Oakes Irrigation Research Site

Carrington Research Extension Center
North Dakota State University

Garrison Diversion Conservancy District

2012 ANNUAL REPORT

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In addition to the major sponsors: Garrison Diversion Conservancy District and North Dakota State University; we would like to acknowledge and thank the following people and companies for their support of the Oakes Irrigation Research Site.

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RESEARCH PROGRAM

Data on irrigated crop production have been collected for the past 43 years on approximately 20 acres at the Oakes Irrigation Research Site located on the Robert Titus farm. The site is located 4.5 miles south of Oakes adjacent to North Dakota State Highway 1. The objectives of these studies are:

1. Provide irrigators with information that results in efficient crop production.

2. Develop and refine Best Management Practices that are producer acceptable.

3. Promote irrigation development in North Dakota.

4. Determine alternate and specialty crops to be grown under irrigation in North Dakota and develop agronomic practices for their successful adaptation.

A cooperative agreement between North Dakota State University and the Garrison Diversion Conservancy District makes this research effort possible. The University provides technical staff; Walter Albus as research agronomist, Leonard Besemann as research specialist and Heidi Eslinger as research technician. The Garrison Diversion Conservancy District provides most of the financial resources. North Dakota State University faculty and staff from the departments of Soil Science, Plant Science, Agricultural and Biosystems Engineering, Plant Pathology and the Agricultural Experiment Station participate in conducting experiments at the site.

WEATHER 2012

The winter of 2011 - 2012 was warmer than average with below average snowfall. Spring planting began with barley and wheat March 17. The last frost in the spring was on April 22. Summer temperatures were above average for most of the growing season. The maximum temperature equaled or exceeded 90°F thirty times; once in May, four times in June, sixteen times in July, five times in August and four times in September. The highest temperature was 99°F on August 29. Precipitation was above average in April and below average in the remainder of the growing season. Annual precipitation was more than 6 inches below the long term average. The mean daily temperatures were above average in April, May, June and July; near average in August and September and below average in October. The first frost was September 22 with the first hard frost (≤ 28°F) September 23. All crops reached maturity before frost. Growing degree units in 2012 were above average.

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Table 1. Precipitation and temperature at the Oakes Irrigation Research Site.

	Precipitation			Average daily temperatures		
Month	2012	15-year average	25-year average	2012	15-year average	25-year average
	----------inches----------			----------°F----------		
April	3.57	1.65	1.61	47	45	44
May	2.20	3.30	2.94	59	57	57
June	1.64	4.59	3.89	69	66	67
July	2.33	3.07	3.25	76	72	71
August	1.06	2.38	2.20	68	69	69
September	0.22	2.79	2.83	59	60	60
October	1.57	2.10	1.95	43	46	46

Table 2. Growing degree units[1] at the Oakes Irrigation Research Site.

Month	2012	10-year average	15-year average	25-year average
May	346	295	302	315
June	572	494	492	503
July	755	660	663	635
August	559	577	586	584
September	395	371	372	367
Total	2625	2397	2414	2403

[1]Growing degree units = $(Temp_{max} + Temp_{min})/2 - 50$. If $Temp_{max}$ is greater than 86, then $Temp_{max} = 86$. If $Temp_{min}$ is less than 50, then $Temp_{min} = 50$. Temperature is in degrees F.

Table 3. Dates of last and first frosts.

	2012	10-year average	15-year average	25-year average
Last frost in Spring				
32 °F or less	22-Apr	3-May	30-Apr	4-May
28 °F or less	11-Apr	23-Apr	24-Apr	27-Apr
First frost in Fall				
32 °F or less	22-Sep	3-Oct	2-Oct	30-Sep
28 °F or less	23-Sep	10-Oct	7-Oct	6-Oct
Frost free period (days)	153	154	155	150

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Table 4. Irrigation water applied, 2012.

Study	Irrigation water applied
	inches
Barley variety trial	8.0
Dry edible bean trials	
Misc and navy bean	14.4
Pinto bean	11.5
Energy beet variety trial	19.1
Field corn hybrid performance trial	17.8
Field corn variety and row width study	16.4
Hard red spring wheat variety trial	8.5
Hard red spring wheat nitrogen study	7.5
Onion hybrid performance trial	16.9
Onion weed control study	15.1
Optimum corn stover removal for bio-fuel	
corn on corn	14.5
corn on soybean	14.5
soybean on corn	14.5
Potato trials	17.8
Soybean nursery	
conventional experimental lines	16.0
conventional advanced breeding lines	15.4
Soybean variety performance trials	
conventional	14.7
roundup ready	14.7
Strip-till sugarbeet hybrid performance trial	19.8
Strip-till	
corn on soybean	15.0
soybean on corn	15.5
corn on corn	16.7
Sunflower head rot study*	6.8

*Received additional irrigation via the misting system

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Barley Variety Trial

W. Albus, L. Besemann and H. Eslinger

Irrigation allows better nitrogen(N) utilization in malting barley which enhances grain quality. Intense management in barley including; plant population, seeding depth, disease control, nitrogen rate and timing have made great strides in increasing yield levels of quality grain.

The objective of this study is to find barley varieties that are viable in irrigated cropping systems in Southeastern, ND and to develop and demonstrate agronomic practices that promote barley production.

MATERIALS AND METHODS

Soil:	Maddock sandy loam; pH 7.4; 1.7 % organic matter; soil-N 18 lbs/acre; soil-P, soil-K and soil-S were very high.
Previous crop:	2011 – Soybean.
Seedbed preparation:	Spring no-tilled with a Seedmaster drill.
Planting:	Planted on March 17 with a Seedmaster drill. Planting rate was 2.8 bu/acre (1,400,000 seeds/acre).
Plots:	Plots were 76 ft long by 10 ft wide.
Fertilizer:	At planting 25 lbs N/acre, 39 lbs P_2O_5/acre, 48 lbs K_2O/acre, 19 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1 with a separate shank ¾" to the side and ½" below the seed. Stream bar applied 76 lbs N/acre April 16 as 28-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Wolverine (1.7 pt/acre) April 30, Headline (6 oz/acre) May 3 and Tilt (4 oz/acre) May 18.
Harvest:	July 11 with a Hege plot combine. Harvest area was five feet wide and 76 feet in length.

RESULTS

Three six-row malting barley varieties: Lacey, Stellar-ND, and Tradition have been tested for seven years under irrigation at this site. Their medium-short stature and strong to very strong straw strength resist lodging. These three varieties have averaged 110.6 bu/acre and 12.0% protein over this seven year period.

Table 1. Barley variety trial at the Oakes Irrigation Research Site in 2012.

Variety	Days to Head	Plant Lodge[1]	Plant Height	Plump >6/64	Thin <5/64	Grain Protein 2012	Grain Protein 3-yr Avg.	Test Weight	Grain Yield 2012	Grain Yield 2-yr Avg.	Grain Yield 3-yr Avg.
		0-9	inch	%	%	------%-------		lb/bu	----------%----------		
Tradition	59.8	--	37.0	94.2	0.6	10.6	12.6	47.4	84.9	96.8	101.6
Lacey	60.0	--	36.5	91.1	1.4	10.8	10.8	47.7	100.1	100.1	100.1
Celebration	60.8	--	39.0	88.5	1.6	11.0	11.0	46.5	100.8	100.8	100.8
Stellar-ND	61.0	--	37.5	93.4	0.8	10.8	10.8	45.6	93.3	93.3	93.3
ND22421	59.5	--	33.5	91.7	1.4	10.7	10.7	46.6	91.9	91.9	91.9
MEAN	60.2		36.7	91.8	1.2	10.8		46.8	94.2		
CV %	2.3		2.5	2.1	44.2	2.7		1.2	6.0		
LSD.05	NS		1.4	2.9	NS	NS		0.8	8.7		

[1]Lodging not significant to measure.

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Dry Edible Bean Variety Trials

W. Albus, L. Besemann and H. Eslinger

Dry edible beans play a significant role in irrigated rotations in southeastern ND. As universities and private companies develop new varieties it is important to test them upon their release. Many producers have gone to direct harvesting of pinto beans. Pinto beans have historically been knifed, windrowed, and harvested with a bean combine. Therefore it is important to test determinate, upright, short vine pinto varieties that facilitate direct harvesting and compare their yield to the upright vine and vine types.

MATERIALS AND METHODS

Soil: Pinto bean - Maddock sandy loam; pH 7.1; 1.7 % organic matter; soil-N 27 lbs/acre, soil-P was very high, soil-K was high.

Navy and misc bean - Maddock sandy loam and Hecla sandy loam: pH 7.3; 2.0 % organic matter; soil-N 25 lbs/acre; soil-P and soil-K were very high.

Previous crop: Pinto bean: 2011 – field corn. Navy and misc bean: 2011 – field corn and wheat.

Seedbed Preparation: Spring conventional tillage.

Planting: Planted May 29.

Plots: Plots were 17 ft long by 5 ft (2 rows) wide. There were 4 reps.

Fertilizer: March 22 broadcast 26 lbs N/acre, 41 lbs P_2O_5/acre, 49 lbs K_2O/acre, 20 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1.

Irrigation: Overhead sprinkler irrigation as needed.

Pest control: Endura (11 oz/acre) July 11, July 18 and July 25 for disease control. Sevin (1.5 qt/acre) July 25 for insect control. Section 2EC(10 oz/acre) + COC (1% v/v) June 8 (pinto only), cultivation and hand weed for weed control.

Harvest: Hand harvested when mature. Pinto bean August 27, navy bean August 28 and misc bean September 4 except for Merlot and Sedona matured September 13. Harvest area for all bean varieties was: seventeen feet of two rows. Beans were threshed with a stationary plot thresher.

Table 1. Pinto Bean Variety Trial at the Oakes Irrigation Research Site in 2012.

Variety	Days to PM	Seed Weight	Test Weight	Yield 2012
		gram/100	lb/bu	lb/ac
LaPaz	87	37.4	63.2	3340
Lariat	90	42.8	61.7	3411
Stampede	82	36.6	61.3	2923
Maverick	88	42.0	61.5	3002
ND-307	86	43.0	60.1	3258
Medicine Hat	78	35.2	61.3	2274
Windbreaker	84	39.4	61.1	3125
ND020351-R	86	37.7	60.4	2731
MEAN	85	39.2	61.3	3008
C.V.%	2.4	5.2	1.1	15.0
LSD .05	3.0	3.0	1.0	662.5

Table 2. Navy Bean Variety Trial at the Oakes Irrigation Research Site in 2012.

Variety	Days to PM	Seed Weight	Test Weight	Yield 2012
		gram/100	lb/bu	lb/ac
HMS Medalist	90	16.2	65.6	2205
Avalanche	85	18.4	65.5	2341
Ensign	83	17.2	66.1	2478
Vista	91	17.4	66.1	2327
T9905	90	20.5	65.8	2855
Norstar	87	16.5	66.3	1573
Navigator	87	16.3	64.4	2254
MEAN	87	17.5	65.7	2290
C.V.%	1.9	3.7	1.4	9.2
LSD .05	2.4	1.0	NS	313

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Table 3. Misc Bean Variety Trial at the Oakes Irrigation Research Site in 2012.

Variety	Days to PM	Seed Weight	Test Weight	Yield 2012
		gram/100	lb/bu	lb/ac
Eclipse	86	22.1	64.0	3764
Zorro	86	22.1	65.4	3999
Merlot	100	43.9	63.4	4072
Sedona	103	43.1	58.6	4330
Carman Black	86	22.6	61.7	3292
Loreto	90	20.3	65.6	3851
Fuji	87	30.0	66.2	4520
Hime	92	30.3	67.2	3960
Erimo	96	11.1	66.3	3193
MEAN	92	27.3	64.3	3887
C.V.%	3.3	2.5	1.0	7.9
LSD .05	4	1.0	0.9	449

Corn Hybrid Performance Trial

W. Albus, L. Besemann and H. Eslinger

Corn for grain commands the most irrigated acres of all crops in North Dakota. The fact that significant differences in the accumulation of growing degree units for corn and other weather related issues exist across the state, it is vital that corn hybrids be tested in specific locations and regions. It is the goal of this trial to provide yield and other agronomic parameters for corn growers in southeastern, North Dakota.

MATERIALS AND METHODS

Soil:	Embden loam; pH=7.3; 2.3 % organic matter; soil-N 60 lbs/acre; soil-P and soil-K were very high.
Previous crops:	2011 – Barley and wheat.
Seedbed preparation:	Spring strip till.
Planting:	Planted May 1 in 30-inch rows. Thinned to 36,900 plants/acre.
Fertilizer:	March 22 broadcast 26 lbs N/acre, 41 lbs P_2O_5/acre, 49 lbs K_2O/acre, 20 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1. Dribble 53 lbs N/acre and 18 lbs S/acre as 28-0-0 and 15-0-0-20 April 26. Sidedress 155 lbs of N/acre as 28-0-0 June 5.
Irrigation:	Overhead sprinkler irrigation as needed
Pest Control:	Roundup (30 oz/acre) + AMS (14 lbs/100 gal) April 26 and Harness (1 pt/acre) + Lumax (1 pt/acre) + Atrazine (0.5 lb/acre ai) May 3.
Harvest:	October 11 with a plot combine. Harvest area was two rows 17 feet long

Table 1. Corn hybrid performance trial at the Oakes Irrigation Research Site in 2012.

Brand	R.M.	Hybrid	Silk Date	Ear Height	Plant Height	Root[3] Lodged	Grain Protein	Grain Starch	Grain Oil	Harvest Moisture	Test Weight	Grain Yield[1] 2012	Grain Yield[1] 2-yr[2] Avg.
				inch	inch	0-9	%	%	%	%	lb/bu	----bu/ac----	
Ag Venture	84	2774 RR/BT	7/10	51	99	0.5	9.0	72.3	3.4	13.8	58.8	247.2	
Ag Venture	87	3349 Viptera	7/14	52	97	1.5	9.0	73.0	3.2	16.0	59.6	239.2	
Ag Venture	92	4342 3000GT	7/15	57	102	2.0	9.7	72.8	2.8	15.1	60.4	253.1	
Ag Venture	95	4802 RL/HBW	7/12	54	102	0.0	9.0	72.5	3.2	14.6	59.0	261.0	
Ag Venture	101	5925 RB/HBW	7/16	55	103	2.3	9.5	71.8	3.5	16.0	60.1	264.6	
Channel Brand	99	199-29STX	7/16	52	100	1.8	9.6	71.8	3.4	15.6	60.0	260.0	
Dairyland Seed	91	DS9291SSX	7/16	52	100	0.8	9.3	72.4	3.2	14.5	58.5	262.8	
Dairyland Seed	92	DS9992 VT3	7/14	49	98	0.8	9.1	72.0	3.5	14.1	60.8	224.1	
Dairyland Seed	102	DS9402SSX	7/18	56	100	0.0	9.3	72.2	3.4	15.9	57.5	242.3	
Dairyland Seed	98	DS1803 Conventional	7/15	51	101	0.0	9.4	72.2	3.4	15.9	57.7	286.2	
Dekalb	93	DKC43-48 GENVT3P	7/14	52	101	0.3	9.4	72.3	3.2	13.9	60.2	239.0	
Dekalb	96	DKC46-20 GENVT3P	7/14	51	99	1.0	9.5	71.7	3.4	15.0	61.7	244.6	
Dekalb	98	DKC48-12 RIB	7/15	51	100	0.0	8.7	72.3	3.5	15.3	58.4	267.2	
Dyna-Gro Seed	94	D34VP52 GENVT3P	7/15	49	96	0.0	9.1	72.2	3.2	15.3	60.3	255.7	
Dyna-Gro Seed	95	D35VP40 GENVT3P	7/14	51	97	1.3	9.6	71.9	3.4	15.0	59.3	258.8	
Dyna-Gro Seed	97	D37VP71 GENVT3P	7/14	51	99	0.0	10.3	71.3	3.3	15.4	60.3	279.8	
G2 Genetics	97	5X-895 AMXtra	7/15	54	101	0.0	9.8	72.8	2.7	14.6	58.3	260.5	
G2 Genetics	97	5H-797 AgrisureRW	7/15	54	101	0.3	9.0	72.7	3.2	14.8	59.0	252.4	
G2 Genetics	98	5Z-198 AMXtra	7/16	57	103	0.5	9.5	72.8	2.9	15.1	56.2	270.1	
Mean			7/14	52	100	0.8	9.4	72.3	3.2	15.3	59.6	257.7	
CV%				4.1	2.9	113.9	2.2	0.5	5.2	3.3	0.8	5.9	
LSD.05				3	4	1.2	0.3	0.5	0.2	0.7	0.6	21.4	

[1]Yield calculated @15.5% moisture.

[2]Corn significantly green snapped in 2011, making 2 yr averages meaningless.

[3]0 = erect, 9 = flat.

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Table 1. Corn hybrid performance trial at the Oakes Irrigation Research Site in 2012.

Brand	R.M.	Hybrid	Silk Date	Ear Height	Plant Height	Root[3] Lodged	Grain Protein	Grain Starch	Grain Oil	Harvest Moisture	Test Weight	Grain Yield[1] 2012	Grain Yield[1] 2-yr[2] Avg.
				inch	inch	0-9	%	%	%	%	lb/bu	----bu/ac----	
G2 Genetics	99	3H-399 AgrisureRW	7/16	58	101	0.0	9.4	72.3	3.2	15.3	57.7	309.5	
G2 Genetics	100	5X-0004 AMXtra	7/16	50	98	0.3	9.0	72.8	3.2	16.3	55.0	282.4	
G2 Genetics	96	5H-696 AgrisureRW	7/15	54	98	0.0	9.0	72.5	3.2	15.5	59.4	261.4	
Garst	92	89T43 3000GT	7/14	59	106	1.0	9.0	72.9	3.1	14.3	59.9	285.0	
Garst	96	88A69 3000GT	7/15	55	101	1.0	9.6	72.0	3.3	15.3	58.0	247.2	
Garst	101	87P52 3000GT	7/16	55	106	1.5	9.4	72.6	3.1	15.5	60.2	270.8	
Hyland Seeds	95	8377 SmartStax	7/16	51	101	0.3	9.4	72.6	3.1	14.8	58.6	267.7	
Integra	95	9455 VT3PRO	7/12	53	100	0.0	9.7	71.6	3.4	14.6	59.2	273.1	
Northstar Genetics	94	94-594 3000GT	7/14	49	99	1.3	9.5	72.0	3.3	14.8	61.3	223.2	
Northstar Genetics	96	96-596 3000GT	7/15	48	97	0.3	9.6	72.8	2.7	15.3	60.3	272.4	
Northstar Genetics	92	90-102 3000GT	7/15	57	103	2.0	9.5	72.2	3.3	14.9	60.6	242.0	
Northstar Genetics	99	99-122 3000GT	7/15	49	96	0.0	9.2	71.8	3.7	15.6	58.6	255.1	
NuTech	97	5N-197 AgrisureGT	7/16	56	103	0.3	9.9	72.2	2.9	14.7	60.4	276.1	
NuTech	98	5N-798 AgrisureGT	7/15	52	100	1.3	9.6	71.8	3.3	15.7	61.1	260.4	
NuTech	101	5N-001 AgrisureGT	7/16	54	104	1.0	8.9	72.8	3.0	16.3	55.8	263.4	
PFS	96	55S96 GENVT3PRO	7/15	47	98	0.3	9.5	72.6	3.0	15.4	59.8	269.7	
PFS	93	75T93 GENVT2 PRO RIB	7/13	50	97	1.0	9.2	71.4	3.6	14.8	60.8	228.8	
PFS	95	76Z95 GENVT2 PRO RIB	7/13	46	97	0.5	8.4	72.6	3.2	15.6	61.3	261.2	
Pioneer	96	P9675AMX	7/14	55	98	0.8	9.1	71.5	3.5	15.1	60.6	249.5	
Pioneer	99	P9917AM1	7/14	53	98	0.0	10.8	70.8	4.0	15.7	60.0	271.9	
Mean			7/14	52	100	0.8	9.4	72.3	3.2	15.3	59.6	257.7	
CV%				4.1	2.9	113.9	2.2	0.5	5.2	3.3	0.8	5.9	
LSD.05				3	4	1.2	0.3	0.5	0.2	0.7	0.6	21.4	

[1]Yield calculated @15.5% moisture.

[2]Corn significantly green snapped in 2011, making 2 yr averages meaningless.

[3]0 = erect, 9 = flat.

Table 1. Corn hybrid performance trial at the Oakes Irrigation Research Site in 2012.

Brand	R.M.	Hybrid	Silk Date	Ear Height	Plant Height	Root[3] Lodged	Grain Protein	Grain Starch	Grain Oil	Harvest Moisture	Test Weight	Grain Yield[1] 2012	Grain Yield[1] 2-yr[2] Avg.
				inch	inch	0-9	%	%	%	%	lb/bu	-----bu/ac-----	
Pioneer	100	P0062XR	7/17	51	97	1.3	9.8	72.9	2.5	15.7	57.6	266.4	
Proseed	90	990 3111GT	7/15	54	93	2.0	9.4	73.2	2.5	15.1	60.5	237.2	
Proseed	91	1191 SS RIB	7/12	47	95	0.0	9.7	72.7	2.7	14.2	59.8	256.2	
Proseed	92	1292 VT2P	7/15	51	101	1.3	8.8	72.6	3.5	13.9	60.2	237.6	
Proseed	95	1295 SS RIB	7/14	51	99	1.0	9.4	72.0	3.4	15.0	61.5	234.7	
Proseed	93	1193VT3P	7/14	47	99	0.5	9.3	72.7	3.1	15.3	61.4	231.9	
QSG	95	QSG 6395 Conventional	7/16	47	94	3.8	9.8	72.5	3.0	20.7	56.9	202.5	
QSG	96	QSG 6396 Conventional	7/15	53	99	0.5	9.5	72.2	3.2	15.5	60.9	267.2	
Renk	94	RK530VT3P	7/13	46	100	0.5	9.4	72.4	3.4	15.0	61.5	220.5	
Renk	93	RK492VT3P	7/11	56	103	0.5	9.2	71.8	3.8	14.0	60.4	255.3	
Renk	95	RK568VT3P	7/14	49	96	0.0	10.4	71.8	3.0	15.3	60.3	269.0	
Seeds 2000	95	9503 VT2P	7/13	51	101	0.3	8.7	73.1	2.8	15.4	61.0	272.0	
Seeds 2000	95	9504 VT3P	7/12	46	95	0.0	10.1	71.6	3.3	15.3	60.7	251.7	
Seeds 2000	99	9902 VP3111	7/16	57	107	1.3	9.7	73.1	2.6	15.6	60.6	265.7	
Thunder Seed	90	6090GT	7/14	56	102	1.0	9.7	71.7	3.3	15.1	59.9	273.2	
Wensman	96	W7268VT3	7/15	51	100	1.8	9.6	71.9	3.4	15.2	59.8	244.2	
Wensman	98	W9288VT3PRO	7/16	53	102	1.3	9.2	72.2	3.1	16.0	58.8	276.1	
Wensman	99	W 290VT3PRO	7/14	53	100	0.5	9.8	72.4	2.9	15.7	60.9	269.5	
Wensman	101	W 7320VT3PRO	7/15	52	99	0.8	10.1	72.5	2.7	16.6	59.4	272.5	
Wensman	97	W 7270VT3PRO	7/13	52	99	0.3	9.6	72.0	3.3	15.0	60.3	259.4	
Mean			7/14	52	100	0.8	9.4	72.3	3.2	15.3	59.6	257.7	
CV%				4.1	2.9	113.9	2.2	0.5	5.2	3.3	0.8	5.9	
LSD.05				3	4	1.2	0.3	0.5	0.2	0.7	0.6	21.4	

[1]Yield calculated @15.5% moisture.

[2]Corn significantly green snapped in 2011, making 2 yr averages meaningless.

[3]0 = erect, 9 = flat.

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Corn Hybrid Performance Trial – Dryland

A dryland corn hybrid performance trial was initiated in 2011 to provide information for corn producers in southeast and south central ND. This study is conducted on Barnes-Svea soils that dominate the dryland farming in the area.

Table 2. Corn hybrid performance trial (dry land) at Dickey County Fullerton, ND - Oakes Irrigation Research Site in 2012. (Page 1 of 3)

Brand	R.M.	Hybrid	Harvest Moisture	Test Weight	Grain Yield[1] 2012	Grain Yield[1] 2-yr Avg.
			%	lb/bu	bu/ac	bu/ac
Channel Brand	92	192-09VT3P	13.2	55.7	125.7	
Channel Brand	93	193-35VT3P	13.7	59.3	128.7	
Channel Brand	96	196-06VT3P	13.4	56.0	118.7	139.6
Channel Brand	97	197-67VT3P	14.4	58.2	136.5	
Dairyland Seed	91	DS9291SSX	13.9	56.5	141.5	150.4
Dairyland Seed	92	DS9992	12.5	57.3	171.9	169.3
Dairyland Seed	95	DS9395SSX	13.4	57.1	142.9	
Dairyland Seed	94	DS9402SSX	16.4	55.8	134.5	
Dekalb	96	DKC46-20	14.3	59.5	145.1	
Dekalb	93	DKC43-48	13.3	56.6	132.4	
Dekalb	88	38-03VT2PRO	13.0	55.9	125.3	
Dyna-Gro Seed	94	D34VP52	14.0	57.1	139.4	
Dyna-Gro Seed	95	D35VP40	13.5	56.1	121.4	
Dyna-Gro Seed	97	D37VP71	13.7	57.2	125.8	
G2 Genetics	94	5X-9402	13.6	57.0	141.1	
G2 Genetics	94	5X-795	13.8	57.1	148.5	151.8
G2 Genetics	97	5X-895	14.3	56.7	127.6	141.9
G2 Genetics	97	5H-797	13.2	56.5	131.5	153.6
G2 Genetics	98	5Z-198	14.1	55.2	147.5	
G2 Genetics	99	3H-399	14.4	55.9	138.8	
G2 Genetics	100	5X-0004	14.2	56.4	151.4	
Garst	88	89A19	13.8	57.1	166.7	
Garst	92	89T43	13.2	55.5	142.7	
Garst	96	88A69	13.7	55.5	137.4	
Mean			13.9	57.1	138.5	
CV%			6.1	1.7	14.4	
LSD.05			1.2	1.3	27.9	

[1]All yields adjusted to 15.5% moisture.

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Table 2. Corn hybrid performance trial (dry land) at Dickey County Fullerton, ND - Oakes Irrigation Research Site in 2012. (Page 2 of 3)

Brand	R.M.	Hybrid	Harvest Moisture	Test Weight	Grain Yield[1] 2012	Grain Yield[1] 2-yr Avg.
			%	lb/bu	---------bu/ac---------	
Integra	95	9455	13.6	55.3	136.1	
Kruger	92	KR-4292VT2P	12.8	55.1	115.7	152.6
Kruger	93	K4R-9593VT3P	13.9	58.0	124.1	
Kruger	94	K-7194VT3P	14.4	58.3	164.5	176.2
Kruger	95	K4R-9495	13.8	57.1	140.7	
Kruger	95	K-7195	13.5	57.1	132.8	
Kruger	96	K-7696	13.0	56.9	125.4	
Kruger	97	K-7597	13.6	57.2	130.4	
Kruger	99	K4R-9599	14.4	58.9	128.4	142.6
Kruger	100	K-7600	14.6	61.0	142.6	
Kruger	100	K-7400	14.3	56.3	128.3	
Kruger	101	K-6201	14.4	58.1	132.3	167.6
Kruger	101	K4R-9302	16.2	56.0	146.5	157.5
Northstar Genetics	94	94-594	14.0	57.7	144.7	
Northstar Genetics	96	96-596	14.2	58.5	146.4	
Northstar Genetics	92	90-102	13.3	56.0	136.4	
Northstar Genetics	99	99-122	13.3	56.3	124.4	
NuTech	97	5N-197	14.1	57.1	143.2	150.4
NuTech	98	5N798	14.0	58.1	150.6	
NuTech	101	5N-001	13.5	52.3	126.8	143.3
PFS	96	55S96	13.7	58.0	145.9	
PFS	93	75T93	13.8	57.4	128.4	
PFS	95	76Z95	13.4	59.0	130.6	
Pioneer	96	P9675AMX	13.8	58.7	150.6	
Pioneer	99	P9917AM1	14.3	58.6	164.8	
Pioneer	100	P0062XR	14.3	55.6	156.3	
Mean			13.9	57.1	138.5	
CV%			6.1	1.7	14.4	
LSD.05			1.2	1.3	27.9	

[1]All yields adjusted to 15.5% moisture.

Table 2. Corn hybrid performance trial (dry land) at Dickey County Fullerton, ND - Oakes Irrigation Research Site in 2012. (Page 3 of 3)

Brand	R.M.	Hybrid	Harvest Moisture	Test Weight	Grain Yield[1] 2012	Grain Yield[1] 2-yr Avg.
			%	lb/bu	---------bu/ac---------	
Proseed	90	990 3111GT	14.2	56.6	152.5	
Proseed	91	1191 SS RIB	12.8	54.7	115.0	141.4
Proseed	92	1292 VT2P	13.7	57.1	151.4	
Proseed	95	1295 SS RIB	13.9	58.1	141.2	
Proseed	93	1193VT3P	13.7	58.0	142.9	155.5
QSG	95	6395	15.8	56.3	114.6	
QSG	96	6396	14.5	57.4	141.5	
REA	90	3B330-RIB	13.6	57.3	150.5	167.3
REA	91	3V440	13.2	56.8	119.7	139.1
REA	92	3V921	13.1	57.4	143.2	
REA	92	3V929	13.6	56.2	120.4	
REA	93	4B285-RIB	13.2	56.6	144.3	159.7
REA	94	4A589-RIB	13.7	58.7	124.9	
REA	94	4V941	14.7	57.6	148.6	
REA	95	4V950	12.9	56.5	122.4	
REA	96	4A654-RIB	14.0	57.6	141.3	
Renk	94	RK530VT3P	13.9	58.5	127.3	154.5
Renk	93	RK492VT3P	12.8	56.9	141.9	
Renk	95	RK568VT3P	14.4	57.9	132.4	
Seeds 2000	92	9202 VT2P	13.3	55.8	131.3	
Seeds 2000	95	9503 VT2P	13.6	58.1	134.6	
Seeds 2000	95	9504 VT3P	13.7	56.8	137.9	177.6
Thunder Seed	90	6090GT	13.3	56.0	140.8	
Wensman	90	W 7110VT3PRO	13.5	57.3	133.7	
Wensman	92	W 8120VT2RIB	13.1	56.2	159.0	168.1
Wensman	93	W 7140VT3PRO	14.7	59.1	167.0	167.7
Wensman	95	W 8184VT3PRO	14.0	57.4	126.1	
Wensman	96	W 7268VT3	14.3	57.3	140.8	152.8
Wensman	98	W 7273VT3	13.3	56.5	140.1	163.3
Wensman	98	W 9288VT3PRO	14.9	57.5	161.5	
Wensman	99	W 7290VT3PRO	13.7	57.9	136.3	145.7
Wensman	101	W 7320VT3PRO	16.0	58.9	151.1	
Mean			13.9	57.1	138.5	
CV%			6.1	1.7	14.4	
LSD.05			1.2	1.3	27.9	

[1]All yields adjusted to 15.5% moisture.

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Hard Red Spring Wheat Variety Trial

W. Albus, L. Besemann and H. Eslinger

Although wheat yields seem to have leveled off, researchers and producers using intensive management are having different results. In intensive management, all areas of production; plant population, seeding depth, fungicide applications, nitrogen rate, time of application, weed control, etc., are closely monitored. Healthy wheat plants that lodge less result in higher yields and grain protein content.

The objective of this trial is to test hard red spring wheat varieties for yield and other agronomic parameters grown with intensive management in an irrigated environment.

MATERIALS AND METHODS

Soil:	Egeland loam and Maddock sandy loam; pH=7.4; 1.7 % organic matter; soil-N 18 lbs/acre; soil-P and soil-K were very high.
Previous crop:	2011 - soybean.
Seedbed preparation:	Spring no-tilled with a Seedmaster drill.
Planting:	Planted on March 19 with a Seedmaster drill. Planting rate was 2 bu/acre (1,600,000 seeds/acre).
Plots:	Plots were 76 ft long by 10 ft wide.
Fertilizer:	At planting 25 lbs N/acre, 39 lbs P_2O_5/acre, 48 lbs K_2O/acre, 19 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1 with a separate shank ¾" to the side and ½" below the seed. Stream bar applied 76 lbs N/acre April 16 and 50 lbs N/acre April 26 as 28-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Wolverine (1.7 pt/acre) April 30, Headline (6 oz/acre) May 3, Tilt (4 oz/acre) May 18, Folicur (4 oz/acre) June 6 and Proline (5 oz/acre) June 9.
Harvest:	July 19 with a Hege plot combine. Harvest area was five feet wide and 76 feet in length.

RESULTS

Yield, test weight, grain protein and plant height were significantly different among varieties. Yields averaged 80.2 bu/acre in 2012 compared to the five year average of 68.0 bu/acre. Fungal diseases in more susceptible varieties were kept in check with fungicides.

Table 1. Hard red spring wheat variety trial at the Oakes Irrigation Research Site in 2012.

Variety	Days to Head	Plant Lodge[1]	Plant Height	Grain Protein 2012	Grain Protein 3-yr Avg.	1000 KWT	Test Weight	Grain Yield 2012	Grain Yield 2-yr Avg.	Grain Yield 3-yr Avg.
		0-9	inch	--------%-------		gram	lb/bu	----------bu/ac----------		
Glenn	62.7	--	44.7	14.8	15.4	33.5	61.5	70.4	60.1	56.9
Faller	67.3	--	40.7	13.8	14.5	36.3	58.5	75.2	66.3	64.5
RB07	65.0	--	38.3	14.8	--	32.7	59.2	82.6	69.0	--
Barlow	65.0	--	43.7	14.8	15.7	35.1	61.3	75.5	64.1	63.3
Brennan	65.3	--	35.7	15.1	15.5	33.1	60.9	79.3	65.7	69.4
Samson	66.0	--	34.3	14.5	--	38.9	60.9	88.7	--	--
Soren	66.7	--	34.7	14.1	--	31.2	60.9	85.5	75.2	--
WB-Maville	66.7	--	35.3	14.9	--	37.8	61.0	84.1	--	--
MEAN	65.6		38.4	14.6		34.8	60.5	80.2		
CV %	1.2		2.5	1.8		2.1	0.9	4.9		
LSD.05	1.4		1.7	0.5		1.3	1.0	6.8		

[1]Lodging not significant to measure..

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Onion Hybrid Performance Trial

W. Albus, L. Besemann and H. Eslinger

Onions have done well under irrigation in ND. Yellow sweet Spanish is the predominate type grown. This study tested 16 sweet Spanish hybrids.

MATERIALS AND METHODS

Soil: Embden loam and Maddock sandy loam; pH=7.3; 2.3 % organic matter; soil-N 60 lbs/acre; soil-P and soil-K were very high.

Previous crops: 2011 – barley.

Seedbed preparation: Spring strip-till.

Planting: Direct seeded onions (285,000 seeds/acre) April 20 with a Monosem precision planter. Onions were planted: 2 lines per row with 2.5 inches between lines and rows on 16-inch centers.

Plots: Plots were 3 ft (two rows) wide by 17 ft long. The study had 4 reps.

Fertilizer: March 22 broadcast 26 lbs N/acre, 41 lbs P_2O_5/acre, 49 lbs K_2O/acre, 20 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1. Stream-bar 60 lbs N/acre May 21, June 15 and July 3 as 28-0-0.

Irrigation: Overhead sprinkler irrigation as needed.

Pest control: Roundup (30 oz/acre) + AMS (14 lbs/100 gal) April 26; Buctril (2 oz/acre) + COC (0.5% v/v) May 10, May 14 and May 21; Section 2EC (6 oz/ac) May 18, Buctril (1 pt/acre) + Goal 2XL (0.6 oz/acre) June 4, Section (8 oz/acre) + NIS (0.25% v/v) June 28 and hand weeding for weed control. Ridomil MZ 72 (2.5 lbs/acre) August 2 and August 6 for disease control.

Harvest: Pulled all onions September 6 and left to field dry. After field drying onions were topped and graded September 11 – September 13.

RESULTS

Onions responded well to the hot long growing season. As in the past six years, longer season onions (115-120) have performed best. The outcome in a short growing season caused by earlier frost may have different results. Previous years data; Sedona, Delgado, and Crocket averaged 815, 741, and 705 cwt/acre respectively from 2007-2010. Sedona, Delgado, and Crocket averaged 556, 552 and 467 cwt/acre in the greater than three inch size from 2007-2010.

Table 1. Onion hybrid performance trial at the Oakes Irrigation Research Site in 2012.

Hybrid	Seed Source	Maturity Days	Half Down[1]	> 4"	3 to 4"	2¼ to 3"	1 to 2¼"	Total	Culls	Single Center	Total Bulbs
				cwt						%	/ac
Elbrus	SM	112	8/16	24	428	236	29	716	9	86	152552
Belmar	SM	118	8/25	82	680	153	18	933	10	90	158317
Ruffian	SM	116	8/21	79	576	138	24	816	16	86	145825
Marquette	SM	115	8/16	34	396	141	25	596	3	90	118918
Patterson	BE	105	8/20	0	363	138	15	516	1	86	106906
Hamilton	BE	118	8/22	64	707	136	20	927	12	90	156155
Sedona	BE	118	8/26	87	565	93	11	754	5	80	115795
Crockett	BE	118	8/25	66	451	73	9	600	5	76	95134
Calibra	BE	115	8/17	40	554	171	20	784	13	70	141981
Delgado	BE	115	8/17	66	685	132	16	899	6	76	143662
Gunnison	BE	110	8/14	27	662	150	20	859	3	96	160239
Talon	BE	110	8/17	19	412	70	13	513	3	80	90090
Frontino	NZ	125	8/23	165	653	89	9	915	10	90	132852
Maverick	NZ	120	8/22	137	601	96	11	844	10	96	125885
Cruiser (37-64)	NZ	115	8/15	5	451	252	29	738	5	76	161200
Ventura (4012)	NZ	113	8/14	25	504	171	23	722	2	80	136696
Mean			8/19	57	543	140	18	758	7	84	133888
CV%			12.0	39.0	12.0	19.0	31.0	10.0	103.6	18.0	10.0
LSD.05			3	32	97	38	8	110	NS	1	18953

[1]Date when 50% of onion tops down.

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Soybean Variety Trial

W. Albus, L. Besemann and H. Eslinger

Two soybean variety trials were conducted at the Oakes Irrigation Research Site, a non-GMO (conventional trial) and a roundup ready trial. Results for the conventional trial are listed in (Table 1) and results for the roundup ready trial are listed in (Table 2).

MATERIALS AND METHODS

Soil:	Maddock sandy loam; pH=7.1; 1.7 % organic matter; soil-N 27 lbs/acre; soil-P was very high; soil-K was high.
Previous crop:	2011 – field corn.
Seedbed preparation:	Spring conventional tillage.
Planting:	Planted soybean May 10 in 30-inch rows.
Plots:	Plots were 17 ft long by 5 ft (2 rows) wide. There were 4 reps.
Fertilizer:	March 20 broadcast 26 lbs N/acre, 41 lbs P_2O_5/acre, 49 lbs K_2O/acre, 20 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Valor (2 oz/acre) May 14, Section (10 oz/acre) + COC (1% v/v) June 8; Raptor (5 oz/acre) + NIS (0.25%v/v) June 21 for weed control. Endura (11 oz/acre) July 11 and July 18, Proline (5 oz/acre) July 25 for disease control. Sevin (1.5 qt/acre) July 25 for insect control.
Harvest:	September 25 with a plot combine.

RESULTS

Grain yield, seed oil and protein %, test weight and plant lodging were significantly affected by variety in the roundup ready trial. Grain yield, seed oil and protein %, and test weight were significantly affected by variety in the conventional trial. Yields in the Roundup Ready trial averaged 72.0 bu/acre compared to the four year average of 64.1 bu/acre.

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Table 1. Soybean variety trial (conventional) at the Oakes Irrigation Research Site in 2012.

	Variety	Mat. Group	Type	Maturity Date	Plant Lodge[1]	Seed Protein	Seed Oil	Test Weight	Seed Yield[2] 2012	Seed Yield[2] 2-yr Avg.
					0-9	%	%	lb/bu	---bu/ac---	
SK	0786	0.7	Conv.	9/12	8	37.5	17.6	58.4	60.0	
SK	0796	0.7	Conv.	9/13	8	37.7	17.6	57.3	58.3	
SK	095	0.9	Conv.	9/16	8	36.0	16.4	59.5	51.7	
Richland IFC	MK0508	0.5	Conv.	9/15	8	33.1	16.9	59.0	54.9	43.8
Richland IFC	MK831	0.8	Conv.	9/10	6	33.8	17.8	59.5	60.4	56.4
SK	9814	1.4	Conv.	9/17	6	34.0	21.0	57.2	71.1	
Richland IFC	MK1016	1.0	Conv.	9/14	7	35.6	16.6	59.3	59.2	58.4
Richland IFC	MK89101	1.0	Conv.	9/14	5	35.3	20.4	57.3	70.9	
Richland IFC	Titan	1.0	Conv.	9/8	3	34.2	17.6	58.2	83.3	
Richland IFC	Challenger	1.3	Conv.	9/19	8	28.0	13.4	56.2	57.6	
Legend	LS1172LLN	1.1	LL	9/14	8	32.1	18.9	57.4	67.0	
Seeds 2000	2082 L	0.8	LL	9/14	5	33.6	18.5	58.5	85.0	
MEAN				9/14	6	34.3	17.7	58.1	64.9	
CV %					10.9	15.7	14.8	1.2	10.5	
LSD.05					1	NS	3.8	1.0	9.8	

[1]0 erect, 9 flat

[2]Yield adusted to 13% moisture.

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Table 2. Soybean variety trial (roundup ready) at the Oakes Irrigation Research Site in 2012. (1 of 2)

Variety	Mat. Group[1]	Maturity Date	Plant Lodge[2]	Test Weight	Seed Protein	Seed Oil	Seed Yield[3] 2012	Seed Yield[3] 2-yr Avg.	Seed Yield[3] 3-yr Avg.
			0-9	lb/bu	%	%	------bu/ac-------		
Fill		0.9	9/16	5	58.2	31.8	19.0	56.8		
Dairyland	DSR-0747/R2Y	0.7	9/17	3	58.5	34.0	18.0	77.3	69.5	
Dairyland	DSR-0904/R2Y	0.8	9/11	3	58.1	33.4	19.0	76.6		
Dairyland	DSR-1215/R2Y	1.2	9/16	3	58.4	33.5	17.7	84.4	77.2	72.7
Dairyland	DSR-1370/R2Y	1.3	9/18	5	58.0	33.1	18.0	76.4	72.1	71.8
Dyna-Gro Seed	31RY08	0.8	9/12	2	57.8	34.6	18.3	68.3		
Dyna-Gro Seed	37RY10	1.0	9/11	3	58.1	34.6	18.5	71.0		
Dyna-Gro Seed	39RY14	1.4	9/15	1	58.0	33.1	18.3	82.9		
Dyna-Gro Seed	S13RY93	1.3	9/16	1	57.8	30.7	19.0	74.0		
G2 Genetics	6070	0.7	9/9	2	58.5	34.8	18.3	72.2		
G2 Genetics	6088	0.8	9/13	2	57.9	34.2	18.6	79.5	76.8	74.0
G2 Genetics	6092	0.9	9/13	4	59.2	34.5	18.3	72.4	71.6	
G2 Genetics	6098	0.9	9/10	2	58.8	32.4	19.0	76.4	71.5	70.9
G2 Genetics	6143	1.4	9/13	2	59.0	34.2	17.9	74.5		
G2 Genetics	6162	1.5	9/15	3	58.4	32.6	18.6	69.2		
G2 Genetics	7110	1.1	9/11	3	58.3	33.2	18.8	72.1	69.0	67.1
Integra	20810	0.8	9/11	2	59.1	33.0	18.1	72.5		
Integra	21102	1.1	9/14	5	58.4	34.9	17.8	68.3	65.4	
Integra	78070R	0.7	9/11	1	58.2	34.0	18.7	71.1	72.5	70.7
Kruger	K2-0101	0.1	8/31	3	59.0	35.0	17.6	64.9	64.0	
Kruger	K2-0402	0.4	9/5	3	58.2	34.4	18.2	67.0		
Kruger	K2-0503	0.5	9/9	3	58.0	34.9	17.8	71.5		
Kruger	K2-0504	0.5	9/9	1	58.5	33.8	18.4	74.5		
Kruger	K2-0601	0.6	9/7	4	58.2	33.7	18.0	67.5	68.2	
Kruger	K2-0701	0.7	9/14	3	58.4	31.7	19.0	76.5	71.0	
Kruger	K2-0801	0.8	9/10	3	58.4	33.9	18.3	74.3	72.2	
Kruger	K2-0901	0.9	9/10	2	58.3	33.2	19.1	71.0		
Kruger	K2-1001	1.0	9/13	6	58.7	33.3	18.3	71.0	69.2	66.8
Kruger	K2-1102	1.1	9/17	5	58.6	34.4	17.9	73.4	67.3	
Kruger	K2-1301	1.3	9/17	3	58.7	34.2	17.5	81.5		
Mean			9/12	3.0	58.3	33.7	18.4	72.0		
CV%				35.6	0.7	0.9	0.9	6.8		
LSD.05				1.5	0.6	0.4	0.2	6.8		

[1]Maturity group based on data provided by company.

[2]Lodging is from 0 to 9; 0 is erect, 9 is flat.

[3]Yield is adjusted to 13% moisture.

Table 2. Soybean variety trial (roundup ready) at the Oakes Irrigation Research Site in 2012. (2 of 2)

	Variety	Mat. Group[1]	Maturity Date	Plant Lodge[2]	Test Weight	Seed Protein	Seed Oil	Seed Yield[3] 2012	Seed Yield[3] 2-yr Avg.	Seed Yield[3] 3-yr Avg.
				0-9	lb/bu	%	%	------bu/ac-------		
Legend	LS 13R21	1.3	9/16	4	58.2	33.5	17.7	80.5		
Legend	LS 14R22N	1.4	9/15	3	58.4	33.1	19.1	83.1		
Northstar Genetics	NS1257R2	1.1	9/14	5	58.4	34.7	17.9	67.7	66.1	
PFS	12R10	1.0	9/12	2	57.9	34.6	18.6	69.3	68.7	
PFS	12R12	1.1	9/14	4	58.4	34.6	18.1	65.8	62.2	
Pioneer	90M80	0.8	9/12	4	58.4	31.5	19.8	63.7	63.1	
Pioneer	90Y70	0.7	9/13	3	58.7	33.4	19.0	67.6		
Pioneer	90Y80	0.8	9/9	3	58.1	33.4	19.4	73.1	74.1	70.1
Pioneer	91Y01	1.0	9/10	6	58.4	32.2	19.1	56.5		
Pioneer	91Y10	1.1	9/12	3	58.7	33.6	18.3	64.9		
Pioneer	91Y30	1.3	9/13	3	57.7	31.8	19.4	71.8		
Prairie Brand	PB-0441 R2	0.4	9/2	2	58.2	33.8	18.3	77.6		
Prairie Brand	PB-0863R2	0.8	9/9	2	57.9	33.2	19.1	77.4		
Proseed	P2 11-110	1.1	9/13	4	58.6	34.7	18.5	71.4	67.8	
Proseed	P2 11-90	0.9	9/13	2	57.8	34.5	18.5	68.4	69.9	
Proseed	P2 20-90 RR2Y	0.9	9/13	4	58.5	34.1	18.3	69.9		
Proseed	P2 2-140	1.4	9/17	3	58.6	33.3	19.0	68.4		
REA	66G22	0.6	9/9	4	58.5	34.6	17.9	64.2		
REA	67G61	0.7	9/9	3	58.7	33.5	18.6	69.4		
REA	69G13	0.9	9/9	3	58.1	33.3	19.1	77.7		
REA	71G20	1.1	9/12	4	58.5	33.3	18.2	70.6		
Seeds 2000	2091RR2Y	0.9	9/15	3	58.6	33.8	18.2	76.8	70.4	
Seeds 2000	2121 RR2Y	1.2	9/14	4	58.6	35.2	17.8	69.8	68.5	
Thunder	3114R2Y	1.4	9/19	5	57.9	33.8	17.9	82.0		
Thunder	3211R2Y	1.1	9/13	4	57.9	35.1	18.0	71.2	67.4	
Wensman	W 3050NR2	0.5	9/6	3	58.0	34.4	18.3	63.1		
Wensman	W 3076R2	0.7	9/11	2	58.4	34.4	18.2	73.6		
Wensman	W 3090NR2	0.9	9/12	3	58.2	33.5	19.0	73.4		
Wensman	W 3099R2	0.9	9/11	3	58.3	35.0	18.4	69.5	69.8	
Wensman	W 3101R2	1.0	9/12	1	58.8	35.1	18.0	72.4		
Mean			9/12	3.0	58.3	33.7	18.4	72.0		
CV%				35.6	0.7	0.9	0.9	6.8		
LSD.05				1.5	0.6	0.4	0.2	6.8		

[1]Maturity group based on data provided by company.

[2]Lodging is from 0 to 9; 0 is erect, 9 is flat.

[3]Yield is adjusted to 13% moisture.

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Soybean Breeding Nursery

Ted Helms, NDSU Department of Plant Sciences

Breeding experiments were conducted at the Oakes Irrigation Research Site in 2012. These experiments are combined with testing at other sites to provide information regarding how experimental soybean lines perform in diverse environments. The best experimental lines are then advanced to the next stage of testing or perhaps released as named cultivars. The released cultivars are then distributed to farmers to grow on their farms. Oakes is an especially useful testing site because of the high yield and the tendency for the plants to grow tall and lodge, due to the application of irrigation. Those genotypes that are susceptible to lodging can then be identified and discarded. Farmers do not want cultivars that are susceptible to lodging and Oakes is the best location to identify lodging problems. The studies consisted of an experiment to evaluate conventional soybean experimental lines and an experiment to evaluate conventional soybean advanced breeding lines.

MATERIALS AND METHODS

Soil:	Conventional advanced breeding: Maddock sandy loam, Hecla sandy loam and Embden sandy loam; pH=7.1; 1.7% organic matter, soil-N 27 lbs/acre, soil-P was very high; soil-K was high. Conventional experimental breeding: Maddock sandy loam, Hecla sandy loam and Embden sandy loam; pH=7.0; 2.1% organic matter, soil-N 32 lbs/acre, soil-P and soil-K was very high.
Previous crop:	Conventional - advanced breeding: 2011 – field corn. Conventional - experimental lines 2011 – field corn and onion.
Seedbed preparation:	Spring conventional tillage.
Planting:	Advanced breeding May 10 and experimental lines May 15, in 30-inch rows.
Plots:	Plots were 17 ft long by 5 ft (2 rows) wide. All studies had 3 reps.
Fertilizer:	March 20 broadcast 26 lbs N/acre, 41 lbs P_2O_5/acre, 49 lbs K_2O/acre, 20 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Valor (2 oz/acre) May 14 advanced and May 18 experimental. Section (10 oz/acre) + COC (1% v/v) June 8; Raptor (5 oz/acre) +NIS (0.25%v/v) June 21 for weed control. Endura (11 oz/acre) July 11 and July 18, Proline (5 oz/acre) July 25 for disease control. Sevin (1.5 qt/acre) July 25 for insect control.
Harvest:	September 29 with a plot combine.

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Table 1. Conventional experimental lines at the Oakes Irrigation Research Site in 2012. (1 of 2)

Entry	Yield	Maturity* date	Lodging** score
	bu/A		
Traill	48.1	3-Sep	3.3
Cavalier	55.8	4-Sep	1.3
ND09-3505(Rps)	55.2	4-Sep	1.8
ND09-3724(Rps)	62.3	6-Sep	1.2
ND09-4592(Rps)	66.6	7-Sep	2.0
ND09-4392(Rps)	48.6	7-Sep	2.7
ND09-5604(Rps)	66.1	8-Sep	1.7
AG 0231	69.5	9-Sep	1.7
ND09-3571(Rps)	60.0	9-Sep	2.5
ND09-5275(Rps)	56.4	9-Sep	1.2
ND09-3424(Rps)	56.4	9-Sep	1.7
ND09-5800(Rps)	67.8	9-Sep	1.5
ND09-3163(Rps)	56.7	10-Sep	3.0
ND09-5609(Rps)	65.8	10-Sep	2.2
ND09-3153(Rps)	58.7	10-Sep	3.2
ND09-4141(Rps)	55.7	10-Sep	2.5
ND09-5708(Rps)	67.4	10-Sep	2.0
ND09-3180(Rps)	54.8	10-Sep	3.5
ND09-5526(Rps)	68.4	10-Sep	1.7
ND09-5709(Rps)	68.3	11-Sep	2.8
ND09-3175(Rps)	63.2	11-Sep	3.2
ND09-4023(Rps)	61.2	11-Sep	2.7
ND09-5637(Rps)	60.0	11-Sep	2.0
ND09-3674(Rps)	63.2	11-Sep	2.7
ND09-4046(Rps)	54.5	11-Sep	2.7
ND09-5762(Rps)	57.8	11-Sep	2.7
ND09-4432(Rps)	65.2	12-Sep	1.3
ND09-5562(Rps)	69.8	12-Sep	1.3
Ashtabula	65.3	12-Sep	1.8
ND09-4446(Rps)	67.9	12-Sep	1.7
ND07-3761(Rps)	64.1	12-Sep	1.8
ND09-4044(Rps)	62.8	12-Sep	2.8
Mean	65.1	12-Sep	2.2
LSD(0.05)	9.4	2	0.6
CV	9.0	5.4	25.3

*Date of 95% mature pods.

**Lodging score; 1- upright, 5-flat on ground.

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Table 1. Conventional experimental lines at the Oakes Irrigation Research Site in 2012. (2 of 2)

Entry	Yield	Maturity* date	Lodging** score
	bu/A		
ND09-5276(Rps)	63.2	12-Sep	2.0
ND09-5695(Rps)	68.7	12-Sep	2.0
ND09-5757(Rps)	68.0	12-Sep	2.0
ND09-5765(Rps)	69.5	12-Sep	1.7
ND09-4027(Rps)	65.5	13-Sep	2.8
ND07-2205(Rps)	77.8	13-Sep	1.8
ND07-3376(Rps)	70.8	13-Sep	3.0
ND09-5516(Rps)	71.6	13-Sep	2.7
ND09-4444(Rps)	62.5	13-Sep	1.8
ND09-5355(Rps)	67.8	13-Sep	2.3
ND09-5419(Rps)	82.3	13-Sep	2.5
ND09-5225(Rps)	66.8	14-Sep	2.0
ND09-5268(Rps)	62.1	14-Sep	2.2
AG 0730	72.2	14-Sep	1.8
ND09-5764(Rps)	71.4	14-Sep	1.8
ND09-3954(Rps)	60.8	14-Sep	2.8
ND09-5720(Rps)	68.8	14-Sep	3.0
ND09-5311(Rps)	67.0	15-Sep	1.8
ND09-5755(Rps)	71.7	15-Sep	1.5
ND09-5366(Rps)	66.0	15-Sep	2.3
ND09-5798(Rps)	77.0	15-Sep	1.0
ND09-5233(Rps)	66.2	15-Sep	2.3
MN 0902CN	62.6	16-Sep	2.7
ND09-5285(Rps)	72.8	16-Sep	2.2
ND09-4322(Rps)	64.8	16-Sep	2.3
ND09-5367(Rps)	67.9	16-Sep	3.2
ND09-5699(Rps)	81.1	17-Sep	2.7
Sheyenne	71.2	17-Sep	2.2
ND09-4024(Rps)	63.0	17-Sep	3.7
ND09-4326(Rps)	65.1	17-Sep	2.3
ND09-5722(Rps)	71.5	17-Sep	2.2
ND07-3947(Rps)	67.8	18-Sep	2.7
Mean	65.1	12-Sep	2.2
LSD(0.05)	9.4	2	0.6
CV	9.0	5.4	25.3

*Date of 95% mature pods.

**Lodging score; 1- upright, 5-flat on ground.

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Table 2. Conventional advanced breeding lines at the Oakes Irrigation Research Site in 2012.

Entry	Yield	Maturity* date	Lodging** score
	bu/A		
Cavalier	50.0	30-Aug	2.2
Traill	45.9	3-Sep	3.8
AG 0231	67.5	4-Sep	2.2
AG 0202	62.6	8-Sep	1.8
ND1005T	47.1	8-Sep	3.5
AG 0604	54.7	9-Sep	2.8
AG 0730	68.1	12-Sep	2.2
ND08-9127(Rps)	65.3	13-Sep	2.5
ND08-9273(Rps)	64.0	13-Sep	2.3
Ashtabula2	56.9	13-Sep	3.0
ND06-4642(Rps)	69.4	13-Sep	2.0
P.91M10	77.8	13-Sep	2.2
MN 0902CN	59.9	14-Sep	2.5
ND07-2303(Rps)	69.6	14-Sep	3.5
ND07-3761(Rps)	64.0	14-Sep	2.3
Ashtabula	58.3	15-Sep	3.2
AG 0803	71.0	15-Sep	2.5
Sheyenne	77.3	15-Sep	2.8
ND07-3947(Rps)	58.0	16-Sep	2.8
ND07-2205(Rps)	73.9	16-Sep	2.8
ND08-9141(Rps)	68.6	17-Sep	3.2
ND07-3376(Rps)	56.0	17-Sep	4.2
Sheyenne2	67.1	17-Sep	3.2
ProSoy	52.2	18-Sep	4.2
Mean	62.7	12-Sep	2.8
LSD(0.05)	7.2	1	0.5
CV	7	3.7	15.4

*Date of 95% mature pods.

**Lodging score: 1-upright, 5- flat on ground.

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Strip-Till Sugarbeet Hybrid Performance Trial

W. Albus, L. Besemann and H. Eslinger

Sugarbeet stand establishment can be a difficult proposition. Generally, dryland beets are planted into a well worked, firm, level, seedbed to maintain accurate depth control and seed spacing into moist soil. This results in a very smooth surface that is susceptible to wind erosion. The emerging plants and seedlings are easily cut off by blowing soil. Wind can cause the young seedlings to spin out of the ground, called helicoptering. In either event, replanting is required. The replanting is not only expensive but results in lost growing time which is important to maximize yield. Strip-till is a procedure used by producers to protect the plants from wind. Narrow black strips that match the row width of the planter are made in the fall on previous small grain or other suitable crop stubble. The strips are made with a knife that works and lifts the soil. Berm builders, coulters that contain the soil coming off the knife, make a berm. Some strip-till machines used angled fluted coulters to till the strip and form a berm. The widths of the black strips vary with the machine used but typically are about 6 inches wide. The planter units plant on the tilled black strips made the previous fall or spring. The un-worked stubble in-between the strips acts as a wind buffer to protect the seedlings from wind damage.

The objectives of this study are to determine if viable sugarbeet stands can be established in strip-till zones and to show the advantages of irrigation to keep the small, shallow seeds moist during germination and seedling growth.

MATERIALS AND METHODS

Soil:	Egeland loam and Maddock sandy loam; pH=7.23; 2.3 % organic matter; soil-N 60 lbs/acre; soil-P and soil-K were very high.
Previous crops:	2011 – barley.
Seedbed preparation:	Spring strip till.
Planting:	April 19. Sugarbeet were planted in rows on 22-inch centers. Thinned to 40,000 plants/acre.
Plots:	Plots were 7⅓ ft (four rows) wide by 17 ft long. The study had 4 reps.
Fertilizer:	March 22 broadcast 26 lbs N/acre, 41 lbs P_2O_5/acre, 49 lbs K_2O/acre, 20 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1. Stream-bar 60 lbs N/acre May 21 as 28-0-0; broadcast 120 lbs N/acre on June 8 as 46-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Roundup Power Max (30 oz/acre) April 26, Roundup Power Max (40 oz/acre) May 21, June 9 and July 21 for weed control. Proline (5.7 oz/acre) July 25, August 6 and August 30, Headline (12 oz/acre) August 15 for disease control. Sevin (1.5 qt/acre) July 25 for insect control.
Harvest:	September 25 and September 26.

RESULTS

Although sugarbeets emerged well, growth was slowed some early in the season due to adjacent barley residue. Barley residue had a positive effect by giving some protection to young seedlings from wind. The long hot growing season coupled with adequate soil moisture from irrigation produced exceptional yields. Plant populations were significantly lower in the Vanderhave SV36711 resulting in lower yields.

Table 1. Sugar content, root yield and overall sugar yield of energy beet varieties at the Oakes Irrigation Research Site in 2012.

			Sugar	Recoverable				
	Yield	Sugar	Loss	Sugar	Sugar	Sodium	Potassium	Amino N
	ton/ac	-------%-------		lb/ton	lb/ac	----------ppm----------		
Crystal 658	45.4	16.5	1.6	298	13504	150	1914	658
Crystal 768	44.8	17.3	1.7	312	13970	158	1920	769
Crystal 878	46.7	16.9	1.9	301	14072	155	2164	828
Vanderhave SV36711	43.3	16.3	1.8	289	12522	187	2280	738
Mean	45.0	16.8	1.8	300	13517	162	2070	748
CV%	6.8	2.0	3.7	2.2	5.6	16.8	3.9	5.8
LSD.05	NS	0.5	0.1	11	NS	NS	130	69

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Corn Hybrid and Row Width Study

W. Albus, L. Besemann and H. Eslinger

A three year study on corn row width and population from 2006-2008 showed no significant yield advantage to 15-inch or 30-inch paired rows over 30-inch rows. The lack of response to narrower rows goes against research at this site in the 70's and 80's. Although the lack of response to narrow rows was very consistent from 2006-2008, row width is such a major decision in planter selection that row width studies should be continued. Since 15-inch rows gives the most inter-row plant spacing it was decided there is no reason to test other narrow row configurations until we get a consistent yield response to 15-inch rows. 2012 is the seventh year of comparing 15-inch rows to 30-inch rows.

MATERIALS AND METHODS

Soil:	Maddock sandy loam; pH=7.3; 1.7% organic matter; soil-N 24 lbs/acre; soil-P was high and soil-K was medium.
Previous crop:	2011 – potato.
Seedbed Preparation:	Conventional tillage practices.
Planting:	Planted May 9 in 30-inch (41,800/acre) and 15-inch (39,000/acre) row spacing.
Plots:	Plots 157 ft long by 10 ft wide. Plots with 30-inch row spacing had 4 rows; plots with 15-inch spacing had 8 rows. The study had 3 reps.
Fertilizer:	March 20 broadcast 26 lbs N/acre, 41 lbs P_2O_5/acre, 49 lbs K_2O/acre, 20 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1. Stream bar 60 lbs N/acre May 21, May 31 and June 7 as 28-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Lumax (3 pt/acre) May 11.
Harvest:	Harvested October 4 and October 5. Harvest area was four rows in the 30 inch rows and eight rows from the 15 inch rows.

RESULTS

Although 15-inch rows yielded 5.7 bu/acre more than 30-inch rows in 2012 it wasn't significant. In seven years of study 15-inch rows have significantly out yielded 30-inch rows in one year only. The relationship between 15-inch and 30-inch rows from 2006-2012 is presented in Figure1.

Table 1. Corn hybrid and row width study at the Oakes Irrigation Research Site in 2012.

	Grain[1] Yield	Harvest Moisture	Test Weight	Population	Ear Height	Mature Date
	bu/ac	%	lb/bu	plants/ac	------inches--------	
Row Width						
15	262.3	15.8	59.0	37319	48.3	9/23
30	257.5	16.0	59.0	33327	47.2	9/23
Mean	259.9	15.9	59.0	35323	47.8	9/23
CV%	2.2	1.5	0.7	6.0	2.1	
LSD.05	NS	NS	0.4	2427	NS	
Hybrid						
W7320	265.2	17.2	59.0	33116	45.9	9/26
P9917A	253.4	16.5	59.1	35656	49.9	9/22
DKC43-27	261.2	14.1	59.0	37198	47.5	9/22
CV%	5.7	3.1	0.9	4.2	4.0	
LSD.05	NS	0.8	0.9	2398	NS	
Row by Hybrid						
15 W7320	267.0	17.0	59.0	34658	46.2	9/26
15 P9917A	254.3	16.3	59.1	38469	50.6	9/22
15 DKC4327	265.7	14.1	58.9	38831	48.2	9/22
30 W7320	263.4	17.3	58.9	31573	45.7	9/26
30 P9917A	252.6	16.6	59.1	32843	49.2	9/22
30 DKC4327	256.6	14.1	59.1	35565	46.8	9/22

[1]Yield adjusted to 15.5% moisture.

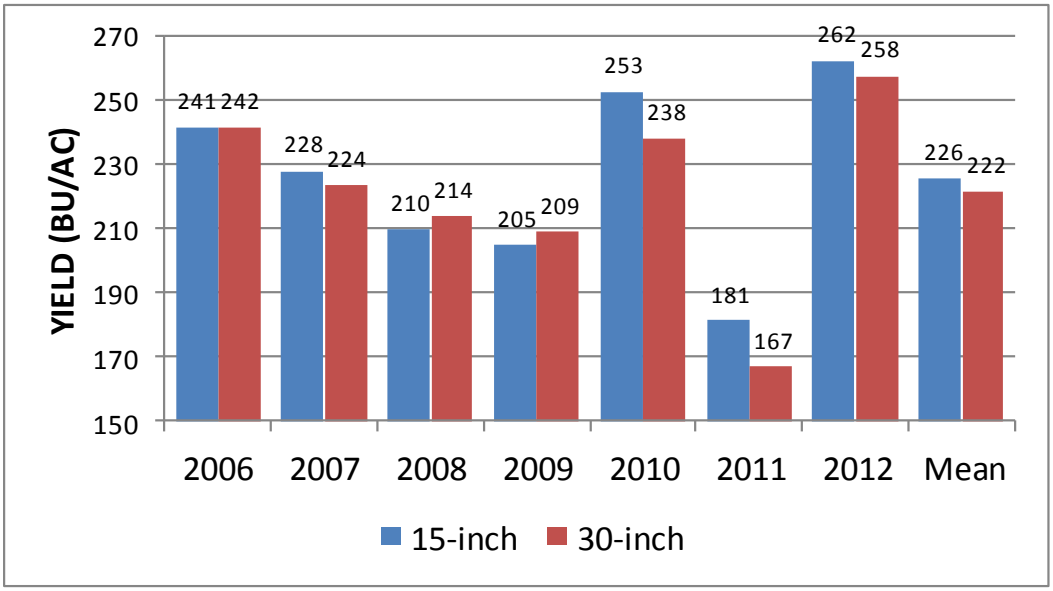

Figure 1. Corn yield in 15-inch versus 30-inch rows at the Oakes Irrigation Research Site from 2006 to 2012.

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Energy Beet Variety Trial

Syngenta, Green Vision and NDSU

An irrigated energy beet variety trial was initiated in the Oakes in 2009 as a cooperative project among the Green Vision Group, Syngenta was continued in 2012. Syngenta partners in the trial at Oakes. Energy beets hold a great potential as feed stock for ethanol plants. High yielding energy beet germplasm may yield higher than germplasm for sugarbeets that must meet rigid sugar quality and impurity indexes. It is the objective of this trial to determine the yield potential of energy beets under irrigation in SE ND.

MATERIALS AND METHODS

Soil:	Embden sandy loam and Hecla sandy loam; pH=6.9; 2.4 % organic matter; soil-N 38 lbs/acre; soil-P and soil-K were very high.
Previous crops:	2011 – wheat.
Seedbed preparation:	Conventional tillage practices.
Planting:	April 23. Sugarbeet were planted in rows on 22-inch centers.
Plots:	Plots were 5.5 ft (three rows) wide by 20 ft long. The study had 3 reps.
Fertilizer:	March 22 broadcast 26 lbs N/acre, 41 lbs P_2O_5/acre, 49 lbs K_2O/acre, 20 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1. Stream-bar 60 lbs N/acre May 21 and July 23 as 28-0-0; broadcast 100 lbs N/acre on June 12 as 46-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Roundup Power Max (32 oz/acre) May 21 and Roundup Power Max (40 oz/acre) June 15 for weed control. Proline (5.7 oz/acre) August 7 and August 30, Headline (12 oz/acre) August 14 for disease control.
Harvest:	October 1.

Results

The long hot growing season with ample moisture supplied by overhead irrigation resulted in the highest yield recorded at this site of 49.6 tons/acre. Sugarbeets have averaged 38.7 tons/acre over the past seven years.

Table 1. Sugar content, root yield and overall sugar yield of energy beet Varieties at the Oakes Irrigation Research Site in 2012.

	Sugar Content	Root Yield	Sugar Yield
	%	tons/acre	lbs/acre
1	17.3	44.0	15,173
2	16.8	43.5	14,647
3	16.9	42.9	14,499
4	16.7	45.0	14,997
5	17.4	41.0	14,296
6	17.1	41.3	14,137
7	15.7	49.6	15,615
8	16.4	44.5	14,649
9	16.1	47.9	15,380
MEAN	16.7	44.4	14,821
C.V. %	2.7	3.9	4.2
LSD .05	0.8	2.9	1058

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Fine Tuning Microrates for Early-Season Broadleaf Weed Control in Onion.

Harlene Hatterman-Valenti and Collin Auwarter.

Weed control in onion is essential to produce marketable bulbs and is compounded by the crop's notoriously non-competitive nature, especially during establishment when onion can take anywhere from 4-10 weeks to reach the 2-leaf stage. Broadleaf weeds such as common lambsquarters and redroot pigweed gain a competitive advantage over the establishing onion crop if effective weed control methods are not implemented. Most preemergence (PRE) herbicide options are ineffective and no postemergence (POST) herbicides can be applied prior to the onion 2-leaf stage. This study was conducted at the Oakes Irrigation Research Facility near Oakes, ND to compare early-season weed control of bromoxynil (Buctril) and oxyfluorfen (GoalTender) applied at microrates to a standard pre-emergence treatment of DCPA (Dacthal) or ethofumesate (Nortron) in onion. 'Sedona' onion was planted May 14 as twin rows on 18" centers and a planting population of 175,000 seeds/A. PRE treatments included 1 or 2 lb/A ethofumesate and 13.33 lb/A DCPA and were applied 8 days after planting (DAP). Microrate applications began when broadleaf weeds were in the cotyledon to one-leaf stage, which corresponded to onion between the flag and one-leaf stage, 21 DAP. Bromoxynil and oxyfluorfen were applied at the 0.25X and 0.13X, respectively, of the lowest labeled rate along with 0.031 lb/A clethodim (Select) and applied as four or five weekly sequential applications. Petroleum oil-surfactant (Herbimax) (1 pt/a) was tank mixed with the microrate application. The pre-emergence treatments received Buctril at 1 pt/A and Goal at 2 pt/A when onion reached the five-leaf stage.

Table1. Herbicides applied and the application timings for the various treatments.

Trt No.	Trt Name	Rate	Unit/A	App Code	Trt No.	Trt Name	Rate	Unit/A	App Code	Trt No	Trt Name	Rate	Unit/A	App Code
1	Buctril	4	floz	B	4	Buctril	4	Floz	B	9	Buctril	2	Floz	B
	Select Max	4	floz	B		Select Max	4	Floz	B		Select Max	4	Floz	B
	Herbimax	1	pt	B		Herbimax	1	Pt	B		Herbimax	1	Pt	B
	Buctril	4	floz	C		Buctril	4	Floz	C		Buctril	2	Floz	C
	Select Max	4	floz	C		Select Max	4	Floz	C		Select Max	4	Floz	C
	Herbimax	1	pt	C		Herbimax	1	Pt	C		Herbimax	1	Pt	C
	Buctril	2	floz	D		Buctril	4	Floz	D		Buctril	2	Floz	D
	Goal Tender	2	floz	D		Select Max	4	Floz	D		Goal Tender	2	Floz	D
	Select Max	4	floz	D		Herbimax	1	Pt	D		Select Max	4	Floz	D
	Herbimax	1	pt	D		Buctril	4	Floz	E		Herbimax	1	Pt	D
	Buctril	2	floz	E		Select Max	4	Floz	E		Buctril	2	Floz	E
	Goal Tender	2	floz	E		Herbimax	1	Pt	E		Goal Tender	2	Floz	E
	Select Max	4	Floz	E		Buctril	4	Floz	F		Select Max	4	Floz	E
	Herbimax	1	Pt	E		Select Max	4	Floz	F		Herbimax	1	Pt	E
2	Buctril	2	Floz	B		Herbimax	1	Floz	F	10	Buctril	4	Floz	B
	Select Max	4	Floz	B	5	Goal Tender	2	Floz	B		Select Max	4	Floz	B
	Herbimax	1	Pt	B		Select Max	4	Floz	B		Herbimax	1	Pt	B
	Buctril	2	Floz	C		Herbimax	1	Pt	B		Buctril	4	Floz	C
	Select Max	4	Floz	C		Goal Tender	2	Floz	C		Select Max	4	Floz	C
	Herbimax	1	Pt	C		Select Max	4	Floz	C		Herbimax	1	Pt	C
	Buctril	2	Floz	D		Herbimax	1	Pt	C		Buctril	4	Floz	D
	Select Max	4	Floz	D		Goal Tender	2	Floz	D		Goal Tender	2	Floz	D
	Herbimax	1	Pt	D		Select Max	4	Floz	D		Select Max	4	Floz	D
	Buctril	2	Floz	E		Herbimax	1	Pt	D		Herbimax	1	Pt	D
	Goal Tender	2	Floz	E		Goal Tender	2	Floz	E		Buctril	4	Floz	E
	Select Max	4	Floz	E		Select Max	4	Floz	E		Goal Tender	2	Floz	E
	Herbimax	1	Pt	E		Herbimax	1	Pt	E		Select Max	4	Floz	E
	Buctril	2	Floz	F		Goal Tender	2	Floz	F		Herbimax	1	Pt	E
	Goal Tender	2	Floz	F		Select Max	4	Floz	F	11	Buctril	4	Floz	B
	Select Max	4	Floz	F		Herbimax	1	Pt	F		Select Max	4	Floz	B
	Herbimax	1	Pt	F	6	Dacthal	10	Lb	A		Herbimax	1	Pt	B
3	Goal Tender	1	Floz	B		Buctril	1	Pt	F		Buctril	4	Floz	C
	Buctril	2	Floz	B		Goal	2	Pt	F		Select Max	4	Floz	C
	Select Max	4	Floz	B		Select Max	12	Floz	F		Herbimax	1	Pt	C
	Herbimax	1	Pt	B		Herbimax	1	Pt	F		Buctril	4	Floz	D
	Goal Tender	1	Floz	C	7	Nortron	4	Pt	A		Select Max	4	Floz	D
	Buctril	2	Floz	C		Buctril	1	Pt	F		Herbimax	1	Pt	D
	Select Max	4	Floz	C		Goal	2	Pt	F		Buctril	4	Floz	E
	Herbimax	1	Pt	C		Select Max	12	Floz	F		Goal Tender	2	Floz	E
	Goal Tender	1	Floz	D		Herbimax	1	Pt	F		Select Max	4	Floz	E
	Buctril	2	Floz	D	8	Nortron	2	Pt	A		Herbimax	1	Pt	E
	Select Max	4	Floz	D		Buctril	1	Pt	F		Buctril	4	Floz	F
	Herbimax	1	Pt	D		Goal	2	Pt	F		Goal Tender	2	Floz	F
	Goal Tender	1	Floz	E		Select Max	12	Floz	F		Select Max	4	Floz	F
	Buctril	2	Floz	E		Herbimax	1	Pt	F		Herbimax	1	Pt	F
	Select Max	4	Floz	E						12	Untreated			
	Herbimax	1	Pt	E										
	Goal Tender	1	Floz	F										
	Buctril	2	Floz	F										
	Select Max	4	Floz	F										
	Herbimax	1	Pt	F										

Table 2. Spray application information.

Date:		5/22/12	6/4/12	6/12/12	6/21/12	6/27/12	7/2/12
TIme:		A	B	C	D	E	F
Sprayer:	GPA:	20	20	20	20	20	20
	PSI:	40	40	40	40	40	40
	Nozzle:	11002	8002	8002	8002	11002	11002
Air Temperature(F):		63	72	50	63	78	93
Relative Humidity (%):		53	60	81	73	74	53
Soil Moisture:		Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
Wind (MPH):		11	6	4	8	9	5
Cloud Cover (%):		40	5	0	60	50	0
Onion Stage:		Seed Cracking	1 leaf	2 leaf	3 leaf	4 leaf	5 leaf

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Table 3. Weed control and onion injury ratings.

Trt	----------6/12/2012----------			----------6/21/2012----------			----------6/27/2012----------			----------7/9/2012----------		
	---------- % ----------											
No	CHEAL*	AMARE	Injury	CHEAL	AMARE	Injury	CHEAL	AMARE	Injury	CHEAL	AMARE	Injury
1	88 ab	94 a	18 a	94 ab	99 a	15 a	94 a	89 a	6 ab	93 ab	99 a	0 a
2	80 ab	91 ab	13 a	86 bc	96 a	11 a	88 ab	91 b	5 ab	93 ab	100 a	0 a
3	71 b	85 c	14 a	81 cd	95 a	9 a	78 c	98 a	2 b	89 b	100 a	0 a
4	94 a	95 a	15 a	98 a	96 a	12 a	96 a	99 a	6 ab	100 a	100 a	0 a
5	86 ab	94 a	16 a	84 c	100 a	12 a	84 bc	98 a	4 ab	89 b	100 a	0 a
6	88 ab	86 bc	16 a	71 e	76 b	13 a	94 a	95 ab	9 a	94 ab	98 a	0 a
7	90 a	93 a	20 a	75 de	94 a	14 a	95 a	95 ab	7 ab	99 a	100 a	0 a
8	88 ab	94 a	16 a	73 e	90 a	10 a	95 a	95 ab	6 ab	96 ab	99 a	0 a
9	78 ab	90 abc	13 a	89 abc	94 a	10 a	84 bc	94 ab	3 b	90 b	98 a	0 a
10	95 a	95 a	15 a	96 a	96 a	11 a	96 a	99 a	3 b	100 a	100 a	0 a
11	93 a	94 a	15 a	98 a	99 a	11 a	96 a	96 a	5 ab	98 a	98 a	0 a
12	0 c	0 d	0 b	0 f	0 c	0 b	0 d	0 c	0 c	0 c	0 c	0 a
LSD(P=.05)	11.7	4.4	6.1	6.3	8.5	6.4	6.0	3.3	5.2	5.0	3.4	0.0

*Abbreviations: CHEAL = common lambsquarters, AMARE = redroot pigweed.

Table 4. Treatment effects on onion yield and grade.

	----------2 Double Rows X 6'----------												
Trt	----<1"----		-1" – 2.25"-		-2.25" – 3"-		---3" – 4" ---		----- >4" -----		----Total----		
No	#	Lbs	#	Lbs	#	Lbs	#	Lbs	#	Lbs	#	Lbs	CWT/A
1	0 a	0 a	1 ab	0.2 ab	9 ab	3.8 a	15 abc	11 bc	0.5 a	0.6 a	26.3 b	15.4 bc	372 bc
2	0 a	0 a	3 ab	0.4 ab	14 ab	5.3 a	20 ab	14 abc	0.3 a	0.3 a	36.5 ab	20.4 abc	493 abc
3	0 a	0 a	7 ab	1.1 ab	16 a	5.2 a	5 cd	3 cd	0.0 a	0.0 a	28.0 ab	9.75 c	236 c
4	0 a	0 a	2 ab	0.4 ab	9 ab	3.3 a	18 abc	14 abc	1.8 a	2.2 a	31.0 ab	20.1 abc	485 abc
5	0 a	0 a	5 ab	0.8 ab	15 a	5.5 a	9 bcd	5 cd	0.0 a	0.0 a	29.0 ab	11.5 c	278 c
6	0 a	0 a	3 ab	0.5 ab	10 ab	3.6 a	15 abc	12 bc	2.0 a	2.7 a	29.0 ab	18.5 abc	447 abc
7	0 a	0 a	1 ab	0.2 ab	5 bc	2.0 ab	18 abc	14 abc	1.3 a	1.6 a	25.8 b	17.3 abc	418 abc
8	0 a	0 a	2 ab	0.4 ab	5 bc	2.0 ab	24 a	19 ab	2.0 a	2.4 a	32.8 ab	23.2 ab	562 ab
9	0 a	0 a	11 a	1.5 a	9 ab	3.2 a	7 bcd	4 cd	0.0 a	0.0 a	25.5 b	8.8 c	213 c
10	0 a	0 a	1 ab	0.1 ab	9 ab	3.5 a	28 a	23 a	0.8 a	1.0 a	38.3 a	27.1 a	655 a
11	0 a	0 a	2 ab	0.4 ab	12 ab	4.6 a	16 abc	11 bc	0.0 a	0.0 a	30.0 ab	16.0 abc	387 abc
12	0 a	0 a	0 b	0.0 b	0 c	0 b	0 d	0 d	0.0 a	0.0 a	0.0 c	0.0 d	0 d
LSD (P=.05)	0	0	5.9	0.8	5.4	2.1	8.9	6.8	2.0	2.5	7.3	7.2	175

Treatments that included bromoxynil during at least one of the application timings provided better common lambsquarters control throughout the trial compared to treatments without bromoxynil. In contrast, the treatment with oxyfluorfen applied alone had poor common lambsquarters control. However, applying bromoxynil at the 0.0625 lb/A followed by tank mixes of bromoxynil and oxyfluorfen at 0.0625 lb/A provided the best common lambsquarters control compared to all other treatments. Applying bromoxynil at the 0.031 lb/A followed by tank mixes of bromoxynil and oxyfluorfen at the 0.0625 lb/A had significantly less control of common lambsquarters.

The highest yielding treatment was when bromoxynil was applied at 0.0625 lb/A followed by tank mixes of bromoxynil and oxyfluorfen at 0.0625 lb/A with 655 CWT/A. The lowest yielding treatment besides the untreated, which didn't produce any marketable bulbs, was when bromoxynil was applied at 0.031 lb/A followed by tank mixes of bromoxynil and oxyfluorfen at 0.0625 lb/A with 213 CWT/A. The preemergence conventional treatment of ethofumesate at 1 lb/A had the second highest yield of 562 CWT/A.

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Nitrogen Management in Hard Red Spring Wheat Utilizing Remote Sensing

W. Albus, L. Besemann and H. Eslinger

Intense management in hard red spring wheat including; plant population, seeding depth, disease control, weed control, nitrogen rate and timing have made great strides in increasing yield levels of quality grain. Nitrogen(N) uptake in wheat occurs during late spring and early summer when soil mineralization of N can vary greatly from year to year. Excessive N, results in increased lodging that reduces yield. Insufficient N, results in low yields and low protein. Therefore the next step in intensive management is to use plant indicators that determine plant N sufficiency in real time. Plant indicators can also allow us to determine if post flowering applications of N will increase grain protein.

To meet these objectives Faller hard red spring wheat was grown under intensive management at six N rates: 50, 100, 125 (NDRE), 150, 180 and 200 lbs N/acre. Glenn hard red spring wheat was grown under four N rates: 100, 150, 180 and 200 lbs N/acre. The 50 and 100 lb N treatments were applied in two applications by April 16. The 150 and 200 lb N treatments were applied in three applications by April 26. The 180 lb N treatment was treated as the 150 lb N treatment with the addition of 30 lb N/acre on June 6 to increase grain protein. The 50 + NDRE treatment was treated as the 50 lb N treatment until nitrogen was determined insufficient by the NDRE readings on May 9, when an additional 75 lbs N/acre was applied for a total of 125 lbs N/acre. Faller is grown on a significant acreage in ND and tends to be low in grain protein, whereas Glenn tends to have high grain protein content. The 100, 150, 180 and 200 lb N/acre treatments in the Glenn study were applied as in the Faller study. Normalized difference red edge values (NDRE) is a plant sensed indice that measures vegetation by both red edge color and bio-mass and thus can be used as a measure of plant N sufficiency. A goal in this study is to determine what sufficiency value is required to meet plant needs.

MATERIALS AND METHODS

Soil:	Maddock sandy loam; pH=7.4; 1.7 % organic matter; soil-N 18 lbs/acre; soil-P and soil-K were very high.
Previous crop:	2011 soybean.
Seedbed preparation:	Spring no-tilled with a Seedmaster drill.
Planting:	Planted on March 19 with a Seedmaster drill. Planting rate was 2 bu/acre (1,600,000 seeds/acre).
Plots:	Plots were 17 ft long by 20 ft wide (two passes) wide. There were four reps.
Fertilizer:	At planting 25 lbs N/acre, 39 lbs P_2O_5/acre, 48 lbs K_2O/acre, 19 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1 with a separate shank ¾" to the side and ½" below the seed. Stream bar 76 lbs N/acre to all treatments except the 50 lb N treatments which received 26 lbs N/acre April 16. Stream bar 50 lbs N/acre to the 150 and 180 lb treatments and 100 lbs N/acre to the 200 lb treatment April 26. Stream bar 75 lbs N/acre to 50 + NDRE treatment May 9 and 30 lbs N/acre to the 180 lb treatment June 6 as 28-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.

Pest control:	Wolverine (1.7 pt/acre) April 30, Headline (6 oz/acre) May 3, Folicur (4 oz/acre) June 6 and Proline (5 oz/acre) June 9.
Remote sensing:	Remote sensing was achieved with a Holland Crop Circle ACS active canopy sensor (normalized difference red edge – NDRE).
Harvest:	July 19 with a Hege plot combine. Harvest area was one five feet wide passes 17 feet in length from the center of each plot.

RESULTS

Grain yields were not affected by N rate. Test weights were lowered with increasing N rates. Protein content increased with increasing N rate. Applying 30 lbs N/acre post anthesis tended to increase grain protein. Soil nitrate-N (0-2') on July 27, increased with increasing N level. Normalized difference red edge (NDRE) values increased with increasing N. Return to N was not significantly different among N rates in Faller but was significantly different in Glenn. Evidently, soil mineralization of soil organic N was much higher than expected as evidenced by the lack of return to N above 100 lbs/acre. Also, wheat photosynthesis slows down and may stop at temperatures of 82 to 85 degrees F whereas respiration continuous to increase with increasing temperatures up to 100 degrees. Heat stress becomes severe at 90 degrees. Daily maximum temperatures exceeded 84 degrees 27 times and exceeded 89 degrees 15 times from May 15 to July 15 (Fig. 1). This temperature induced stress may have prevented the wheat at the higher N rates to express it's additional yield potential.

Plant N sufficiency value was based on the NDRE value of an N treatment compared to an NDRE value of a high reference N treatment (N applied at a rate above that known to be sufficient). The hypothesis in this study was to assume that if the NDRE value of an N treatment was between 95-98% of the value in the high N reference treatment, no additional fertilizer N would need to be applied. The 200 lb N/acre rate was used as the high reference treatment. In this data set, NDRE values indicated the 150 lb/acre N rate was the appropriate N rate to provide sufficient N to meet chlorophyll and biomass requirements. In the 50 lb N rate plus NDRE treatment, the sufficiency index (NDRE) was low on May 9, at 76 percent. Seventy-five lbs/acre of N was applied on May 9, to bring the N sufficiency above the 95 % critical level for this treatment. Measurements on later dates showed N sufficiency less than 90%. The 75 lbs/acre N application on My 9 may not have been high enough.

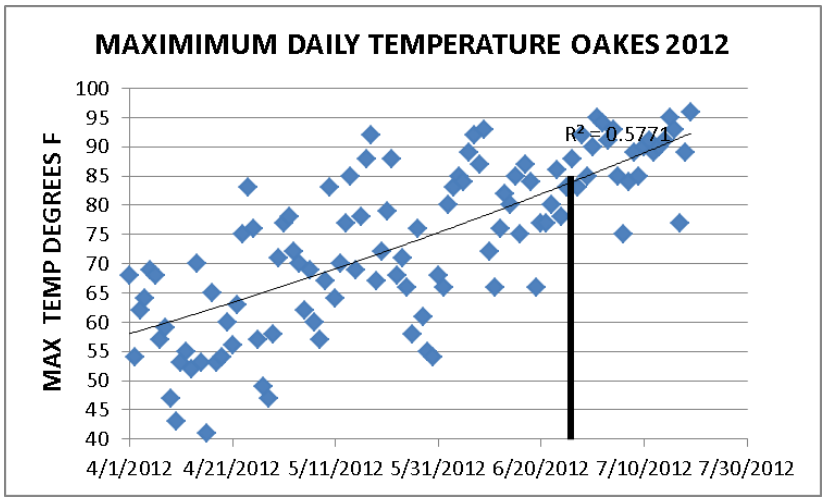

Figure 1. Daily maximum temperatures at Oakes ND 2012.

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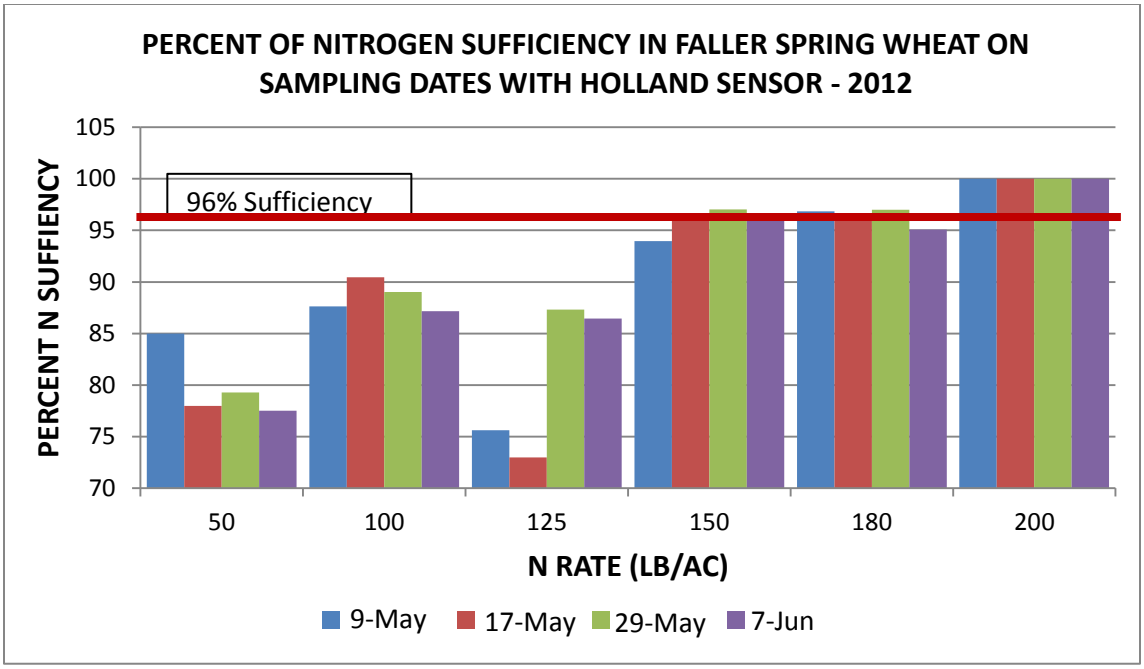

Figure 2. Nitrogen sufficiency for N rates at sampling dates for Faller spring wheat at the Oakes Irrigation Research Site in 2012.

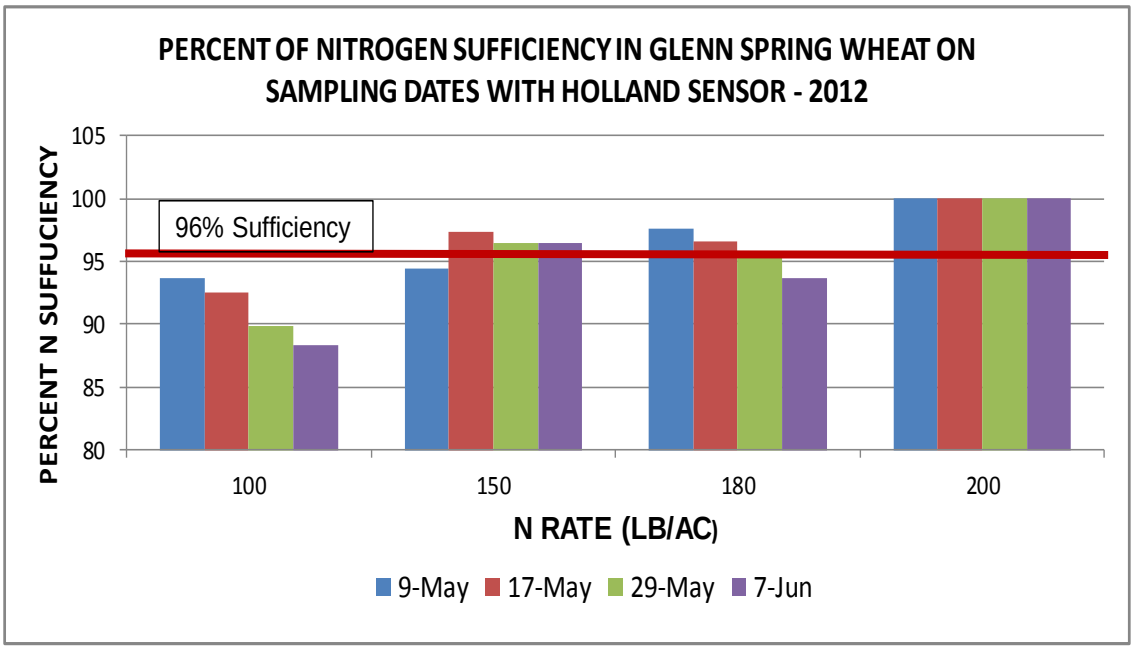

Figure 3. Nitrogen sufficiency for N rates at sampling dates for Glenn spring wheat at the Oakes Irrigation Research Site in 2012.

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Table 1. Nitrogen management in faller wheat utilizing remote sensing at the Oakes Irrigation Research Site in 2012.

N Rate	Grain Yield	Protein	Moist	Test Weight	NDRE Value[4] 9-May	17-May	29-May	7-Jun	Height	Soil-Nitrate-N Fall 2011	Fall 2012	Return to N[5]
	bu/ac	%	%	lb/bu					Inches	----lb/ac----		$/ac
50[1]	69.2	10.3	14.0	59.3	85	77	74	70	36.3	18	34	$486
100[1]	72.9	11.6	14.3	57.7	88	90	89	87	39	18	35	$500
200[1]	69.9	13.2	14.1	55.9	100	100	100	100	38.3	18	44	$460
150[1]	73.7	12.6	13.9	57.1	94	97	97	96	38.5	18	45	$505
150[1]+30[2]	70.0	13.7	14.0	56.6	97	97	97	95	38.8	18	48	$483
50[1]+NDRE[3]	69.1	12.2	14.0	57.3	76		92	93	37.8	18	38	$472
MEAN	70.8	12.2	14.0	57.3	89.8	92.1	91.6	90.0	38.1		40.7	$484
CV %	6.1	12.2	2.5	1.2		4.1	4.4	6.0	3.5		15.8	10.4
LSD.05	NS	0.7	NS	1.1		3	3	4	NS		10	NS

1 Applied by April, 26.

[2]Applied June 6, post flower.

[3]Applied 75 N/ac as dictated by NDRE values on May 9.

[4]NDRE value from Holland sensor.

[5]Wheat price $8 per bushel, nitrogen price $0.50 per pound.

Table 2. Nitrogen management in glenn wheat utilizing remote sensing at the Oakes Irrigation Research Site in 2012.

Nitrogen Management in Wheat Utilizing RemoteSensing

N Rate	Grain Yield	Protein	Moist	Test Weight	NDRE Value[3] 9-May	17-May	29-May	7-Jun	Height	Soil-Nitrate-N Fall 2011	Fall 2012	Return to N[4]
	bu/ac	%	%	lb/bu					Inches	----lb/ac----		$/ac
100[1]	65.4	13.3	13.8	62.3	94	93	90	88	45	18	45	$466
150[1]	66.4	14.8	13.6	61.7	94	97	96	96	45	18	37	$464
200[1]	62.3	15.3	13.7	60.7	100	100	100	100	44	18	50	$410
150[1]+30[2]	66.0	15.4	13.4	61.5	98	97	95	94	44	18	39	$451
MEAN	65.0	14.7	13.6	61.5	96	97	95	95	44		42.8	$448
CV %	3.9	2.0	2.3	0.8	3.2	1.6	1.5	1.7	21.6		21.6	4.9
LSD.05	NS	0.5	0.5	0.8	NS	2	2	3	NS		NS	35

[1]Applied by April, 26.

[2]Applied June 6, post flower.

[3]NDRE value from Holland sensor.

[4]Wheat price $8 per bushel, nitrogen price $0.50 per pound;

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Potato Starter Fertilizer Trial. Harlene Hatterman-Valenti and Collin Auwarter.

This study was conducted at the Oakes Irrigation Research Station to evaluate various rates of in-furrow starter fertilizer on Russet Burbank potato. Plots were 4 rows by 17 feet arranged in a randomized complete block design with four replicates. Starter fertilizers, fert-A and fert-B, was tank-mixed and applied at different rates (shown below). There was also a grower standard application with 10-34-0 at 25 gal/A and an untreated that didn't receive any starter fertilizer. Soil tests taken prior to the trial showed 24 lb N, 17 ppm P, and 145 ppm K. Pre-plant applications of 51 lbs N as 46-0-0 and 200 lbs K (grower standard application, treatment 2) or 140 lbs K (treatments 3-6) as 0-0-60 were applied and incorporated on May 10, 2012. Closing disks were removed from the planter as we planted potatoes to allow in-furrow application of starter fertilizers. In addition to fert-A and fert-B, 28% urea was tank mixed to bring the total N to 100 lbs in each treatment. Fertilizer amounts after planting were 100 lbs N, various lbs P, 200 lbs K in treatment 2, and 140 lbs K in treatments 3-6. Nitrogen, as 28-0-0 was stream barred and immediately irrigated with 0.30" irrigation on June 25 (47 lbs) and July 25 (53 lbs). Potatoes were harvested October 9 with a single-row digger and graded in Fargo.

Table 1. Effect of fertilizer treatments on potato yield and grade.

Trt	Trt	Form	Form		Rate	App	----------CWT/A----------					
No	Name	Conc	Type	Rate	Unit	Code	Total	0-4oz	4-6oz	6-10oz	>10oz	>4oz
1	N	28%	L	47	lb ai/a	C	380	106	97	120	57	274
	N	28%	L	53	lb ai/a	E						
2	N	46%	GR	51	lb ai/a	A	470	117	109	149	95	353
	K	60%	GR	200	lb ai/a	A						
	10-34-0	10,34%	L	25	gal/a	B						
	N	28%	L	47	lb ai/a	B						
	N	28%	L	53	lb ai/a	E						
3	N	46%	GR	51	lb ai/a	A	493	129	101	164	99	364
	K	60%	GR	140	lb ai/a	A						
	^Fert-A	na	L	15	gal/a	B						
	^Fert-B	na	L	3	gal/a	B						
	N	28%	L	47	lb ai/a	C						
	N	28/%	L	53	lb ai/a	E						
4	N	46%	GR	51	lb ai/a	A	549	122	118	184	125	427
	N	60%	GR	140	lb ai/a	A						
	^Fert-A	na	L	10	gal/a	B						
	^Fert-B	na	L	2	gal/a	B						
	N	28%	L	47	lb ai/a	C						
	N	28%	L	53	lb ai/a	E						
5	N	46%	GR	51	lb ai/a	A	455	144	97	121	93	311
	K	60%	GR	140	lb ai/a	A						
	^Fert-A	na	L	15	gal/a	B						
	^Fert-B	na	L	3	gal/a	B						
	N	28%	L	47	lb ai/a	C						
	*Foliar	na	L	na	na	D						
	N	28%	L	53	lb ai/a	E						
	*Foliar	na	L	na	na	F						
6	N	46%	GR	51	lb ai/a	A	435	133	99	133	70	302
	K	60%	GR	140	lb ai/a	A						
	^Fert-A	na	L	10	gal/a	B						
	^Fert-B	na	L	2	gal/a	B						
	N	28%	L	47	lb ai/a	C						
	*Foliar	na	L	na	na	D						
	N	28%	L	53	lb ai/a	E						
	*Foliar	na	L	na	na	F						
			LSD (P=.05)				125	44	36	65	47	119

Table 2. Effect of fertilizer treatments on the number of tubers produced.

Trt No	Trt Name	Form Conc	Form Type	Rate	Rate Unit	App Code	----------Tuber Count in 34 feet-------- Total	0-4oz	4-6oz	6-10oz	>10oz
1	N	28%	L	47	lb ai/a	C	369	212	80	59	18
	N	28%	L	53	lb ai/a	E					
2	N	46%	GR	51	lb ai/a	A	354	198	73	63	20
	K	60%	GR	200	lb ai/a	A					
	10-34-0	10,34%	L	25	gal/a	B					
	N	28%	L	47	lb ai/a	B					
	N	28%	L	53	lb ai/a	E					
3	N	46%	GR	51	lb ai/a	A	423	246	79	70	28
	K	60%	GR	140	lb ai/a	A					
	^Fert-A	na	L	15	gal/a	B					
	^Fert-B	na	L	3	gal/a	B					
	N	28%	L	47	lb ai/a	C					
	N	28/%	L	53	lb ai/a	E					
4	N	46%	GR	51	lb ai/a	A	356	187	75	68	26
	N	60%	GR	140	lb ai/a	A					
	^Fert-A	na	L	10	gal/a	B					
	^Fert-B	na	L	2	gal/a	B					
	N	28%	L	47	lb ai/a	C					
	N	28%	L	53	lb ai/a	E					
5	N	46%	GR	51	lb ai/a	A	377	229	72	54	22
	K	60%	GR	140	lb ai/a	A					
	^Fert-A	na	L	15	gal/a	B					
	^Fert-B	na	L	3	gal/a	B					
	N	28%	L	47	lb ai/a	C					
	*Foliar	na	L	na	na	D					
	N	28%	L	53	lb ai/a	E					
	*Foliar	na	L	na	na	F					
6	N	46%	GR	51	lb ai/a	A	383	236	69	59	19
	K	60%	GR	140	lb ai/a	A					
	^Fert-A	na	L	10	gal/a	B					
	^Fert-B	na	L	2	gal/a	B					
	N	28%	L	47	lb ai/a	C					
	*Foliar	na	L	na	na	D					
	N	28%	L	53	lb ai/a	E					
	*Foliar	na	L	na	na	F					
		LSD (P=.05)					99	66	24	25	11

^Fert –A & B – Confidential

*Foliar – Confidential

Fertilizer application code:
A = 5/14/12 – Treatments 2-6 @ Pre-plant
B = 5/14/12 – Treatments 2-6 @ Planting
C = 6/25/12 – Treatments 1-6 @ Tuber initiation
D = na
E = 7/25/12 – Treatments 1-6 @ Early tuber bulking
F = na

Potatoes receiving treatment 4 had the highest total yield at 549 cwt/A, and highest marketable yield at 427 cwt/A. The total and marketable yield was 17 and 21% higher, respectively, than the grower standard (treatment 2). Total tuber counts for treatments 2 and 4 were similar, while the distribution for the various grade categories indicated a shift towards larger tubers with treatment 4.

Black Label Zn Starter Fertilizer Trial on Potatoes Harlene Hatterman-Valenti and Collin Auwarter.

This study was conducted at the Oakes Irrigation Research Station near Oakes, ND to evaluate various rates of Loveland's Black Label Zn applied in-furrow on Russet Burbank potatoes. Plots were 4 rows by 17 feet arranged in a randomized complete block design with four replicates. Black Label Zn was applied at rates; 3, 6, 9, and 12 gal/A at planting. There was a grower standard application with 10-34-0 at 12 gal/A and an untreated that didn't receive any additional phosphorus at planting. Soil tests taken prior to the trial showed 24 lb N, 17 ppm P, and 145 ppm K. Pre-plant applications of 51 lbs N as 46-0-0 and 50 lbs K as 0-0-60 were applied and incorporated on May 10, 2012. Closing disks were removed from the planter as we planted potatoes to expose seed piece in-furrow and applied starter fertilizer. In addition to the Black Label Zn, tank mixing 28-0-0 urea was added to bring the total N to 100 lbs in each treatment. At this point, 100 lbs N, various lbs P, and 50 lbs K, 47 lbs N was applied on June 14 (tuber initiations stage) and 53 lbs N was applied on July 25 (early tuber bulking) to bring total N to 200 lbs.

Treatment 1: 3 gal/A Black Label Zn In-furrow at planting
Treatment 2: 6 gal/ A Black Label Zn In-furrow at planting
Treatment 3: 9 gal/ A Black Label Zn In-furrow at planting
Treatment 4: 12 gal/ A Black Label Zn In-furrow at planting
Treatment 5: 12 gal/ A 10-34-0 In-furrow at planting
Treatment 6: No starter

Table 1. Effect of Black Label Zn on potato yield and grade and tuber set.

Treatment	----------CWT/A----------						---------Tuber Counts in 34 feet----------				
	Total	0-4oz	4-6oz	6-10oz	>10oz	>4oz	Total	0-4oz	4-6oz	6-10oz	>10oz
1	411	118	109	123	61	293	355	193	83	61	18
2	453	127	116	139	71	326	366	190	88	68	20
3	459	141	113	138	67	318	400	225	86	70	19
4	459	152	126	132	49	307	417	241	96	65	15
5	410	122	119	125	44	288	358	193	90	62	13
6	408	119	111	117	61	289	353	192	84	58	19
LSD (P=.05)	89.0	28.4	27.5	36.4	46.5	81.0	89.8	43.5	21.4	18.0	12.4

Potatoes receiving at least 6 gal/A Black Label Zn in-furrow at planting yielded over 450 cwt/A, and had over 300 cwt/A of marketable tubers. This was approximately 10 and 12% more marketable and total yield, respectively, compared to the 10-34-0 starter treatment or the no starter treatment. Tuber count data suggested that the yield increase was not necessarily due to larger sets since only treatments 3 and 4 averaged 400 or more tubers in 34 ft of row. Tuber set for the no starter fertilizer treatment was approximately 10 tubers/plant, while the highest set occurred with treatment 4 with approximately 12 tubers/plant.

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The Response of Three Potato Cultivars to Nitrogen Rate

W. Albus, A. Thompson, L. Besemann and H. Eslinger

Three potato varieties, Russet Burbank, Bannock Russet and Dakota Trailblazer were grown in separate trials each at 120, 180, 240 and 300 lbs N /acre. Measurements were taken periodically to measure nitrogen sufficiency utilizing the following: Dry petioles and petiole sap were analyzed for nitrate-N; chlorophyll meter readings with a Minolta SPAD 502; and canopy vegetative indexes with a Crop Circle ACS 430. The canopy index used in these comparisons was the normalized difference red edge index (NDRE). The objective of these trials is to study varietal response to nitrogen(N) and determine if N sufficiency in a growing crop expressed by canopy index measurements can be used to determine the most efficient N application and rate.

MATERIALS AND METHODS

Soil:	Maddock sandy loam and Embden sandy loam; pH=7.1; 1.7 % organic matter; soil-N 27 lbs/acre; soil-P was very high, soil-K was high.
Previous crop:	2011 – field corn.
Seedbed Preparation:	Conventional tillage practices.
Planting:	April 25. Planting rate was one seed piece per foot.
Plots:	Plots were 17 ft long by 12 ft wide (4 rows). There were four reps.
Fertilizer:	March 20 broadcast 26 lbs N/acre, 41 lbs P_2O_5/acre, 49 lbs K_2O/acre, 20 lbs S/acre and 2 lbs Zn/acre as 10-16-20-8-1. See (Table 2) for N rate treatments.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Matrix (1.0 oz/acre) + Lexone (0.33 lb/acre) + Dual II Magnum (1¼ pt/acre) + NIS (0.125% v/v) June 4 for weed control. Mustang Max (4 oz/acre) July 25 for insect control. Fungicides used for disease control see (Table 1).
Remote sensing:	Remote sensing was achieved with a Minolta Spad 502 chlorophyll meter and a Holland Crop Circle ACS active canopy sensor (normalized difference red edge – NDRE).
Harvest:	Harvest September 19 to September 27. Harvested one of the two center rows (17 feet) of each plot.

RESULTS

Although fertilizer nitrogen(N) rate didn't significantly affect yield total yield was nearly maximized in all varieties at 180 lbs N/acre. A different picture evolves if one accounts for the graded yield if 0-4 oz, 4-6 oz, 6-12 oz and > 12 oz sized potatoes are given a market value of $5.00/cwt, $14.50/cwt, $12.00/cwt and $16.00/cwt respectively. When graded value is accounted for, the highest return to N was found at the 240 lb N/acre N rate in Bannock Russet

and Russet Burbank and at the 180 N/acre N rate in Dakota Trailblazer. The three year means give us a clearer picture of return to N above 120 lbs N/acre in (Fig. 1) which shows the highest returns for Dakota Trailblazer and Russet Bank at the 300 lb/acre N rate and Bannock Russet at the 180 lb/acre N rate. Plant nitrogen sufficiency, as determined by chlorophyll meter readings on August 23 and NDRE measurements on August 21, showed N sufficiency to be below 96% for all N rates below 300 lbs N/acre (Fig. 2). Nitrate-N in dry petioles exceeded the critical value for all varieties at the 180 and 240 lb N rates through August 3 (Fig. 3). Dry petiole nitrate-N exceeded the critical value on all dates for the 300 lb/acre rate.

Table 1. Fungicide treatments.

Date	Fungicide	Rate
20-Jun	Pennzcob DF 75 + Headline	1.1 lb/ac + 8 oz/ac
3-Jul	Revius Top	7 oz/ac
13-Jul	Pennzcob DF 75	2 lb/ac
18-Jul	T-Methyl	30 oz/ac
25-Jul	Headline	12 oz/ac
2-Aug	Evito	3.1 oz/ac
7-Aug	Revius Top	7 oz/ac
14-Aug	Quadris Opti	1.6 pt/ac
24-Aug	Pennzcob DF 75 + Curzate	1.1 lb/ac + 8 oz/ac
4-Sep	Evito	3.2 oz/ac

Table 2. Nitrogen treatments.

	Application date					
N rate	20-Mar	18-May	1-Jun	19-Jun	3-Jul	16-Jul
	----------lbs N applied----------					
120	26	47	47			
180	26	47	47	60		
240	26	47	47	60	60	
300	26	47	47	60	60	60

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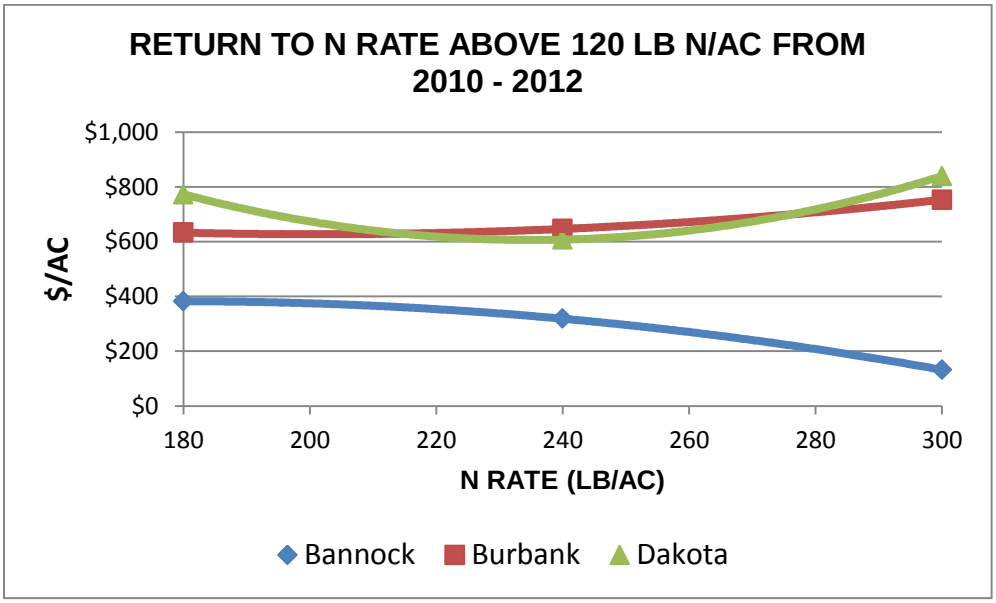

Figure 1. The return to N Rates above 120 lbs N/acre at the Oakes Irrigation Research Site from 2010 to 2012.

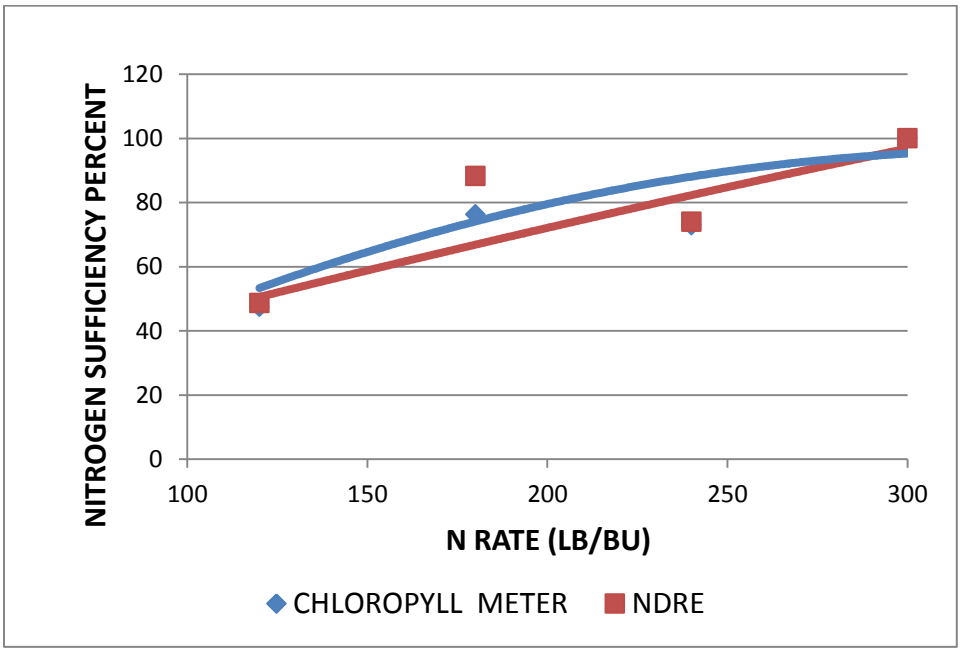

Figure 2. The percent nitrogen sufficiency for N rates determine by chlorophyll meter readings on August 23 and determined by NDRE readings on August 21, at the Oakes Irrigation Research Site in 2012.

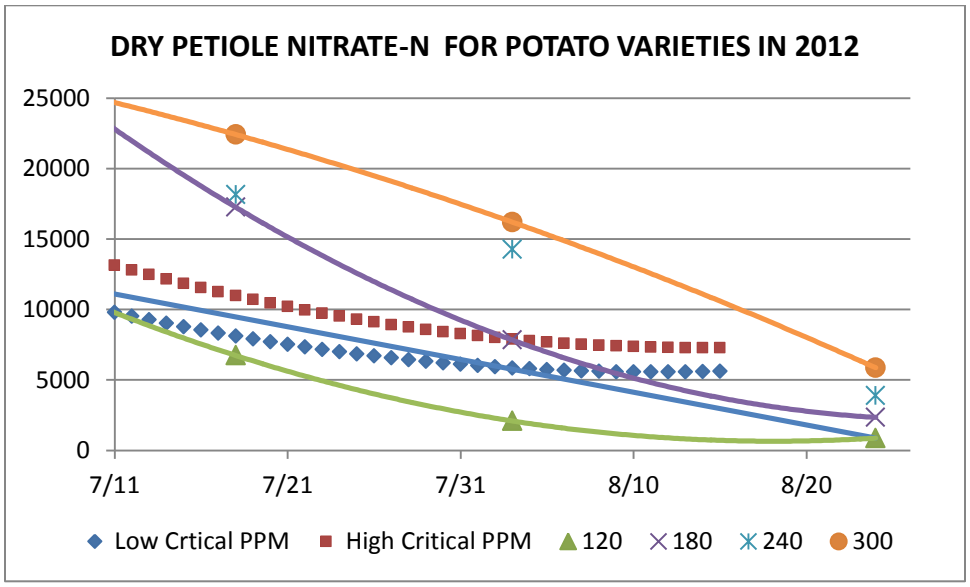

Figure 3. The dry petiole nitrate-N (PPM) means for Russet Bannock, Russet Burbank and Dakota Trailblazer at the Oakes Irrigation Research Site in 2012.

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Table 3. Bannock Russet.

Fertilizer								Chlorophyll Meter		NDRE Value - Holland Sensor	
N Rate	0-4 oz	4-6 oz	6-12 oz	>12 oz	Total	2's	Culls	3-Aug	23-Aug	20-Jul	21-Aug
lb/ac	----------cwt/ac----------										
120	41	80	202	57	380	14	7	12	11	0.2936	0.1532
180	28	43	204	149	424	14	30	15	15	0.3271	0.2476
240	41	44	228	131	444	12	20	15	14	0.3157	0.2122
300	31	41	179	132	383	23	18	19	18	0.3553	0.3015
Mean	35	52	203	117	408	16	19	15	14	0.3229	0.2286
CV%	32.4	23.6	17.4	370.0	9.1	33.0	79.1	9.0	9.3	4.8	28.8
LSD.05	NS	19.7	NS	NS	NS	NS	NS	2.2	2.1	NS	NS

Table 3. Bannock Russet continued.

Fertilizer	Specific	Hollow	Brown	Dry Petiole NO_3-N			Petiole Sap NO_3-N		$ Return Over
N Rate	Gravity	Heart	Center	18-Jul	3-Aug	24-Aug	18-Jul	3-Aug	120 lb/ac N rate
lb/ac		#	#	----------ppm----------			----------ppm----------		$
120				6976	2473	348	690	1053	
180				15121	9234	1411	1500	1745	$902
240				17702	14637	3036	895	1518	$964
300				20260	17782	5717	2100	2175	$315
Mean				15015	11032	2628	1296	1623	$727
CV%							17.1	26.1	10.36
LSD.05							355	677	NS

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Table 4. Russet Burbank.

Fertilizer								Chlorophyll Meter		NDRE Value - Holland Sensor	
N Rate	0-4 oz	4-6 oz	6-12 oz	>12 oz	Total	2's	Culls	3-Aug	23-Aug	20-Jul	21-Aug
lb/ac	----------cwt/ac----------										
120	69	89	148	87	392	22	17	9.9	7.4	0.2644	0.1744
180	53	64	183	151	451	26	26	15.1	12.4	0.3171	0.2714
240	47	67	207	137	457	26	28	13.1	12.5	0.3034	0.2509
300	47	50	222	140	459	37	24	18.8	17.5	0.3393	0.3089
Mean	54	67	190	129	440	28	24	14	12	0.3060	0.2514
CV%	30.8	41.5	24.3	31.7	9.8	78.1	48.4	13.6	19.8	7.0	15.6
LSD.05	NS	NS	NS	NS	NS	NS	NS	3.1	3.9	0.03438	0.0626

Table 4. Russet Burbank continued.

Fertilizer	Specific	Hollow	Brown	Dry Petiole NO_3-N			Petiole Sap NO_3-N		$ Return Over
N Rate	Gravity	Heart	Center	18-Jul	3-Aug	24-Aug	18-Jul	3-Aug	120 lb/ac N rate
lb/ac		#	#	----------ppm----------			---------lb/ac---------		$
120				6895	2550	1938	918	808	
180				15202	9073	3281	775	1505	$1,009
240				16169	15927	7113	905	1158	$1,079
300				23196	17782	8757	1725	2350	$1,077
Mean				15366	11333	5272	1081	1455	$1,055
CV%							27.9	30.7	10.65
LSD.05							482.0	714.0	NS

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Table 5. Dakota Trailblazer.

Fertilizer								Chlorophyll Meter		NDRE Value - Holland Sensor	
N Rate	0-4 oz	4-6 oz	6-12 oz	>12 oz	Total	2's	Culls	3-Aug	23-Aug	20-Jul	21-Aug
lb/ac	----------cwt/ac----------										
120	27	57	226	102	412	6	6	10.0	7.7	0.2651	0.1238
180	24	42	218	203	488	6	12	14.4	13.9	0.3023	0.2990
240	25	31	183	221	459	12	12	12.9	13.4	0.2885	0.2229
300	28	28	219	198	472	18	10	20.2	18.9	0.3277	0.3167
Mean	26	39	212	181	458	10	10	14	14	0.2959	0.2406
CV%	26.0	32.1	106.0	26.3	8.5	96.7	83.3	11.1	14.9	4.4	15.2
LSD.05	NS	20.2	NS	76.1	NS	NS	NS	2.6	3.2	0.021	0.0600

Table 5. Dakota Trailblazer continued.

Fertilizer	Specific	Hollow	Brown	Dry Petiole NO_3-N			Petiole Sap NO_3-N		$ Return Over
N Rate	Gravity	Heart	Center	18-Jul	3-Aug	24-Aug	18-Jul	3-Aug	120 lb/ac N rate
lb/ac		#	#	----------ppm----------			---------lb/ac---------		$
120				6331	1238	331	1125	1345	
180				21435	5174	2329	1600	1620	$1,294
240				20596	12218	1472	1700	1510	$993
300				23784	13024	3112	2000	2225	$1,029
Mean				18037	7914	1811	1606	1675	$1,105
CV%							23.0	30.2	9.9
LSD.05							590	NS	NS

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Strip-Till, Corn on Corn, Nitrogen Rate Study

W. Albus, L. Besemann and H. Eslinger

Corn grain production has made amazing increases in both yield and number of acres planted ND in the past 15 years. The corn acres planted and total bushels harvested in ND from 1997-2012 is shown in (Fig. 1). We are currently planting about 3.39 million acres of corn and producing about 407 million bushels annually.

North Dakota ethanol production capacity is about 398 million gallons. At an efficiency of 2.8 gal/bu of corn this ethanol production requires 142 million bushels of corn annually, which is about one third of the corn grown in the state. This and price ratios with other crops favoring corn production, will continue to push for more corn acres in the state requiring more corn on corn in the traditional corn growing regions in the state.

It is the objectives of this study to grow continuous corn in a strip-till system that eliminates full width tillage and to find efficient nitrogen placement and rates. Plots are spring strip-tilled. Fertilizer nitrogen is applied in two split applications, the first by planting and the second at side-dress. Placement is addressed by applying the planting time N application either with the strip-till operation prior to planting or dribbling to the side of the seed furrow at planting. Determining nitrogen sufficiency in time is important to achieve N efficiency. Remote sensing utilizing aerial photography (light reflectance), a Holland Crop Circle ACS 430 active canopy sensor (normalized difference red edge – NDRE) and a Minolta SPAD 502 chlorophyll meter were tested to determine ability to measure N sufficiency.

MATERIALS AND METHODS

Soil:	Embden sandy loam and Helca sandy loam; pH=7.1; 2.3% organic matter; soil-N average 8 lbs/acre; soil-P and soil-K were high; soil-S was low.
Previous crop:	2011 - field corn.
Seedbed preparation:	Strip-till April 23 with an Orthman strip-till machine.
Hybrid:	Pioneer P9917 AMI.
Planting:	Planted April 24 in 30-inch rows @ 33,000 seeds/ac.
Plots:	Plots were 137 ft long by 20 ft (8 rows) wide. There were four reps.
Fertilizer:	April 5 all plots received a broadcast application of 142 lbs K_2O/acre as 0-0-60. April 23 all plots, except the 25 lb/acre N rate treatments, received 40 lbs N/acre as 28-0-0, 13 lbs N/acre and 18 lbs S/acre as 15-0-0-20 via strip till or dribble (April 26). April 26 all plots received 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 via dribble. The 25 lb/acre plots received 13 lbs N/acre and 18 lbs S/acre as 15 0-0-20 dribbled after planting. Sidedress N treatments June 6; the 200 lb treatments received 135 lbs N/acre and 150 lb treatments received 85 lbs N/acre as 28-0-0 (three inches deep).

Irrigation: Hand move sprinkler irrigation as needed.

Pest control: Harness (1 pt/acre) +Lumax (1 pt/acre) + Atrazine (0.5 lb ai/acre) May 3, Roundup Power Max (32 oz/acre) May 14.

Remote sensing: Remote sensing was achieved with a Minolta Spad 502 chlorophyll meter and a Holland Crop Circle ACS active canopy sensor (normalized difference red edge – NDRE).

Harvest: October 1 with a Case IH 1640 combine. Harvest area was the middle six rows of each plot 137 feet long.

RESULTS

All plots were spring strip-tilled at a six to eight-inch depth with ten gal/acre of 10-34-0 applied. The 10-34-0 was placed at about 2 inches deep in this operation. All plots received 12 lbs N/acre at this time. We are testing the application of the 10-34-0 at this shallow depth in the strip-till application to determine any evident seed burn. No apparent damage to emerged stands was noted from 2010-12. The 25 lb N/acre treatments got another 13 lbs N/acre dribbled to the side of the seed row after planting as ammonium thiosulfate. The remainder of the first N split in the 150 and 200 lb N/acre treatments was applied at a six-inch depth with strip-till as 45 lbs N/acre as UAN and 8 lbs N/acre as ammonium thiosulfate. Note, ammonium thiosulfate must not get in contact with the seed. In the 150d and 200d treatments the remainder of the first split applied was applied as UAN at 45 lbs N/acre and 8 lbs N/acre as ammonium thiosulfate applied in a surface dribbled to the side of the seed row at planting. The second N split in the 150, 200, 150d and 200d treatments was applied as UAN at side-dress in-between every row at a three-inch depth.

Determining nitrogen sufficiency in time is important to achieve N efficiency. Remote sensing utilizing a Holland Crop Circle ACS 430 active canopy sensor (normalized difference red edge – NDRE) and a Minolta SPAD 502 chlorophyll meter were tested to determine ability to measure N sufficiency.

Increasing nitrogen rates (N) increased grain yield, chlorophyll meter readings and normalized difference red edge (NDRE). Remote sensing by chlorophyll meter and the Crop Circle Sensor did well in predicting corn N status. The percent of maximum return to N for each N rate from 2007 to 2012 is shown in (Fig. 2). Maximum economic return to N has been highest at the 200 lb/acre N rate.

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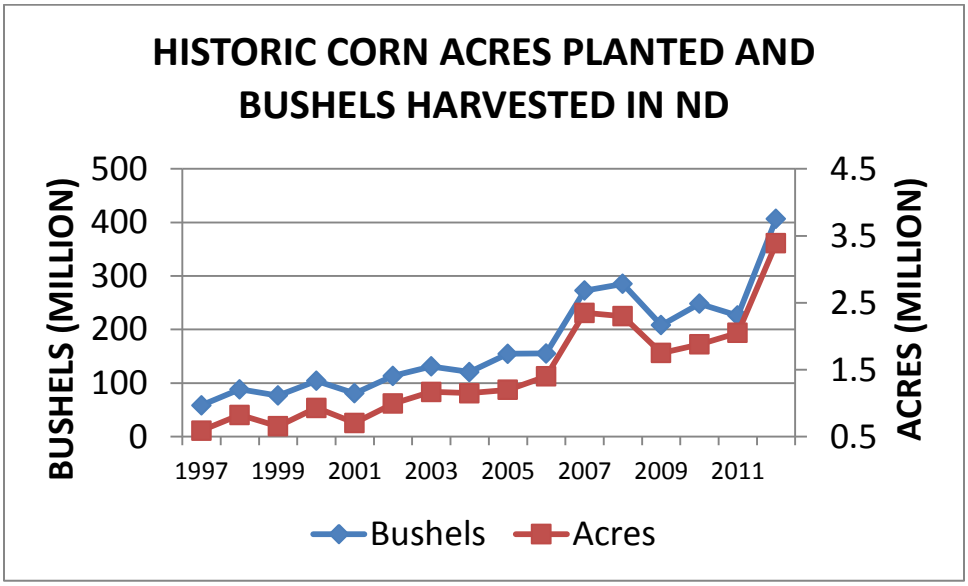

Figure 1. Acres planted to corn and total bushels harvested from 1997-2012 in North Dakota.

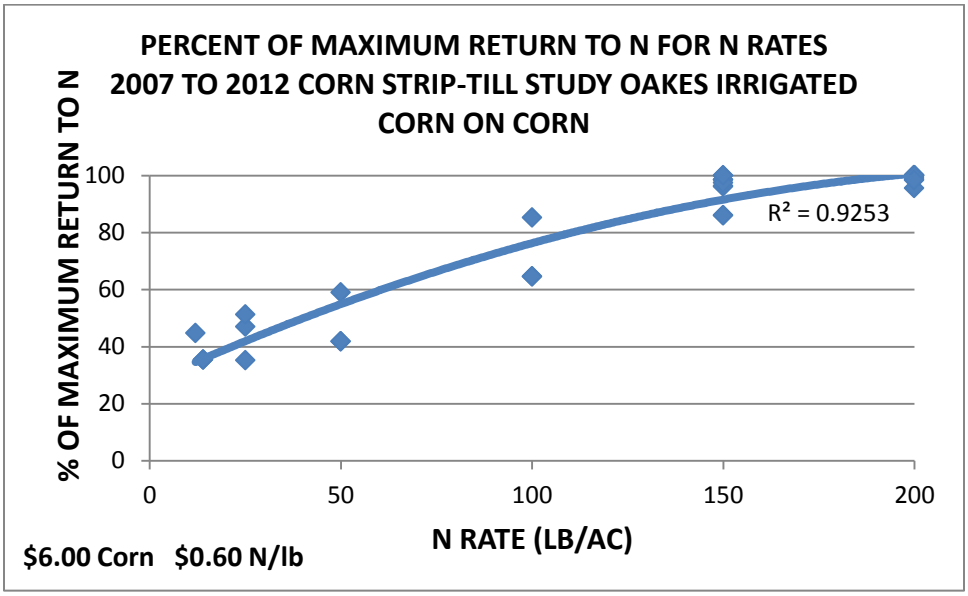

Figure 2. Percent of maximum return to N for N rates from 2007 to 2012 at the Oakes Irrigation Research Site.

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Table 1. Strip-till, corn on corn nitrogen rate study at the Oakes Irrigation Research Site in 2012.

Fertilizer[3] N Rate	Grain Yield[1]	Harvest Moisture	Test Weight	Mature Date	Chlorophyll Meter 6-Aug	Chlorophyll Meter 21-Aug	NDRE Reading 27-Jul	Stalk Nitrate-N	Soil Nitrate-N Fall 2011	Soil Nitrate-N Fall 2012	Return to[4] N Above Low N Rate
lb/ac	bu/ac	%	lb/bu					ppm	------lb/ac------		$
25	82.2	13.7	54.9	9/14	12.5	6.6	0.2611	56	13	13	$478
150d[2]	238.0	17.5	56.1	9/16	53.8	46.6	0.3709	68	18	15	$1,338
200d[2]	243.5	17.9	56.4	9/16	56.2	52.6	0.3781	641	39	38	$1,341
150	232.5	17.4	56.7	9/16	53.8	48.4	0.3814	117	18	16	$1,305
200	246.4	18.1	56.0	9/17	54.3	50.5	0.3774	375	38	35	$1,358
Mean	208.5	16.9	56.0	9/16	46.1	40.9	0.4	251.2		23.4	$1,164
CV%	4.4	3.5	1.8		3.9	5.7	2.5	102.0		54.2	
LSD.05	14.2	0.9	1.5		2.8	3.6	0.0138	397.0		19.6	

[1]Yield adjusted to 15.5% moisture.

[2]45 lbs N /acre of planting N applied as dribble treatment to the side of the row.

[3]65 lbs N/acre with pre-planting strip-till and or at planting. The remainder N sidedressed on June 6, except for the 25 lb N/acre rate which was all applied pre planting strip-till and planting.

[4]Corn @$6.00/bu, N @ $0.60/lb.

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Strip-Till, Corn on Soybean, Nitrogen Rate Study

W. Albus, L. Besemann and H. Eslinger

The objective of this study is to compare corn yields of a corn/soybean rotation to those in a companion corn/corn rotation and to find differences in N response and other agronomic measurements in these no-till rotations, utilizing strip-till.

MATERIALS AND METHODS

Soil:	Embden sandy loam, Hecla sandy loam and Maddock sandy loam; soil-N average 13 lbs/acre.
Previous crop:	2011 – soybean.
Seedbed Preparation:	Strip-till April 23 with an Orthman strip-till machine.
Hybrid:	Pioneer P9917 AMI
Planting:	Planted April 24 @ 33,000 plants per acre in 30 inch rows.
Plots:	Plots were 37 ft long by 15 ft (6 rows) wide. There were four reps.
Fertilizer:	April 5 all plots received a broadcast application of 142 lbs K_2O/acre as 0-0-60. April 23 all plots, except the 25 lbs/acre N rate treatments, received 40 lbs N/acre as 28-0-0, 13 lbs N/acre and 18 lbs S/acre as 15-0-0-20 via strip till or dribble (April 26). April 26 all plots received 12 lbs N/acre and 40 lb P_2O_5/acre as 10-34-0 via dribble. The 25 lb/acre plots received 13 lbs N/acre and 18 lbs S/acre as 15 0-0-20 dribbled after planting. Sidedress N treatments June 6; the 200 lb treatments received 135 lbs N/acre and 150 lb treatments received 85 lbs N/acre as 28-0-0 (three inches deep).
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Harness (1 pt/acre) +Lumax (1 pt/acre) + Atrazine (0.5 lb ai/acre) May 3 and Roundup Power Max (32 oz/acre) May 14.
Remote sensing:	Remote sensing was achieved with a Minolta Spad 502 chlorophyll meter and a Holland Crop Circle ACS active canopy sensor (normalized difference red edge – NDRE).
Harvest:	Hand harvest October 2 and October 3. Harvest area was the two center rows from each plot (seventy-two feet of total row).

RESULTS

All plots were spring strip-tilled at a six to eight-inch depth with ten gal/acre of 10-34-0 applied. The 10-34-0 was placed at about 2 inches deep in this operation. All plots received 12 lbs N/acre at this time. We are testing the application of the 10-34-0 at this shallow depth in the strip-till application to determine any evident seed burn. No apparent damage to emerged stands was noted from 2010-2011. The 25 lb N/acre treatments got another 13 lbs N/acre dribbled to the side of the seed row after planting as ammonium thiosulfate. The remainder of the first N split in the 100, 150 and 200 lb N/acre treatments was applied at a six-inch depth with strip-till as 45 lbs N/acre as UAN and 8 lbs N/acre as ammonium thiosulfate. Note, ammonium thiosulfate must not get in contact with the seed. In the 100d treatment the remainder of the first split was applied as UAN at 45 lbs N/acre and 8 lbs N/acre as ammonium thiosulfate applied surface dribbled to the side of the seed row at planting. The second N split in the 100, 100d, 150, and 200 treatments was applied as UAN at side-dress in-between every row at a three-inch depth.

Determining nitrogen sufficiency in time is important to achieve N efficiency. Remote sensing utilizing aerial photography (light reflectance), a Holland Crop Circle ACS 430 active canopy sensor (normalized difference red edge – NDRE) and a Minolta SPAD 502 chlorophyll meter were tested to determine ability to measure N sufficiency.

Increasing nitrogen rates (N) increased grain yield, chlorophyll meter readings and normalized difference red edge (NDRE). Remote sensing by chlorophyll meter and the Crop Circle Sensor did well in predicting corn N status. The percent of maximum return to N for each N rate from 2007 to 2012 is shown in (Fig. 1). Although maximum economic return to N has been highest at the 200 lb/acre N rate in the corn soybean rotation the increase in return above the 150 lb/acre N rate is less consistent than in the corn on corn rotation.

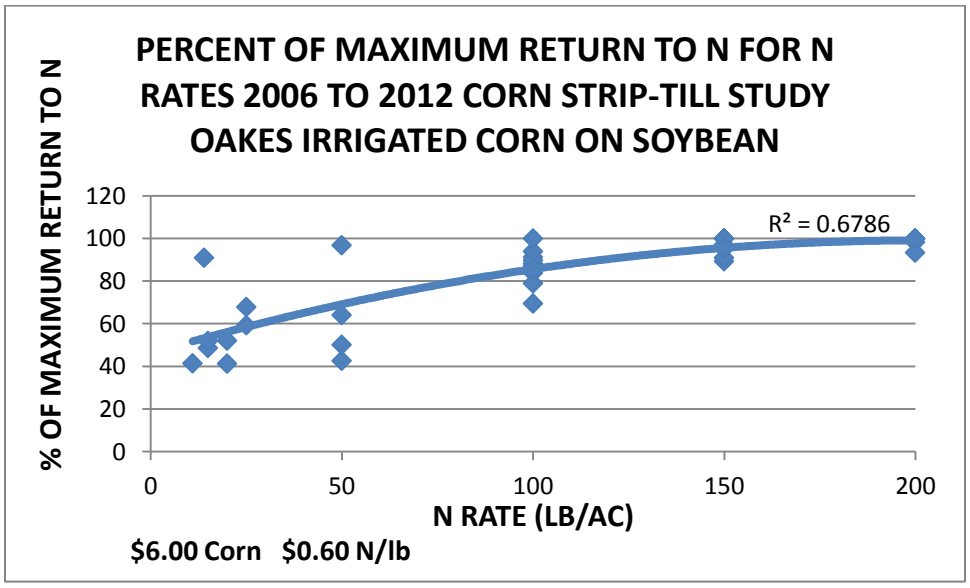

Figure 1. Percent of maximum return to N for N rates from 2006 to 2012 at the Oakes Irrigation Research Site.

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Table 1. Strip-till, corn on soybean, nitrogen rate study at the Oakes Irrigation Research Site in 2012.

Fertilizer[3] N Rate	Grain Yield[1]	Harvest Moisture	Test Weight	Chlorophyll Meter 6-Aug	Chlorophyll Meter 21-Aug	Stalk Nitrate-N	Soil Nitrate-N Fall 2011	Soil Nitrate-N Fall 2012	Return to[4] N Above Low N Rate
lb/ac	bu/ac	%	lb/bu			ppm	----lb/ac----		$
25	146.0	14.8	57.4	22.5	12.1	29	19	8	$861
100d[2]	220.5	15.4	59.6	49.3	35.7	7	14	13	$1,263
100	223.4	15.2	59.4	46.2	34.8	3	15	11	$1,281
150	249.9	15.7	59.8	52.2	43.9	7	18	11	$1,410
200	262.1	16.3	59.5	55.0	51.2	137	31	26	$1,453
Mean	220.4	15.5	59.1	45.0	35.5	36.6		13.8	$1,253
CV%	3.3	1.7	0.8	5.1	7.5	45.9		26.9	
LSD.05	11.1	0.4	0.7	3.6	4.1	25.9		5.7	

[1]Yield adjusted to 15.5% moisture.

[2]45 lbs N /acre of planting N applied as dribble treatment to the side of the row.

[3]65 lbs N/acre with pre-planting strip-till and or at planting. The remainder N sidedressed on June 5, except for the 25 lb N/acre rate which was all applied pre planting strip-till and planting.

[4]Corn @$6.00/bu, N @ $0.60/lb.

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Strip-Till, Soybean on Corn Study

W. Albus, L. Besemann and H. Eslinger

Soil:	Embden sandy loam, Embden loam Hecla sandy loam Gardena loam and Maddock sandy loam.
Previous crop:	2011 – field corn.
Seedbed Preparation:	Strip-till April 24 with an Orthman strip-till machine.
Hybrid:	Syngenta NK, CL0911650-1.
Planting:	Planted May 18 @ 205,000 plants per acre in 30 inch rows.
Plots:	Plots were 37 ft long by 15 ft (6 rows) wide. There were four reps.
Fertilizer:	April 5 all plots received a broadcast application of 142 lbs K_2O/acre as 0-0-60. April 26 all plots received 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 via dribble.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Roundup Power Max (32 oz/acre) May 14 and Roundup Power Max (40 oz/acre June 21. Endura (11 oz/acre) July 11.
Harvest:	September 24 with a 4400 JD combine (60 rows 74 feet long, recorded with a weigh wagon).

RESULTS

All soybean plots were combine harvested and bulked. The soybeans yielded 79.7 bu/acre at 9.7% moisture and had a test weight of 57.0 lbs/bu.

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Optimum Corn Stover Removal for Biofuels and the Environment

W. Albus, L. Besemann and H. Eslinger

The 2007 US energy bill calls for 36 billion gallons of ethanol to be produced by 2020. In 2007 the US produced 6.5 billion gallons of ethanol. If corn grain was able to supply 15 billion gallons of ethanol, 21 billion gallons ethanol would have to come from cellulosic material (biomass) to meet the 2020 mandate. The production of 21 billion gallons of cellulosic ethanol will require 350 million tons of dry biomass. Presently, perennial grasses and corn stover are the most available. About 194 million tons of biomass is produced in US production agriculture annually, with 75 million tons coming from corn stover. Therefore corn stover is being looked at to play a major role in cellulosic ethanol production.

Before we commit ourselves to using corn stover for fuel we need to study the environmental and economic consequences of this action. What effect will stover removal have on soil organic matter, soil erosion and ultimately sustainability of the land resource?
The objective of this study is to determine what rates of stover removal within different cropping systems are conducive to maintaining and possibly improving the productive capacity of the land while providing this Country with a renewable energy source.

MATERIALS AND METHODS

Rotations:	Block I: 2012 – field corn, 2011 - field corn, 2010 - field corn, 2009 - field corn.
	Block II: 2012 – soybean, 2011 - field corn, 2010 - soybean, 2009 - field corn.
	Block III: 2012 – field corn, 2011 - soybean, 2010 - field corn, 2009- soybean.
Soil:	Embden sandy loam, Hecla sandy loam and Maddock sandy loam.
	Block I: soil-N 27 lbs/acre; soil-P and soil-K were very high; soil-S was medium.
	Block II: soil-N 19 lbs/acre; soil-P was very high, soil-K was high; soil-S was medium.
	Block III:
Seedbed preparation:	Strip-till April 23 with an Orthman strip-till machine.
Hybrid: Variety:	Corn: Wensman W7320 VT 3PRO.
	Soybean: Syngenta NK, CL0911650-1.
Planting:	Block I: Planted corn April 24 in 30-inch rows @ 33,000 seeds/acre.
	Block II: Planted soybean May 12 in 30-inch rows @ 205,000 seeds/acre.
	Block III: Planted corn April 24 in 30-inch rows @ 33,000 seeds/acre.

Fertilizer: Block I: April 5 all plots received a broadcast application of 142 lbs K_2O/acre as 0-0-60. April 26 all plots received 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 and 63 lbs N/acre as 28-0-0 via dribble. June 5, sidedress 145 lbs N/acre as 28-0-0.

Block II: April 5 all plots received a broadcast application of 142 lbs K_2O/acre as 0-0-60. April 26 all plots received 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0.

Block III: April 5 all plots received a broadcast application of 142 lbs K_2O/acre as 0-0-60. April 26 all plots received 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 and 63 lbs N/acre as 28-0-0 via dribble. June 5, sidedress 125 lbs N/acre as 28-0-0.

Irrigation: Hand move sprinkler irrigation as needed.

Pest Control: Block I: Harness (1 pt/acre) + Lumax (1 pt/acre) + Atrazine (0.5 lb/acre) May 3 and Roundup Power Max (32 oz/acre) May 14.

Block II: Roundup Power Max (32 oz/acre) May 14 and Roundup Power Max (40 oz/acre) June 21

Block III: Harness (1 pt/acre) + Lumax (1 pt/acre) + Atrazine (0.5 lb/acre) May 3 and Roundup Power Max (32 oz/acre) May 14.

Remote sensing: Remote sensing was achieved with a Minolta Spad 502 chlorophyll meter and a Holland Crop Circle ACS active canopy sensor (normalized difference red edge – NDRE).

Harvest: Block I: Hand harvested the entire length (27 feet) of rows 5 and 8 from each plot on October 4.

Block II: September 24 with a 4400 JD combine (36 rows 106 feet long, recorded with a weigh wagon).

Block III: Hand harvested the entire length (27 feet) of rows 5 and 8 from each plot on October 3.

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RESULTS BLOCK I (Corn/Corn)-2012

Corn stover was removed at the 33, 67 and 100 percent removal rates in block I (corn/corn rotation). Stover removal had no significant effect on grain yield, moisture and test weight. Stover removal had no effect on, chlorophyll readings (Spad 502), Normalized Difference Red Edge indice (Holland Crop Circle ACS 430) and stalk nitrate-N (Table 1). Longer term data from 2009 to 2012 is presented in (Table 2). What happens to the revenue for the higher yield of the 100 percent removal rate compared to the 0 percent removal rate when the cost of N, P and K are accounted for is shown in (Fig. 1). The 0 removal plots averaged $25/acre more revenue from 2008 to 2011 than the 100 percent removal plots even when the 2008 year is included (corn stover was spread in a thick mat in 2008

RESULTS BLOCK III (Corn/Soybean)-2011

Stover removal rates of 33, 67, and 100 had no effect on grain yield, moisture or test weight (Table 3). Longer term data from 2009 to 2012 is presented in (Table 4).

RESULTS BLOCK II (Soybean/Corn)-2011

All soybean plots were combine harvested and bulked. The soybeans yielded 72.2 bu/acre at 9.1% moisture and had a test weight of 56.5 lbs/bu.

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Table 1. The effect of corn stover removal rates on grain yield and other agronomic parameters for corn on corn plots in 2011.

Stover Removal	Grain Yield[1]	Harvest Moisture	Test Weight	Chlorophyll Reading 10-Aug	NDRE Reading 28-Jul	Population	Grain Protein	Stalk Nitrate-N	Silk Date	Mature Date
%	bu/ac	%	lb/bu			plants/ac	%	ppm		
0	258.9	16.2	59.3	59.5	0.3638	31057	8.8	1409	7/16	9/25
33	265.8	15.4	59.9	59.6	0.3652	32267	8.8	1373	7/13	9/24
67	257.8	15.8	60.0	60.4	0.3676	31944	8.8	2307	7/13	9/23
100	260.1	15.9	59.7	61.1	0.3601	30573	9.0	1463	7/12	9/21
Mean	260.7	15.8	59.7	60.2	0.36	31460	8.9	1638.0		
CV%	7.3	2.3	0.5	4.3	1.9	2.7	1.0	29.5		
LSD.05	NS	NS	NS	NS	NS	NS	NS	NS		

[1]Yield adjusted to 15.5% moisture.

Table 2. Corn on Corn Stover Removal - NDSU Oakes Irrigation Research site 2009-2012.

Stover Removal	Grain Yield	Harvest Moisture	Test Weight	Chlorophyll Reading	Reading NDRE	Stalk Nitrate-N	Grain Protein	Silk Date	Mature Date
%	bu/ac	%	lb/bu			ppm	%		
0	218.1	22.7	56.2	55.9	0.3690	1712	8.4	7/22	9/30
33	219.8	22.0	56.8	55.9	0.3671	1814	8.3	7/21	9/28
67	221.6	21.9	56.6	56.5	0.3682	1671	8.3	7/20	9/28
100	221.4	21.1	57.0	56.1	0.3620	2290	8.5	7/19	9/27
Mean	220.2								

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Table 3. The effect of corn stover removal rates on grain yield for corn on soybean plots (Block III) in 2012.

Stover Removal	Grain Yield[1]	Harvest Moisture	Test Weight
%	bu/ac	%	lb/bu
0	261.2	15.0	60.1
33	257.7	14.8	60.0
67	252.8	14.7	60.0
100	256.6	15.0	59.8
Mean	257.1	14.9	60.0
CV%	2.3	1.8	0.6
LSD.05	NS	NS	NS

[1]Yield adjusted to 15.5% moisture.

Table 4. Corn on Soybean Stover removal – NDSU Oakes Irrigation Research site 2009-2012.

Stover Removal	Grain Yield	Harvest Moisture	Test Weight
%	bu/ac	%	lb/bu
0	225.3	22.0	55.7
33	216.4	21.9	55.9
67	221.2	21.3	56.3
100	221.0	21.5	55.9
Mean	221.0		

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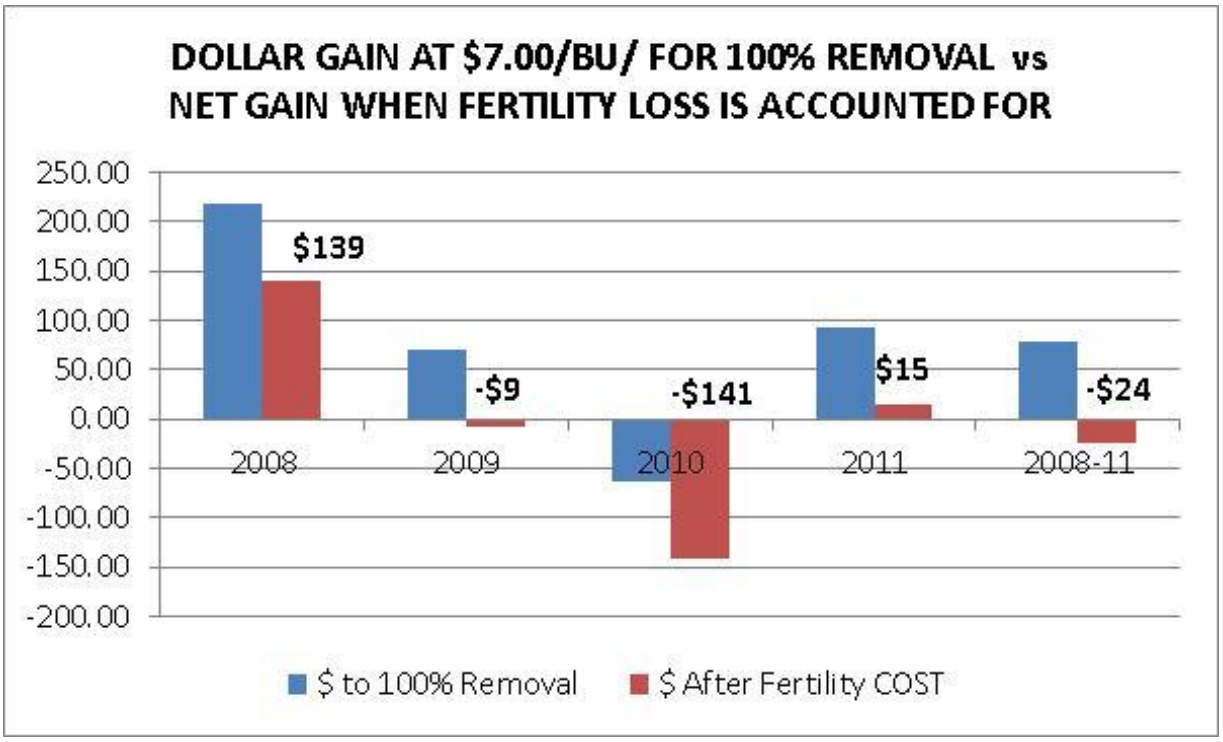

Figure 1. The net return when the fertility cost leaving the field is subtracted from the yield advantage in 100 percent removal plots compared to 0 percent removal for corn on corn plots from 2008 to 2011 at the Oakes Irrigation Research Site.

APPENDIX A

Sources of vegetable seeds

Seed Company	Company Name
BE	Bejo Seeds
NU	Nunhems Seeds
NZ	Nickerson Zwaan (Hazera Seeds, Inc.)

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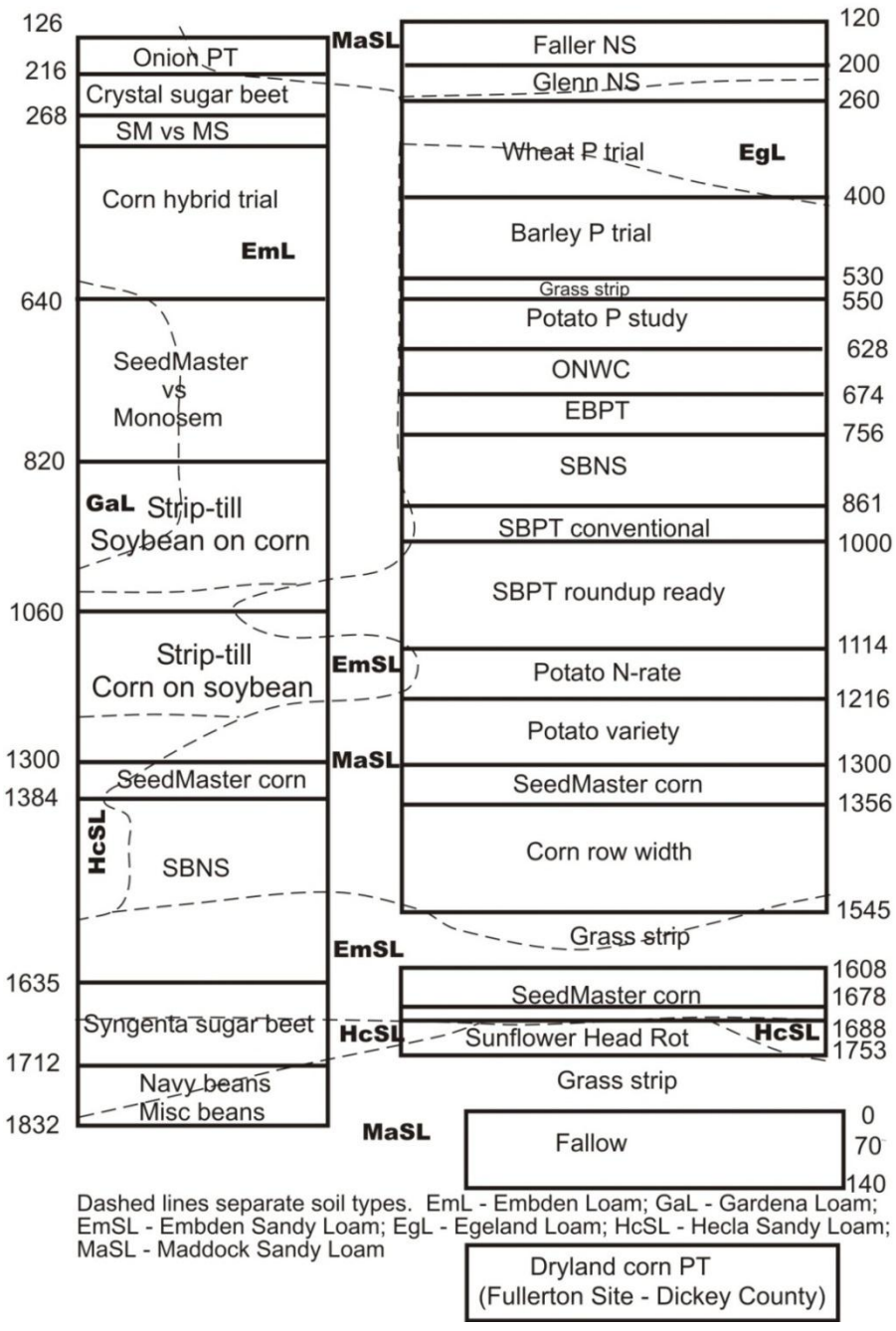
OAKES IRRIGATION RESEARCH SITE

North Section, 2012



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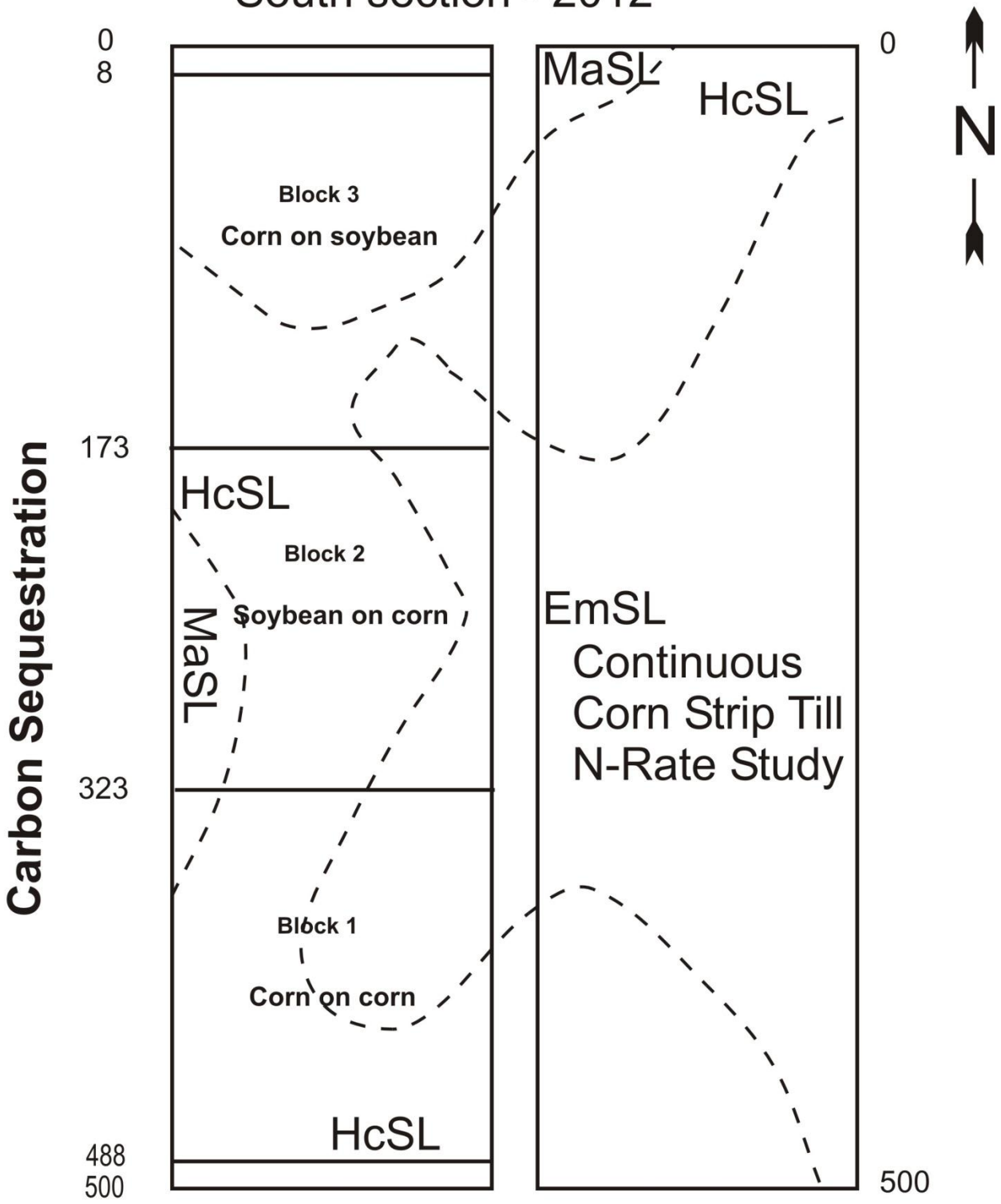
OAKES IRRIGATION RESEARCH SITE

South section - 2012



Dashed lines separate soil types. MaSL - Maddock Sandy Loam; HcSL - Hecla Sandy Loam; EmSL - Embden Sandy Loam.

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