00

Check

13.70

12.20

15.10

0.60

36.00

2 x 15# Foliar

13.50

11.90

15.50

0.60

35.00

30# Stream

13.60

12.20

15.10

0.60

103.00

15# S / 15# F

13.90

12.70

15.60

0.60

75.00

30# Foliar

13.80

12.50

15.80

0.60

76.00

Check

14.00

12.90

16.20

0.70

55.00

15# S / 15# F

13.80

13.00

15.50

0.70

36.00

Check

14.00

12.20

15.70

0.70

107.00

30# Foliar

14.00

11.90

16.70

0.90

106.00

30# Stream

14.10

12.80

15.50

0.60

73.00

2 x 15# Foliar

14.40

11.50

16.40

0.90

86.00

Yield

Treatment

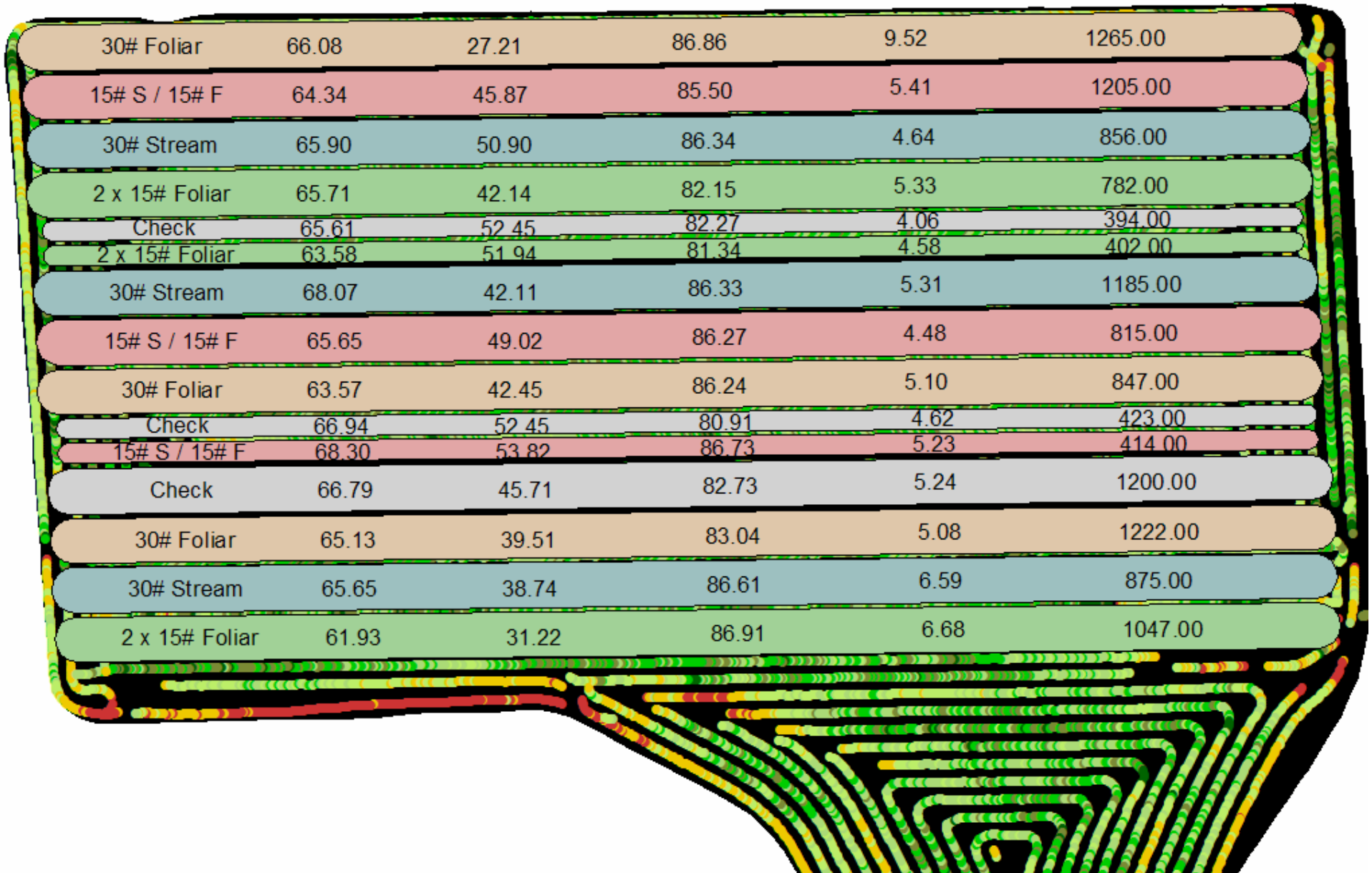
Avg Yield

Min Yld

Max Yld

SDev

Fequency



Treatment	Avg Yield	Min Yld	Max Yld	SDev	Fequency
30# Foliar	66.08	27.21	86.86	9.52	1265.00
15# S / 15# F	64.34	45.87	85.50	5.41	1205.00
30# Stream	65.90	50.90	86.34	4.64	856.00
2 x 15# Foliar	65.71	42.14	82.15	5.33	782.00
Check	65.61	52.45	82.27	4.06	394.00
2 x 15# Foliar	63.58	51.94	81.34	4.58	402.00
30# Stream	68.07	42.11	86.33	5.31	1185.00
15# S / 15# F	65.65	49.02	86.27	4.48	815.00
30# Foliar	63.57	42.45	86.24	5.10	847.00
Check	66.94	52.45	80.91	4.62	423.00
15# S / 15# F	68.30	53.82	86.73	5.23	414.00
Check	66.79	45.71	82.73	5.24	1200.00
30# Foliar	65.13	39.51	83.04	5.08	1222.00
30# Stream	65.65	38.74	86.61	6.59	875.00
2 x 15# Foliar	61.93	31.22	86.91	6.68	1047.00

Leaf Burn

<i>Treatment</i>	<i>Field</i>						<i>Mean</i> ¹
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	
1	3.3 ³	0.7	10.0	0.0	0.0	1.7	2.6
2	10.0	36.7	13.3	25.0	23.3	6.7	19.2
3	3.3	25.0	21.7	36.7	10.0	18.3	19.2
4	5.0	6.7	13.3	13.3	16.7	13.3	11.4
5	3.3	8.3	11.7	23.3	20.0	18.3	14.2
Mean ²	5.0	15.5	14.0	19.7	14.0	11.7	13.3

¹ The LSD (0.05) to compare treatments means averaged across fields is 6.0.

² The LSD (0.05) to compare field means averages across treatments is 6.5.

³ The LSD (0.05) to compare treatments means within and across fields is 14.6.

Grain Protein

Table 2 The grain protein percentage as a result of the application of late season supplemental N in 6 HRSW fields nearby Crookston, MN in 2005.

<i>Treatment</i>	<i>Field</i>						<i>Mean¹</i>
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	
1	14.7 ³	15.3	14.0	14.9	13.9	15.5	14.7
2	14.6	15.4	14.4	15.3	13.9	16.3	15.0
3	14.6	15.7	14.4	15.3	13.7	16.2	15.0
4	14.7	15.8	14.7	15.5	13.9	16.4	15.2
5	14.6	15.4	14.4	15.0	13.8	16.5	15.0
Mean ²	14.6	15.5	14.4	15.2	13.8	16.2	15.0

¹ The LSD (0.05) to compare treatments means averaged across fields is 0.2.

² The LSD (0.05) to compare field means averages across treatments is 0.2.

³ The LSD (0.05) to compare treatments means within and across fields is non significant.

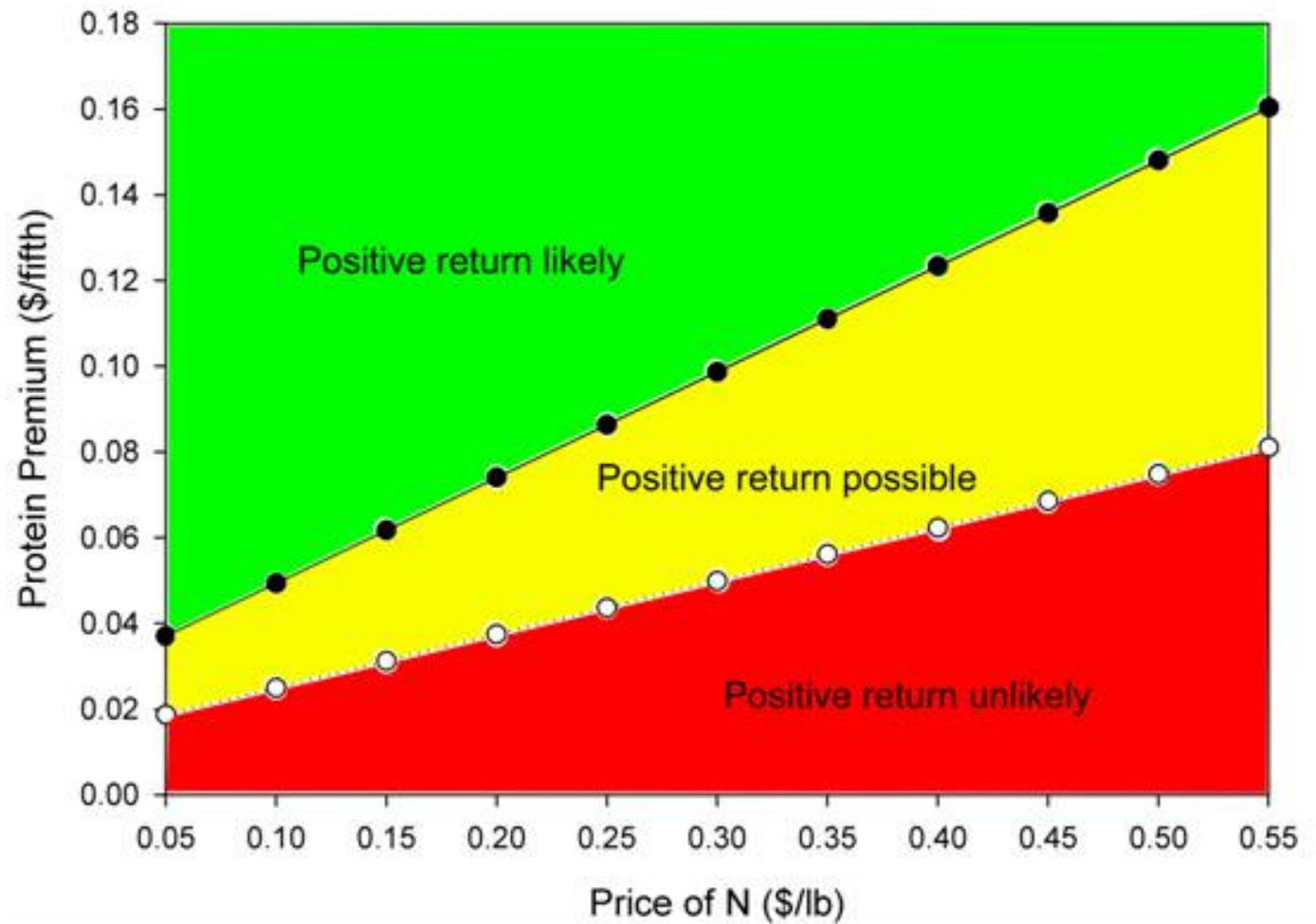
Results

- ★ Significant leaf burning:
 - Split foliar applications reduce risk.
 - Time of day and GPA reduce risk (data not shown).
- ★ No effect on grain yield (data not shown):
- ★ Significant increases in grain protein
 - Split application most effective.
 - About 60 lbs N/ percentage point protein.
 - No response in 2 of the 6 fields

Decision Guide

- ★ The utilization index is between 0.47 and 0.93. This ratios are derived from the two small plot studies.
- ★ The premium/discount per fifth point of grain protein is constant.
- ★ The expected total amount of grain protein to be gained from supplemental N is constant and thus the increase in grain protein percentage is smaller as grain yield increases.
- ★ A single application of 30 lbs. N/A is made with an application cost of \$3.00/A.
- ★ No effects on grain yield, test weight, or kernel weight are expected.

Decision Guide



Acknowledgements

- ★ AWG Farms

- Gary, Wayne and Daryl Wagner

- ★ Ross Farms

- Jim and Jon Ross

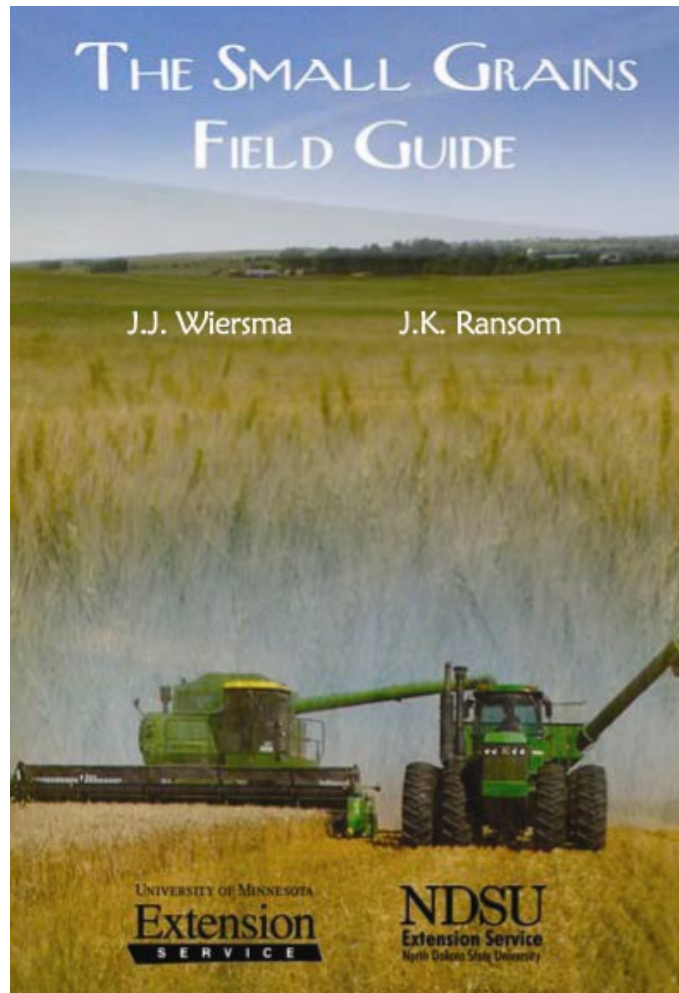
- ★ NDSU

- Terry Gregoire, John Lukach, and Joel Ransom

- ★ Univ. of Minnesota

- George Rehm and Albert Sims

Small Grains Field Guide



★ Updated

★ Jointly with NDSU

★ \$ 12.-

★ Order:

– (800) 876-8636

– (701) 231-1882

– shop.extension.umn.edu

UNIVERSITY OF MINNESOTA
Extension
SERVICE

UNIVERSITY OF MINNESOTA
Extension
SERVICE

NDSU
Extension Service
North Dakota State University