Oakes Irrigation Research Site

Carrington Research Extension Center
North Dakota State University

Garrison Diversion Conservancy District

2014 ANNUAL REPORT

Blaine Schatz Director/Agronomist
Leonard Besemann Research Specialist
Heidi Eslinger Research Technician

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

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.

Companies that have provided financial sponsorship, grants or gifts:

AgVise Laboratories

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James Valley Grain

National Sclerotinia Initiative

North Dakota Corn Growers Association

Orthman Manufacturing, Inc.

Syngenta

Wheat Growers

Companies and individuals that donated seed, chemicals, supplies or equipment:

BASF
Bayer CropScience
Dow AgroSciences
DuPont
Norman Haak
Robert Titus
Walt Albus

Summer help – Christine Halvorson

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RESEARCH PROGRAM

Data on irrigated crop production have been collected for the past 45 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 to:

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; 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 2014

The winter of 2013 - 2014 concluded with below-average snowfall amounts. No record low temperatures were recorded, but daily low temperatures were consistently below zero for much of the winter. Most field work and planting dates were near average. The last frost in the spring was on May 17. The maximum temperature equaled or exceeded 90° F seven times; three times in May, once in June and three times in July. The highest temperature was 93° F on May 30 and July 20. Precipitation was above average in April, June and August. Precipitation was below average in May, July, September and October. The mean daily temperatures were above average in October; near average in May, June, August and September; below average in April and July. The first frost was October 4 with the first hard frost ($\leq$ 28° F) also October 4. All crops reached maturity before frost. Growing degree units in 2014 were below average.

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

	Precipitation			Average daily temperatures		
Month	2014	15-year average	25-year average	2014	15-year average	25-year average
	----------inches----------			----------°F----------		
April	2.47	1.64	1.63	41	44	44
May	1.84	3.17	3.01	57	56	57
June	6.08	4.73	4.37	66	66	66
July	2.01	2.94	3.16	68	71	70
August	4.94	2.36	2.17	68	69	69
September	0.23	2.69	2.78	59	60	60
October	0.26	1.97	2.12	48	46	46

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

Month	2014	10-year average	15-year average	25-year average
May	332	309	300	309
June	496	508	499	498
July	557	659	656	627
August	566	583	582	582
September	350	373	377	371
Total	2300	2433	2414	2387

[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.

	2014	10-year average	15-year average	25-year average
Last frost in Spring				
32° F or less	17-May	6-May	4-May	5-May
28° F or less	22-Apr	24-Apr	26-Apr	27-Apr
First frost in Fall				
32° F or less	4-Oct	5-Oct	3-Oct	1-Oct
28° F or less	4-Oct	12-Oct	8-Oct	7-Oct
Frost free period (days)	140	154	155	150

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Table 4. Irrigation water applied, 2014.

Study	Irrigation water applied
	inches
Dry edible bean variety trials	6.8
Dry edible bean fungicide trial	7.4
Field corn hybrid performance trial	7.5
Field corn study - Mosaic	7.5
Onion hybrid performance trial	7.5
Onion weed control study	7.5
Optimum corn stover removal for biofuel	
corn on corn	8.0
corn on soybean	8.0
soybean on corn	8.0
Potato trials	7.7
Soybean Sclerotina study	8.1
Soybean studies	7.3
Soybean variety performance trials, Roundup Ready ®	7.0
Strip-till	
corn on corn	6.8
corn on soybean	6.5
soybean on corn	7.0
Sunflower fungicide study	7.4
Sunflower variety head rot study*	2.5

*Received additional irrigation via the misting system.

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Dry Edible Bean Variety Trials

L. Besemann and H. Eslinger

Dry edible beans play a significant role in irrigated rotations in southeastern North Dakota. As universities and private companies develop new varieties it is important to test them upon their release.

MATERIALS AND METHODS

Soil:	Gardena loam and Embden loam; pH = 7.1; 2.2% organic matter; soil N 17 lbs/acre; soil P, soil K and soil-S were very high.
Previous crop:	2013 - potato.
Seedbed preparation:	Spring conventional tillage.
Planting:	May 30 in 30-inch rows.
Plots:	Plots were 17 ft long by 7.5 ft (3 rows) wide. The study had four replications.
Fertilizer:	Broadcast 25 lbs N/acre, 44 lbs P_2O_5/acre, 47 lbs K_2O/acre and 19 lbs S/acre as 10-18-19-8 April 21.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Trust (1 pt/acre) May 29, Basagran (1.5 pt/acre) + COC (1.25% v/v) June 24, Raptor (4 oz/acre) + NIS (0.25% v/v) + AMS (1 lb/10 gal) July 7 and Section 2EC (8 oz/acre) + COC (1 pt/acre) July 9 for weed control. Endura (8 oz/acre) July 17 and July 24, T-Methyl (26 oz/acre) July 31 for disease control. Kendo (3 oz/acre) July 17 for insect control.
Harvest:	Hand harvested bean varieties September 15 to September 22 as they matured. Harvest area for all bean varieties was 17 feet of the middle row. Beans were threshed with a stationary plot thresher September 17 to September 23.

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Table 1. Misc Bean Variety Trial at the Oakes Irrigation Research Site in 2014.

Variety	Market Class	Days to PM	Seeds/ Pound	Seed Weight	Test Weight	Seed Yield 2014	2013	2012	2 or 3-yr. Avg.
				grams/100	lb/bu	---------- lb/ac ----------			
Eclipse	Black	95.3	2269	20.0	61.5	2682	3130	3764	3192
Merlot	Small Red	100.0	1190	38.1	57.5	2727	2713	4072	3171
Sedona	Pink	98.0	1006	45.1	56.3	2870	3226	4330	3475
Loreto	Black	98.0	2264	20.1	61.6	2576	2880	--	2728
Rio Rojo	Small Red	100.3	1340	33.9	65.0	3186	3285	--	3236
Montcalm	Kidney Bean	93.8	826	55.0	54.3	1891	--	--	--
Pink Panther	Kidney Bean	84.8	809	56.1	50.7	1132	--	--	--
Rosetta	Pink	91.8	1213	37.4	60.1	2707	--	--	--
Mean		96.3	1261	41.3	58.0	2455	--	--	--
C.V. (%)		1.2	2.3	2.5	1.5	6.5	--	--	--
LSD 0.10		1.4	35	1.3	1.0	191	--	--	--
LSD 0.05		1.7	42	1.5	1.2	230	--	--	--

Planting Date = May 30; Harvest date = September 15; Previous Crop = Potato

Table 2. Navy Bean Variety Trial at the Oakes Irrigation Research Site in 2014.

Variety	Days to PM	Seeds/ Pound	Seed Weight	Test Weight	Seed Yield 2014	2013	2012	3-yr. Avg.
			grams/100		---------- lb/ac ----------			
HMS Medalist	101.0	2496	18.2	63.0	2874	3320	2205	2800
Avalanche	97.3	2179	20.9	62.6	2463	2513	2341	2439
Ensign	95.3	2136	21.3	62.1	2936	3137	2478	2851
Vista	110.3	2333	19.5	63.3	2750	3363	2327	2813
T9905	101.0	1921	23.6	62.2	3321	3883	2855	3353
Norstar	100.5	2430	18.7	64.8	2469	2199	1573	2080
Mean	100.9	2249	20.3	63.0	2802	--	--	--
C.V. (%)	0.8	2.4	2.5	1.1	6.0	--	--	--
LSD 0.10	1.0	66	0.6	0.9	208	--	--	--
LSD 0.05	1.2	80	0.8	1.1	253	--	--	--

Planting Date = May 30; Harvest date = September 15; Vista = September 22; Previous Crop = Potato

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Table 3. Pinto Bean Variety Trial at the Oakes Irrigation Research Site in 2014.

Variety	Days to PM	Seeds/ Pound	Seed Weight	Test Weight	Seed Yield 2014	Seed Yield 2013	Seed Yield 2012	Seed Yield 3-yr. Avg.
			grams/100	lb/bu	---------- lb/ac ----------			
LaPaz	96.3	1261	36.0	60.6	3116	3440	3340	3298
Lariat	111.8	1062	42.8	58.1	3209	3659	3411	3427
Stampede	95.0	1031	44.0	57.6	3046	3020	2923	2996
Maverick	100.5	1026	44.3	57.6	2955	3206	3002	3054
ND-307	101.5	933	48.7	55.9	3105	--	--	--
Windbreaker	89.3	1040	43.7	57.8	3168	3630	3125	3308
Sinaloa	100.0	1140	39.8	60.3	3152	--	--	--
Mean	99.8	1059	43.1	58.4	3119	--	--	--
C.V. (%)	1.0	3.5	3.6	1.0	6.3	--	--	--
LSD 0.10	1.2	44	1.8	0.7	236	--	--	--
LSD 0.05	1.5	53	2.2	0.9	284	--	--	--

Planting Date = May 30; Harvest date = September 15; Lariat = September 22; Previous Crop = Potato

Dry edible bean (navy) trial.

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Corn Hybrid Performance Trial

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. This trial tested 64 hybrids.

MATERIALS AND METHODS

Soil:	Maddock sandy loam, Egeland loam; pH = 7.3; 1.6% organic matter; soil N 20 lbs/acre; soil P and soil K was very high; soil S was medium.
Previous crop:	2013 - soybean.
Seedbed preparation:	Spring conventional tillage.
Planting:	Planted May 14 in 30-inch rows. Thinned to 36,900 plants/acre.
Fertilizer:	Broadcast 25 lbs N/acre, 44 lbs P_2O_5/acre, 47 lbs K_2O/acre and 19 lbs S/acre as 10-18-19-8 April 21. Stream bar 50 lbs N/acre May 28 as 28-0-0. Sidedress 125 lbs N/acre June 17 as 28-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest Control:	Harness (2 pt/acre) May 22, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05% v/v) + AMS (1½ lbs/acre) June 3.
Harvest:	November 14 with a plot combine. Harvest area was two rows 17 feet long.

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Table 1. Corn hybrid performance trial at the Oakes Irrigation Research Site in 2014.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Height		Grain	Content			Test	Grain Yield	
					Ear	Plant	Protein	Starch	Oil	Moist.	Weight	2014	2 yr. Avg.
					---inches---		%	%	%	%	lb/bu	bu/ac	bu/ac
Agventure	RL4616HBW	94	RR/HB/HRW	68.0	40.4	81.7	8.8	72.9	2.9	16.6	54.9	214.4	219.4
Agventure	RL5015YHB	95	RR/LL/YHB	69.0	46.2	90.8	8.8	73.3	2.8	17.2	53.5	228.1	--
Agventure	RL5671HBW	99	RR/HB/RW	70.0	44.3	90.3	8.5	73.2	3.0	17.1	54.3	239.6	248.4
Channel	196-05VT2PRIB	96	VT2P	68.3	36.2	83.2	9.2	73.2	3.1	16.9	55.0	211.6	--
Dairyland Seed	DS-9791RA	91	SSX/RA	70.3	35.5	84.3	9.0	73.6	2.7	16.1	54.5	199.3	204.1
Dairyland Seed	DS-9093	93	A3122	64.8	39.2	78.6	9.1	73.1	2.9	17.9	54.0	198.9	--
Dairyland Seed	DS-1088	88	Con	67.3	35.7	78.0	9.5	74.2	2.0	16.1	52.2	175.8	--
Dairyland Seed	DS-9694RA	94	SSX/RA	70.5	40.2	81.3	9.2	74.0	2.3	15.9	54.0	194.1	--
Dairyland Seed	DS-9796	96	3000GT	69.8	39.9	84.1	10.2	72.3	3.1	16.4	55.4	204.3	216.2
Dairyland Seed	DS-9900SSX	100	SSX	73.0	39.2	86.0	8.5	74.5	2.2	17.3	53.1	218.7	--
Dyna-Gro	D35VC95	95	VT2P	68.3	44.4	86.9	9.5	73.1	2.8	16.0	55.6	224.5	--
Dyna-Gro	D39VP14	99	VT3P	67.3	42.6	85.3	8.8	73.2	3.3	17.0	57.2	231.1	--
Dyna-Gro	CX14100	100	SS	70.8	43.8	90.7	9.2	72.8	3.1	17.7	54.0	231.8	--
Integra	9455		VT3Pro	67.3	42.7	83.8	8.8	73.9	2.6	15.6	54.9	221.1	222.0
Legacy Seeds	L3043	93	VT2Pro	69.3	39.9	84.7	8.8	73.1	3.2	17.7	56.4	206.7	--
Legacy Seeds	L3423	94	GENSS	68.0	40.3	87.7	9.0	73.2	3.0	17.0	55.5	229.2	--
Legacy Seeds	L3612	95	VT3Pro	68.8	42.8	85.7	9.7	73.0	2.8	16.1	54.7	221.2	--
Legacy Seeds	L3712	96	VT3Pro	69.0	38.0	83.1	9.2	73.0	2.9	17.0	56.4	224.5	--
Legacy Seeds	L3844	98	GENSS	69.5	45.2	90.5	9.2	73.4	2.8	16.6	56.1	212.0	--
	MEAN			68.5	40.7	84.7	9.0	73.3	2.8	16.5	55.4	220.1	--
	C.V. (%)			0.7	6.2	3.8	1.9	0.5	6.2	4.4	1.0	4.9	--
	LSD 0.10			0.6	3.0	3.7	0.20	0.4	0.20	0.8	0.6	12.7	--
	LSD 0.05			0.7	3.5	4.4	0.24	0.5	0.24	1.0	0.8	15.2	--

Planting Date = May 14; Harvest Date = November 14; Previous Crop = Soybean

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Table 1. Corn hybrid performance trial at the Oakes Irrigation Research Site in 2014.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Height		Grain Protein	Content		Moist.	Test Weight	Grain Yield	
					Ear	Plant		Starch	Oil			2014	2 yr. Avg.
					---inches---		%	%	%	%	lb/bu	bu/ac	bu/ac
Nuseed	9001 VP3220	90	Viptera 3220	69.5	48.8	91.3	9.6	73.2	2.4	15.7	54.4	223.4	--
Nuseed	9304 VT2P	93	VT Double Pro	68.8	39.0	83.7	8.7	73.2	3.1	16.9	56.3	215.6	223.1
Nuseed	9505 VT2P	95	VT Double Pro	68.3	35.9	78.7	9.0	73.3	2.8	16.1	56.5	227.0	--
Nuseed	9504 VT3P	95	VT Triple Pro	67.3	36.2	81.4	9.0	73.7	2.8	16.4	55.6	209.7	206.2
Nuseed	9904 VT2P	99	VT Double Pro	69.0	45.8	87.2	9.3	72.5	3.0	16.7	56.2	244.2	--
NuTech	5B-195	95	GT/CB/LL/RW/BL	69.0	44.5	85.3	9.1	74.0	2.3	16.2	54.0	212.1	--
NuTech/G2 Genetics	5X-894	94	HXT/RR2/LL	68.3	38.9	80.5	9.0	73.0	2.8	16.5	54.8	204.6	208.8
NuTech/G2 Genetics	5Y-196	96	YGCB/HX1/RR2/LL	69.0	45.6	88.0	9.0	72.9	2.9	16.8	53.1	215.8	--
NuTech/G2 Genetics	5F-295	95	YGCB/HX1/RR2/LL	66.3	39.7	80.8	9.5	73.0	2.8	16.6	55.5	206.3	--
NuTech/G2 Genetics	5X-698	98	HXT/RR2/LL	69.3	42.8	85.5	9.0	73.2	2.8	16.7	56.1	225.8	232.0
NuTech/G2 Genetics	5F-198	98	YGCB/HX1/RR2/LL	69.5	43.0	89.0	9.0	72.5	3.1	17.0	52.1	228.7	--
NuTech/G2 Genetics	5F-399	99	YGCB/HX1/RR2/LL	70.3	44.3	90.0	8.5	73.2	3.0	17.5	53.2	231.8	--
PFS	76S92	92	VT2P	69.0	39.1	83.8	8.7	73.1	3.2	17.1	55.9	211.6	224.6
PFS	81W95	95	SS	67.5	41.3	87.5	8.8	73.3	3.0	17.0	55.2	234.3	--
PFS	55S96	96	VT3P	68.5	39.0	83.2	9.1	73.4	2.7	16.2	56.8	221.1	222.3
PFS	82H99	99	SS	69.5	44.3	85.7	9.2	72.9	2.9	17.1	55.3	232.2	--
Proseed	1385 VT2P	85	VT2P	66.3	36.3	82.5	8.7	73.5	2.8	15.8	56.3	197.2	--
Proseed	990 GT3000	90	3000GT	68.0	40.3	83.4	9.5	73.3	2.5	15.8	52.7	204.3	210.1
Proseed	1292 VT2P	92	VT2P	67.5	41.1	84.8	8.7	73.2	3.2	16.1	55.7	222.4	--
	MEAN			68.5	40.7	84.7	9.0	73.3	2.8	16.5	55.4	220.1	--
	C.V. (%)			0.7	6.2	3.8	1.9	0.5	6.2	4.4	1.0	4.9	--
	LSD 0.10			0.6	3.0	3.7	0.20	0.4	0.20	0.8	0.6	12.7	--
	LSD 0.05			0.7	3.5	4.4	0.24	0.5	0.24	1.0	0.8	15.2	--

Planting Date = May 14; Harvest Date = November 14; Previous Crop = Soybean

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Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Height		Grain Protein	Content		Moist.	Test Weight	Grain Yield	
					Ear	Plant		Starch	Oil			2014	2 yr. Avg.
					---inches---		%	%	%	%	lb/bu	bu/ac	bu/ac
Proseed	1191 VT2P	91	VT2P	67.3	38.7	84.0	8.7	73.6	2.7	15.5	55.8	208.2	--
Proseed	1393 VT2P	93	VT2P	66.5	35.8	78.1	8.5	74.1	2.5	16.1	56.2	211.7	--
Proseed	1397 SS	97	SS	69.8	42.5	87.9	9.3	73.7	2.4	16.8	56.0	221.7	--
Proseed	1396 SS	96	SS	67.8	37.3	82.0	8.8	73.3	3.0	16.0	55.8	204.2	--
REA Hybrids	3B922-RIB	92	RR2 Bt	67.3	39.7	84.8	8.6	73.4	3.0	15.9	56.7	220.7	--
REA Hybrids	3A929-RIB	92	RR2 Bt CRW	68.8	40.9	86.4	9.5	73.1	2.9	16.4	56.4	239.3	235.5
REA Hybrids	4B941-RIB	94	RR2 Bt	68.8	40.0	86.0	9.2	73.3	2.9	16.5	56.8	224.5	223.9
REA Hybrids	4A942-RIB	94	RR2 Bt CRW	68.5	41.9	87.5	9.1	73.2	2.9	17.1	55.9	224.9	--
REA Hybrids	4V953-RIB	95	RR2 Bt CRW	69.0	43.6	91.7	8.7	73.6	2.8	16.1	56.4	249.5	--
REA Hybrids	4A971-RIB	97	RR2 Bt CRW	68.5	43.4	88.2	9.3	73.5	2.7	16.4	57.2	225.4	228.7
REA Hybrids	4A972-RIB	97	RR2 Bt CRW	68.3	43.8	85.7	9.1	73.4	2.8	16.6	55.9	233.2	--
REA Hybrids	4A974-RIB	97	RR2 Bt CRW	68.5	42.7	85.5	9.0	73.2	3.1	17.4	55.7	231.7	--
REA Hybrids	5A992-RIB	99	RR2 Bt CRW	69.3	39.5	81.3	9.0	72.7	3.2	16.8	54.7	229.7	--
Renk	RK522SSTX	94	SSTX	67.8	38.3	83.1	8.8	73.7	2.8	16.5	55.5	218.9	229.9
Renk	RK568VT3P	95	VT3P	68.3	37.8	81.7	9.2	73.3	2.8	16.2	56.5	228.9	231.7
	MEAN			68.5	40.7	84.7	9.0	73.3	2.8	16.5	55.4	220.1	--
	C.V. (%)			0.7	6.2	3.8	1.9	0.5	6.2	4.4	1.0	4.9	--
	LSD 0.10			0.6	3.0	3.7	0.20	0.4	0.20	0.8	0.6	12.7	--
	LSD 0.05			0.7	3.5	4.4	0.24	0.5	0.24	1.0	0.8	15.2	--

Planting Date = May 14; Harvest Date = November 14; Previous Crop = Soybean

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					Ear	Plant		Starch	Oil			2014	2 yr. Avg.
					---inches---		%	%	%	%	lb/bu	bu/ac	bu/ac
Thunder	7993		VT2P	68.3	37.2	80.4	8.7	73.3	3.1	17.3	56.1	216.5	221.0
Thunder	7396		VT2P	68.3	43.1	86.8	9.5	73.2	2.7	16.0	56.0	230.4	236.7
Thunder	4391		VT2P	67.5	41.8	85.2	8.6	73.2	3.0	15.6	55.6	210.9	--
Thunder	9595		VT3P	68.8	37.4	82.0	9.0	73.4	2.7	16.5	56.4	223.8	--
Thunder	7188		VT2P	67.3	40.4	83.0	9.4	72.7	3.0	16.3	57.0	223.5	--
Thunder	6987		VT2P	66.3	37.2	83.0	8.9	73.7	2.5	15.2	55.9	204.6	--
Wensman Seed	W 90941STX	94	Smart Stax, RR2	67.5	39.7	84.1	8.8	73.3	2.9	16.7	54.6	235.6	--
Wensman Seed	W 90967STXRIB	96	Smart Stax, RR2	67.8	41.1	85.7	9.5	73.1	2.7	16.6	56.0	223.6	218.2
Wensman Seed	W 70975VT3PRIB	97	VT3PRO, RR2	68.5	39.0	83.5	9.1	73.1	2.9	16.6	56.5	230.4	--
Wensman Seed	W 90979STX	97	Smart Stax, RR2	69.0	40.3	81.6	8.9	74.0	2.5	16.9	55.8	233.6	--
Wensman Seed	W 9288STXRIB	98	Smart Stax, RR2	70.0	39.4	84.3	8.9	73.2	2.9	16.5	54.8	227.4	238.1
	MEAN			68.5	40.7	84.7	9.0	73.3	2.8	16.5	55.4	220.1	--
	C.V. (%)			0.7	6.2	3.8	1.9	0.5	6.2	4.4	1.0	4.9	--
	LSD 0.10			0.6	3.0	3.7	0.20	0.4	0.20	0.8	0.6	12.7	--
	LSD 0.05			0.7	3.5	4.4	0.24	0.5	0.24	1.0	0.8	15.2	--

Planting Date = May 14; Harvest Date = November 14; Previous Crop = Soybean

[1] Hybrid traits as reported by seed company when hybrids submitted for evaluation.

**Four (4) replications were utilized to record each of the traits reported.

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Corn Hybrid Performance Trial – Dryland

L. Besemann and H. Eslinger

A dryland corn hybrid performance trial was initiated in 2011 to provide information for corn producers in southeast and south central North Dakota. This study is conducted on Barnes-Svea soils that dominate the dryland farming in the area. This trial tested 69 hybrids.

MATERIALS AND METHODS

Soil:	Barnes-Svea; pH = 5.6; 3.4% organic matter; soil N 20 lbs/acre; soil P and soil K were very high; soil S was medium.
Previous crop:	2013 – soybean.
Seedbed preparation:	Spring conventional tillage.
Planting:	Planted May 15 in 30-inch rows. Thinned to 32,800 plants/acre.
Fertilizer:	Broadcast 25 lbs N/acre, 44 lbs P_2O_5/acre and 47 lbs K_2O/acre and 19 lbs S/acre as 10-18-19-8 April 15. Stream bar 50 lbs N/acre as 28-0-0 May 28. Sidedress 85 lbs N/acre June 17 as 28-0-0.
Pest control:	Harness (2 pt/acre) May 26, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05% v/v) + AMS (1½ lbs/acre) June 3.
Harvest:	November 13 with a plot combine. Harvest area was two rows 17 feet long.

RESULTS

Overall yields were the highest since the dryland trial was established in 2011 in the Oakes area. Timely moisture after planting and the growing season produced a mean yield of 185.9 bu/acre.

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Table 2. Corn hybrid performance trial (dryland) Dickey County Fullerton, ND - Oakes Irrigation Research Site 2014.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Height		Grain Protein	Content		Moist.	Test Weight	Grain Yield	
					Ear	Plant		Starch	Oil			2014	2 yr. Avg.
					inches	inches	%	%	%	%	lb/bu	bu/ac	bu/ac
Agventure	RL45616HBW	94	RR/HB/HRW	70.5	38.0	74.3	9.4	71.7	3.4	18.6	54.7	193.9	--
Agventure	RL5015YHB	95	RR/LL/YHB	73.5	38.8	72.9	9.4	72.2	3.2	18.6	53.0	180.7	--
Agventure	RL5718HBW	99	RR/HB/RW	73.5	34.1	64.5	10.4	71.6	3.3	19.0	54.4	161.3	--
Channel	190-13VT2PRIB	90	VT2P	71.0	34.4	71.5	9.6	72.4	3.2	18.3	54.7	175.7	--
Channel	196-05VT2PRIB	96	VT2P	71.3	38.4	77.1	9.6	72.0	3.7	19.2	54.4	201.2	--
Dairyland Seed	DS-9791RA	91	SSX/RA	73.5	34.9	74.6	9.4	72.8	3.1	18.2	54.0	184.6	131.8
Dairyland Seed	DS-9093	93	A3122	68.3	37.0	70.4	9.8	72.1	3.2	19.0	52.7	175.5	--
Dyna-Gro	D35VC95	95	VT2P	72.8	37.6	75.6	9.5	72.0	3.3	19.1	53.8	180.5	--
Dyna-Gro	D39VP14	99	VT3P	72.0	35.2	70.6	9.6	72.4	3.5	20.8	53.8	179.3	--
Dyna-Gro	CX14100	100	SS	73.8	41.6	80.1	9.7	72.0	3.3	18.6	52.4	182.1	--
Funk's Frontiersman	91-E3VT2P	91	VT2ProRIB	69.8	36.1	73.3	9.5	72.1	3.4	17.8	55.4	196.7	145.7
Funk's Frontiersman	97-E4 GENSS	97	GENSS/RIB	74.0	39.8	76.6	9.7	72.4	3.1	18.7	54.2	178.1	--
Hyland Seeds	8305RA	90	SSX-RA	72.0	36.4	69.2	9.4	72.8	3.1	17.7	54.1	165.1	--
Hyland Seeds	8315RA	92	SSX-RA	73.8	35.7	72.2	9.5	72.6	3.2	18.6	53.7	177.9	130.1
Integra	9412		VT2 Pro	70.0	36.3	76.3	9.1	72.5	3.3	19.0	54.8	184.4	--
Integra	3912		VT2 Pro	71.3	33.2	70.3	10.2	71.7	3.4	17.4	54.7	174.7	--
Integra	4342		VT2 Pro	72.5	36.3	73.1	9.3	72.0	3.5	19.2	54.5	185.2	--
Legacy Seeds	L3043	93	VT2Pro	72.3	35.4	69.7	9.4	72.1	3.4	19.0	54.4	192.2	--
	MEAN			71.7	37.6	74.3	9.6	72.1	3.3	18.5	54.5	185.9	--
	C.V. (%)			1.0	9.0	7.4	2.4	0.5	5.3	5.7	1.4	8.8	--
	LSD 0.10			0.8	3.9	6.4	0.27	0.5	0.20	1.2	0.9	19.2	--
	LSD 0.05			1.0	4.7	7.6	0.32	0.6	0.24	1.5	1.0	22.9	--

Planting Date = May 15; Harvest Date = November 13; Previous Crop = Soybean

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Table 2. Corn hybrid performance trial (dryland) Dickey County Fullerton, ND - Oakes Irrigation Research Site 2014.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Height		Grain Protein	Content		Moist.	Test Weight	Grain Yield	
					Ear	Plant		Starch	Oil			2014	2 yr. Avg.
					inches	inches	%	%	%	%	lb/bu	bu/ac	bu/ac
Legacy Seeds	L3423	94	GENSS	71.8	36.2	71.4	9.8	72.2	3.3	17.8	54.3	180.4	--
Legacy Seeds	L3612	95	VT3Pro	73.0	37.4	77.5	9.6	72.4	3.2	19.3	53.9	187.4	--
Legacy Seeds	L3712	96	VT3Pro	73.0	34.1	66.7	10.0	71.9	3.3	18.5	55.4	190.2	--
Legacy Seeds	L3844	98	GENSS	73.3	41.3	78.5	9.7	72.7	3.0	18.0	55.0	189.6	--
Mycogen Seeds	2V357		SSXRA	73.5	33.5	71.4	9.7	72.4	3.4	19.5	53.5	186.0	--
Mycogen Seeds	2G365		3000GT	69.3	37.9	73.3	9.8	72.0	3.4	19.8	52.4	171.3	--
Nuseed	9001 VP3220	90	Viptera 3220	73.8	41.8	80.8	10.3	72.6	2.5	18.1	53.3	173.7	126.3
Nuseed	9304 VT2P	93	vt double pro	72.0	36.1	72.9	9.4	72.3	3.4	18.2	54.9	180.8	--
Nuseed	9505 VT2P	95	vt double pro	71.8	32.5	65.6	10.0	71.6	3.4	18.7	56.0	194.3	--
Nuseed	9504 VT3P	95	vt triple pro	70.3	37.3	74.4	9.5	72.7	3.4	19.0	54.8	178.3	137.1
NuTech	5B-195	95	GT/CB/LL/RW/BL	73.0	39.3	76.9	9.9	73.0	2.5	18.4	53.6	179.6	--
NuTech/G2 Genetics	5X-894	94	HXT/RR2/LL	70.8	36.6	71.7	9.5	71.8	3.4	19.0	54.5	200.9	143.7
NuTech/G2 Genetics	5Y-196	96	YGCB/HX1/RR2/LL	72.8	39.9	73.5	9.4	72.3	3.2	18.1	53.7	199.9	--
NuTech/G2 Genetics	5F-295	95	YGCB/HX1/RR2/LL	69.0	35.3	69.5	10.1	71.6	3.7	19.1	54.5	180.9	--
NuTech/G2 Genetics	5X-698	98	HXT/RR2/LL	72.3	40.8	78.5	9.5	71.8	3.2	18.2	54.3	179.6	133.9
NuTech/G2 Genetics	5F-198	98	YGCB/HX1/RR2/LL	72.5	39.0	78.1	9.3	71.5	3.7	18.8	51.7	198.7	--
NuTech/G2 Genetics	5F-399	99	YGCB/HX1/RR2/LL	73.3	39.0	76.7	8.7	72.3	3.5	19.0	52.6	197.1	--
PFS	76S92	92	VT2P	71.5	40.4	78.4	9.3	72.2	3.6	19.4	55.2	202.5	138.8
	MEAN			71.7	37.6	74.3	9.6	72.1	3.3	18.5	54.5	185.9	--
	C.V. (%)			1.0	9.0	7.4	2.4	0.5	5.3	5.7	1.4	8.8	--
	LSD 0.10			0.8	3.9	6.4	0.27	0.5	0.20	1.2	0.9	19.2	--
	LSD 0.05			1.0	4.7	7.6	0.32	0.6	0.24	1.5	1.0	22.9	--

Planting Date = May 15; Harvest Date = November 13; Previous Crop = Soybean

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Table 2. Corn hybrid performance trial (dryland) Dickey County Fullerton, ND - Oakes Irrigation Research Site 2014.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Height		Grain Protein	Content		Moist.	Test Weight	Grain Yield	
					Ear	Plant		Starch	Oil			2014	2 yr. Avg.
					inches	inches	%	%	%	%	lb/bu	bu/ac	bu/ac
PFS	81W95	95	SS	70.5	39.1	77.0	9.7	72.1	3.4	18.2	53.7	203.6	--
PFS	55S96	96	VT3P	72.0	34.6	67.8	9.8	71.8	3.5	18.5	55.9	188.3	140.6
PFS	82H99	99	SS	73.3	44.1	81.5	10.1	71.0	3.6	18.3	53.7	203.6	--
Proseed	1385 VT2P	85	VT2P	68.5	35.4	76.5	9.6	72.3	3.3	18.2	56.4	165.9	--
Proseed	990 GT3000	90	3000GT	72.0	39.9	75.4	10.1	73.0	2.6	17.4	52.6	193.0	144.7
Proseed	1292 VT2P	92	VT2P	70.3	39.2	77.0	9.0	72.7	3.5	18.3	55.1	203.0	--
Proseed	1191 VT2P	91	VT2P	69.8	38.7	76.8	9.3	72.0	3.5	18.7	54.6	174.4	--
Proseed	1393 VT2P	93	VT2P	69.3	37.1	74.2	9.6	72.6	3.2	18.2	55.8	173.0	--
Proseed	1397 SS	97	SS	73.5	36.2	69.6	9.9	72.1	3.1	17.7	54.5	183.8	--
Proseed	1396 SS	96	SS	72.5	36.0	75.0	9.6	71.7	3.6	17.8	55.3	186.0	--
REA Hybrids	3B922-RIB	92	RR2 Bt	70.5	37.1	71.2	9.1	72.5	3.4	18.8	55.7	189.7	--
REA Hybrids	3A929-RIB	92	RR2 Bt CRW	72.0	34.9	70.2	9.9	72.0	3.3	18.2	55.1	185.5	137.5
REA Hybrids	4B285-RIB	93	RR2 Bt	70.0	40.7	76.9	9.2	72.3	3.2	18.7	54.4	179.5	132.4
REA Hybrids	4B941-RIB	94	RR2 Bt	72.0	38.5	76.5	10.0	71.8	3.3	18.0	55.3	193.2	--
REA Hybrids	4A942-RIB	94	RR2 Bt CRW	71.8	38.3	73.5	9.7	72.0	3.3	17.9	54.9	190.9	--
REA Hybrids	4V953-RIB	95	RR2 Bt CRW	72.8	38.6	78.2	9.7	72.3	3.1	18.7	54.8	199.5	--
REA Hybrids	4A971-RIB	97	RR2 Bt CRW	72.5	38.3	72.8	9.6	72.7	3.1	19.6	54.6	199.4	--
REA Hybrids	4A972-RIB	97	RR2 Bt CRW	71.8	38.5	74.7	9.6	71.7	3.4	18.1	55.2	185.5	--
	MEAN			71.7	37.6	74.3	9.6	72.1	3.3	18.5	54.5	185.9	--
	C.V. (%)			1.0	9.0	7.4	2.4	0.5	5.3	5.7	1.4	8.8	--
	LSD 0.10			0.8	3.9	6.4	0.27	0.5	0.20	1.2	0.9	19.2	--
	LSD 0.05			1.0	4.7	7.6	0.32	0.6	0.24	1.5	1.0	22.9	--

Planting Date = May 15; Harvest Date = November 13; Previous Crop = Soybean

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Table 2. Corn hybrid performance trial (dryland) Dickey County Fullerton, ND - Oakes Irrigation Research Site 2014.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Height		Grain Protein	Content		Moist.	Test Weight	Grain Yield	
					Ear	Plant		Starch	Oil			2014	2 yr. Avg.
					inches	inches	%	%	%	%	lb/bu	bu/ac	bu/ac
Renk	RK522SSTX	94	SSTX	71.3	38.0	77.2	9.9	71.9	3.4	19.3	54.2	198.4	--
Renk	RK568VT3P	95	VT3P	71.5	36.4	72.3	9.9	72.0	3.4	17.8	55.9	191.4	--
Thunder	7993		VT2P	71.5	35.9	72.1	9.4	71.9	3.6	18.4	55.1	185.3	--
Thunder	7396		VT2P	71.8	40.8	81.0	9.4	72.7	3.0	17.1	54.3	195.8	--
Thunder	4391		VT2P	71.0	38.5	75.1	9.3	72.3	3.4	18.1	54.5	180.7	--
Thunder	9595		VT3P	72.0	37.4	72.5	9.9	72.0	3.2	18.3	56.1	183.1	--
Thunder	7188		VT2P	69.8	39.6	79.3	10.0	71.1	3.6	17.3	56.7	179.3	--
Thunder	6987		VT2P	69.0	36.6	77.1	9.4	72.4	3.4	18.1	56.9	153.9	--
Wensman Seed	W 90935STXRIB	93	Smart Stax, RR2	70.3	40.1	77.4	9.9	72.1	3.2	17.8	55.9	178.8	--
Wensman Seed	W 90941STX	94	Smart Stax, RR2	70.8	39.6	77.0	9.4	71.5	3.6	18.4	53.5	188.9	--
Wensman Seed	W 7268VT3RIB	96	VT3PRO, RR2	71.3	37.6	75.0	9.3	72.3	3.3	18.2	54.9	201.6	--
Wensman Seed	W 90967STXRIB	96	Smart Stax, RR2	71.3	37.1	73.0	9.9	72.5	3.0	19.8	54.7	184.3	--
Wensman Seed	W 70975VT3PRIB	97	VT3PRO, RR2	72.0	37.6	71.9	10.0	71.8	3.4	19.5	55.7	190.7	--
Wensman Seed	W 90979STX	97	Smart Stax, RR2	73.5	39.3	77.1	9.5	72.5	2.9	18.0	53.8	194.0	--
Wensman Seed	W 9288STXRIB	98	Smart Stax, RR2	73.8	40.6	79.3	9.1	71.9	3.5	19.1	53.3	183.3	--
	MEAN			71.7	37.6	74.3	9.6	72.1	3.3	18.5	54.5	185.9	--
	C.V. (%)			1.0	9.0	7.4	2.4	0.5	5.3	5.7	1.4	8.8	--
	LSD 0.10			0.8	3.9	6.4	0.27	0.5	0.20	1.2	0.9	19.2	--
	LSD 0.05			1.0	4.7	7.6	0.32	0.6	0.24	1.5	1.0	22.9	--

Planting Date = May 15; Harvest Date = November 13; Previous Crop = Soybean

[1] Hybrid traits as reported by seed company when hybrids submitted for evaluation.

**Four (4) replications were utilized to record each of the traits reported.

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Onion Hybrid Performance Trial

L. Besemann and H. Eslinger

Onions have done well under irrigation in North Dakota. Yellow sweet Spanish is the predominate type grown. This study tested 10 sweet Spanish hybrids.

MATERIALS AND METHODS

Soil:	Embden sandy loam and Maddock sandy loam; pH = 7.2; 1.4% organic matter; soil N 27 lbs/acre; soil P and soil K were very high; soil S was low.
Previous crop:	2013 – wheat.
Seedbed preparation:	Spring conventional tillage.
Planting:	Direct seeded onions (285,000 seeds/acre) April 25 with a Monosem precision planter. Onions were planted: 2 lines per row with 2.5 inches between lines. The rows were on 16-inch centers.
Plots:	Plots were 3 ft (two rows) wide by 17 ft long. The study had four replications.
Fertilizer:	Broadcast 25 lbs N/acre, 44 lbs P_2O_5/acre, 47 lbs K_2O/acre and 19 lbs S/acre as 10-18-19-8 April 21. Stream bar 30 lbs N/acre June 10, June 24, July 7 and July 14 as 28-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Moxy 2E (4 oz/acre) + Goal Tender (1 oz/acre) May 27, Section 2EC (4 oz/acre) + COC (1 pt/acre) May 27, Moxy 2E (1.5 pt/acre) + Goal Tender (8 oz/acre) June 4, Section 2EC (8 oz/acre) + COC (1 pt/acre) July 9, Section 2EC (12 oz/acre) + COC (1 pt/acre) July 28 and hand weeding for weed control. Quadris Opti (3 pt/acre) August 22, Ridomil 72MZ (2.5 lb/acre) August 29 and September 5 for disease control.
Harvest:	Pulled all onions September 23 and left to field dry/cure. Onions were topped and bagged September 29. Onions were graded October 27 to October 30.

RESULTS

SV6672NW and Sedona had the highest yield overall and in the 3 to 4 inch range. Hamilton and SV6646NW had the highest yield of onions greater than four inches. Total yields ranged from 599 cwt/acre to 986 cwt/acre with a mean of 741 cwt/acre.

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Table 1. Onion hybrid performance trial at the Oakes Irrigation Research Site in 2014.

Hybrid	Seed Source	Maturity[1] Days	Half down	>4"	3 to 4"	2¼ to 3"	1 to 2¼"	Total	Culls	Single Center	Total Bulbs
				----------cwt----------						%	/ac
Calibra	Bejo	115	6-Sep	78	370	124	27	599	60	70	118918
Crockett	Bejo	118	8-Sep	25	534	208	23	790	31	80	156876
Delgado	Bejo	115	4-Sep	33	486	157	35	710	37	75	141741
Gunnison	Bejo	110	27-Aug	33	381	228	40	681	10	90	155915
Hamilton	Bejo	118	8-Sep	142	525	111	12	789	18	85	126125
Patterson	Bejo	105	3-Sep	35	343	217	42	637	10	90	146305
Sedona	Bejo	118	7-Sep	70	569	150	20	808	9	90	134774
SV6646NW	Seminis	120	11-Sep	101	416	123	22	661	31	90	117236
SV6672NW	Seminis	116	6-Sep	69	630	261	25	986	7	100	185224
XP 07716000	Seminis	118	11-Sep	63	500	156	27	746	9	100	135734
Mean			6-Sep	65	475	174	27	741	22	87	141885
C.V.(%)			1.5	60.9	17.1	24.6	38.5	11.4	74.3	15.8	11.6
LSD 0.10			2.4	47	98	51	13	107	20	NS	19821
LSD 0.05			2.9	57	118	62	15	122	24	NS	23883

Planting Date = April 25; Pulled/harvested = September 23; Previous Crop = Wheat

Fertilizer lbs/acre; 145 N, 44 P, 47 K, 19 S; Irrigation = 7.45 inches

[1]Maturity given by seed supplier.

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Processing Potato Trial Oakes, North Dakota 2014

Asunta (Susie) Thompson

Yield and evaluation trials were grown at eight locations in North Dakota and Minnesota in 2014, five irrigated (Larimore, Oakes, Inkster, Williston, and Park Rapids) and three non-irrigated (Hoople, Crystal and Grand Forks) locations. This summary reports the results from the Oakes processing trial. Twenty-two advancing dual-purpose russet selections and commercially acceptable cultivars were included in the trial planted on May15. The field plot design was a randomized complete block, with four replicates; cultural practices typical of the growing area were used during the growing season, including sprinkler irrigation. Rows were 36 inches apart, and the within-row spacing was 12 inches. The plot was flailed on September 18 and harvested on September 19. Days to vine kill were 126 and to 127 days to harvest.

Agronomic and quality evaluations, yield and grade, and French fry quality are summarized Tables 1 (agronomic information), 2 (yield and grade information), and 3 (fry quality attributes), respectively. Percentage stand ranged from 81%, for ND071302B-5Russ, to 100% for several clones including Russet Burbank. Vine size ranged from 1.0 (very small) for ND8068-5Russ and ND071302B-5Russ) to 4.8 (large) for Dakota Trailblazer. Similarly, vine maturity ranged from 1.0 (very early) for ND8068-5Russ, ND071302B-5Russ, and Russet Norkotah, to 4.0 (medium late) for Dakota Trailblazer. The NDSU potato breeding program attempts to focus on high yielding, earlier maturing clones because of our often short growing season. Stems per plant are indicative of seed quality (physiological age), tuber eye number, and length of dormancy (genetic). Mean stem numbers per plant ranged from 1.2 to 2.8, with a mean of 2.1. Seed of ND8068-5Russ had been physiologically aged, and Teton Russet may also have been, based on stem number data. Tuber number per plant seemed low for all clones in 2014 from the Oakes site, with the exception of Umatilla Russet. Tuber number per plant ranged from 4.5 for ND071127-1Russ to 9.3 for Umatilla Russet. Umatilla Russet was small and somewhat spindly in all of our trials in 2014. Mean specific gravity was 1.0948, with a range of 1.0762 to 1.1140, for Teton Russet and Dakota Trailblazer, respectively. Specific gravity levels for many selections and cultivars were very high and out of processor specifications for this quality attribute. Percentage hollow heart and brown center ranged from 0 to 29, with a mean of 10. Several entries had high percentages, including clones that typically do not exhibit this physiological disorder. Some large rains and/or irrigation management may have contributed.

Total yield ranged from 270 cwt/acre for ND8068-5Russ, to 559 cwt/acre for Russet Burbank (Table 2). The mean was 442 cwt/acre. Percentage US No. 1 yield varied from 65 to 94. ND8068-5Russ, the very early dual-purpose russet, had 20% undersized tubers; others with many tubers 0-4 ounces included Umatilla Russet. The majority of entries had percentage yield of 6-12 ounce tubers in the 40-60% range. ND071127-1Russ had a propensity of over-sized tubers, and was the clone with low tuber numbers per plant. Manipulation of stem numbers via precutting or other means to increase stem and subsequently tuber numbers, and/or tighter within-row spacing would be appropriate management strategies to minimize tubers over 12 ounces for this selection and several others. ND092358ABC-6Russ, Teton Russet, Shepody and Russet Burbank had high percentages of culls. ND092358ABC-6Russ had shape issues including flat and points as reasons for culling tubers. Shepody and Russet Burbank had high numbers of jelly end tubers, curved tubers, and in the case of Russet Burbank many tubers were spindly shaped (too long for diameter). Teton Russet tubers had many large growth cracks.

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All trial entries were evaluated for blackspot and shatter bruise potential. Blackspot bruise potential is assessed using the abrasive peel method of Pavek and Corsini. On a scale of 1 (none) to 5 (severe), clones ranged from 2.5 for Dakota Trailblazer to 4.4 for Ranger Russet and ND8068-5Russ (Table 1). ND8068-5Russ was possibly over mature, since it had been dead for more than a month. Shatter bruise potential is assessed using a bruising chamber with digger chain link baffles, and rated on a scale of 1 (none) to 5 (many and severe). The mean across trial entries was 1.9, with a range of 1.4 to 2.5 (Table 3). Our research is designed to identify processing (both chip and frozen) germplasm that will reliably and consistently process from long-term cold (38° F and/or 42° F, 3.3° C and/or 5.5° C, respectively) storage. A field (zero time) sample was collected during grading for immediate French fry processing, and after eight weeks storage from 45° F (7.2° C) for fry color, stem end fry color, sugar ends, and other defects. Several advancing selections and industry standards had outstanding French fry color when fried at harvest and after storage at 45° F for 8 weeks. All clones had acceptable French fry color and had leachable sugar ends with the exception of Teton Russet, Russet Norkotah, Russet Burbank and Shepody. Many selections demonstrate sugar end resistance. Our program assesses a sugar end as any color deviation from the main fry. This is more stringent than the processing industry that requires a score of a 3 or 4 on the color chart to be called a sugar end. Clones with stem end colors 2 or less can generally be managed during processing/manufacturing. Following 8 weeks of storage at 45° F, Russet Norkotah (used as a poor processing control) produced the darkest French fry colors. Russet Burbank and Teton Russet exhibited classic sugar ends from storage. French fry/frozen processing selections will also evaluated from 45° F storage in June 2015.

The most promising advancing dual-purpose (frozen processing and tablestock) russet selection is ND8068-5Russ, despite its performance in this trial. ND8068-5Russ has early maturity, seven to ten days earlier than Russet Norkotah. Unlike Russet Norkotah, it processes from the field and 45° F storage. Dakota Russet and Dakota Trailblazer continue to be top performers, although yield potential was reduced for Dakota Russet and Dakota Trailblazer had high levels of hollow heart/brown center. The trial was managed for Russet Norkotah and both of these clones require less nitrogen fertilizer to maximize yield and quality. We are in the early stages of developing a cultivar specific management profile for Dakota Russet. Several selections including ND102677B-1Russ and ND102707-2Russ show great potential and have excellent processing quality. They will be increased and further evaluated.

The potato breeding program is grateful for the opportunity to conduct cooperative and interdisciplinary research with members of the NDSU potato improvement team, the USDA-ARS programs in Fargo and East Grand Forks, the North Central research group and others across the globe. A sincere thank you, to our many grower, industry, and research cooperators in North Dakota, Minnesota, and beyond. I wish to express gratitude to Leonard Besemann and Heidi Eslinger for hosting and conducting the day to day care of this research trial, the North Dakota Agricultural Experiment Station, the Northern Plains Potato Growers Association and MN Area II Potato Research and Promotion Council, R.D. Offutt Co., Hoverson Farms, Enander Seed and Jorde Certified Seed for research funding and certified seed potatoes in support of processing research. Additionally, I am grateful for the assistance of Richard Nilles, Dr. Jose Rodriguez, and our hourly and graduate students, for help planting, maintaining, harvesting, and grading the trial.

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Table 1. Agronomic and quality evaluations for advanced processing selections and cultivars, full season, Oakes, ND, 2014.

Clone	Stand	Vine Size[1]	Vine Maturity[2]	Stems per Plant	Tubers per plant	Specific Gravity[3]	Hollow Heart[4]	Black-spot Bruise[5]
	%						%	
1. ND8068-5Russ	99	1.0	1.0	2.8	6.4	1.0956	0	4.4
2. ND8339C-1Russ	95	3.0	1.8	2.4	8.7	1.0919	29	2.4
3. ND039194AB-1Russ	84	2.5	2.0	1.6	8.0	1.0881	0	4.1
4. ND059846C-4Russ	96	1.8	1.3	2.1	8.0	1.0920	0	3.2
5. ND071127-1Russ	96	3.3	1.8	1.2	4.5	1.0776	0	2.9
6. ND071302B-5Russ	81	1.0	1.0	2.7	6.2	1.0846	3	4.0
7. ND081563C-2Russ	100	4.5	2.5	2.2	8.2	1.1131	4	3.0
8. ND092358ABC-6Russ	88	3.8	2.3	1.6	7.6	1.1015	1	3.4
9. ND102677B-1Russ	100	3.0	3.0	1.4	7.5	1.1057	8	4.5
10. ND102677B-2Russ	95	2.3	2.8	2.1	7.7	1.0993	1	3.6
11. ND102707-2Russ	99	3.3	1.6	2.2	8.2	1.0950	26	4.4
12. WND8624-2Russ	93	2.5	2.1	1.9	5.4	1.0894	0	3.8
13. Alpine Russet	98	3.8	3.0	2.2	7.2	1.0957	0	3.6
14. Bannock Russet	96	4.3	3.8	2.8	6.2	1.0996	25	2.8
15. Dakota Russet	86	2.8	3.0	1.4	6.2	1.1006	4	2.3
16. Dakota Trailblazer	96	4.8	4.0	1.5	5.6	1.1141	28	2.5
17. Ranger Russet	99	3.5	3.3	2.2	7.8	1.1094	6	4.4
18. Russet Burbank	100	3.8	3.0	2.7	8.9	1.0892	20	2.9
19. Russet Norkotah	96	2.0	1.0	2.3	6.2	1.0828	10	3.1
20. Shepody	95	3.8	1.5	2.0	5.5	1.0884	14	3.0
21. Teton Russet	90	1.8	1.5	2.8	5.9	1.0762	21	2.8
22. Umatilla Russet	99	3.5	2.3	2.5	9.3	1.0956	13	3.6
Mean	95	3.0	2.2	2.1	7.1	1.0948	10	3.4
LSD (∞ = 0.05)	10	0.8	0.7	0.3	1.7	0.0063	7	1.2

[1] Vine size – scale 1-5, 1 = small, 5 = large.
[2] Vine maturity – scale 1-5, 1 = early, 5 = late.
[3] Determined using weight-in-air, weight-in-water method.
[4] Hollow heart includes brown center.
[5] Blackspot bruise determined by the abrasive peel method, scale 1-5, 1=none, 5=severe.

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Table 2. Yield and grade for advanced processing selections and cultivars, full season, Oakes, ND, 2014.

Clone	Total Yield	US No. 1	US No. 1	0-4 oz	4-6 oz	6-12 oz.	>12 oz.	US No. 2	Culls
	Cwt/A	Cwt/A	%	%	%	%	%	%	%
1. ND8068-5Russ	270	214	79	20	33	45	1	0	1
2. ND8339C-1Russ	524	421	80	8	16	56	9	4	8
3. ND039194AB-1Russ	484	438	91	6	9	45	37	1	2
4. ND059846C-4Russ	359	282	78	21	30	40	7	0	1
5. ND071127-1Russ	425	390	92	2	4	36	51	6	1
6. ND071302B-5Russ	319	289	90	8	14	47	29	0	2
7. ND081563C-2Russ	525	340	65	10	12	37	16	4	22
8. ND092358ABC-6Russ	538	449	84	5	10	34	39	2	9
9. ND102677B-1Russ	446	406	91	9	18	65	9	0	0
10. ND102677B-2Russ	333	263	79	21	29	47	3	0	0
11. ND102707-2Russ	493	419	85	10	15	51	19	0	5
12. WND8624-2Russ	350	325	93	6	13	57	23	0	1
13. Alpine Russet	539	429	80	6	8	40	31	5	9
14. Bannock Russet	417	367	88	7	12	49	28	2	2
15. Dakota Russet	407	385	94	4	11	60	24	2	0
16. Dakota Trailblazer	476	444	93	1	6	50	37	0	5
17. Ranger Russet	520	418	80	8	13	48	20	2	10
18. Russet Burbank	559	405	72	9	14	38	19	3	17
19. Russet Norkotah	403	377	93	6	14	59	21	1	0
20. Shepody	464	332	71	3	6	31	34	6	19
21. Teton Russet	401	295	74	4	9	39	26	0	22
22. Umatilla Russet	469	352	75	17	22	42	10	2	6
Mean	442	366	83	9	14	46	22	2	6
LSD (∞ = 0.05)	83	81	8	4	5	10	10	3	7

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Table 3. Shatter bruise potential and French fry evaluations following harvest and after 8 weeks storage at 45° F, full season trial, Oakes, ND, 2014.

Clone	Shatter Bruise[1]	Field Fry			Following 8 wks. at 45° F		
		Fry Color[2]	Stem-end Color	% Sugar End[3]	Fry Color[2]	Stem-end Color	% Sugar End[3]
1. ND8068-5Russ	1.7	0.5	1.2	25	0.4	0.7	17
2. ND8339C-1Russ	2.5	0.6	0.8	8	0.8	1.5	50
3. ND039194AB-1Russ	2.2	1.0	0.8	8	1.4	1.6	25
4. ND059846C-4Russ	1.9	0.6	1.9	50	1.3	2.3	67
5. ND071127-1Russ	1.5	0.9	1.7	50	1.1	2.3	75
6. ND071302B-5Russ	2.0	1.0	1.6	67	1.3	1.8	50
7. ND081563C-2Russ	2.3	0.5	0.8	42	1.1	1.5	42
8. ND092358ABC-6Russ	2.3	1.0	1.3	17	1.1	1.7	67
9. ND102677B-1Russ	1.7	0.5	1.0	34	0.5	0.6	17
10. ND102677B-2Russ	1.4	0.4	0.4	0	0.5	0.5	0
11. ND102707-2Russ	1.6	0.5	0.9	25	0.5	0.5	8
12. WND8624-2Russ	2.3	1.0	1.5	25	1.7	1.7	0
13. Alpine Russet	2.4	0.5	0.7	17	0.8	0.9	17
14. Bannock Russet	1.5	0.6	1.6	50	0.9	1.8	75
15. Dakota Russet	1.6	0.5	0.6	8	0.5	0.5	8
16. Dakota Trailblazer	1.4	0.6	0.7	8	0.5	0.5	0
17. Ranger Russet	1.9	0.9	1.8	67	0.9	1.5	42
18. Russet Burbank	1.5	1.1	2.5	67	0.7	3.5	92
19. Russet Norkotah	2.0	1.3	2.9	75	2.2	2.2	0
20. Shepody	2.0	1.0	2.7	75	1.6	3.1	83
21. Teton Russet	2.0	0.7	3.4	100	1.1	3.0	83
22. Umatilla Russet	1.9	0.6	1.7	50	0.6	1.3	75
Mean	1.9	0.7	1.5	39	1.0	1.6	39
LSD (∞ = 0.05)	0.6	0.5	1.0	43	0.6	0.6	47

[1]Shatter bruise is evaluated using a bruising chamber with digger chain link baffles. Tubers are stored at 45° F prior bruising. Shatter bruises are rated on a scale of 1-5, with 1 = none and 5 = many and severe.

[2]Fry color scores: 0.1 corresponds to 000, 0.3 corresponds to 00, 0.5 corresponds to 0, 1.0 equals 1.0 and subsequent numbers follow French fry rating scale 000 to 4.0.

[3]In our evaluation, any stem end darker than the main fry is considered a sugar end, the worst case scenario. The processing industry defines a sugar end as a 3.0 or darker.

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Soybean Variety Trial

L. Besemann and H. Eslinger

One soybean variety trial was conducted at the Oakes Irrigation Research Site, a Roundup Ready ® trial. Results for the Roundup Ready trial are listed in Table 1. The trial had 47 varieties.

MATERIALS AND METHODS

Soil:	Embden loam, Embden sandy loam and Maddock sandy loam; pH = 6.8; 1.6% organic matter; soil N 19 lbs/acre; soil P was very high; soil K was high; soil S was low.
Previous crop:	2013 – field corn.
Seedbed preparation:	Spring conventional tillage.
Planting:	Planted May 21 in 30-inch rows.
Plots:	Plots were 17 ft long by 5 ft (2 rows) wide. The study had four replications.
Fertilizer:	Broadcast 25 lbs N/acre, 44 lbs P_2O_5/acre, 47 lbs K_2O/acre and 19 lbs S/acre as 10-18-19-8 April 21.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Trust (1 pt/acre) May 21, Roundup Power Max (20 oz/acre) + AMS (1 lb/10 gal) June 24, Section 2EC (8oz/acre) + COC (1pt/acre) July 9 controlled weeds. Endura (8 oz/acre) July 17 and July 25, T-Methyl (26 oz/acre) July 31 controlled disease. Kendo (3 oz/acre) July 17 controlled insects.
Harvest:	October 9 with a plot combine.

RESULTS

Yields in the Roundup Ready trial averaged 67.1 bu/acre.

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Table 1. Soybean variety trial (Roundup Ready) at the Oakes Irrigation Research Site in 2014.

Brand	Variety	Mat Group[1]	Days to PM	Plant Ht	Plant Lodge	Seeds/ Pound	Seed Oil	Seed Protein	Test Wt	Seed Yield 2014	Seed Yield 2-yr. Ave.	Seed Yield 3-yr. Ave.
				inch	0 to 9		%	%	lb/bu	----bu/ac----		
Nuseed	2074 RR2YN	0.7	122.8	33.5	0.5	2908	17.7	35.0	54.9	67.2	--	--
Nuseed	2093 RR2YN	0.9	125.3	29.5	0.8	2717	17.8	34.5	56.2	69.9	73.9	--
Nuseed	2122 RR2YN	1.2	125.0	29.3	0.8	2621	18.0	35.8	56.4	64.7	71.2	--
NuTech/G2 Genetics	7063	0.6	121.5	29.8	0.0	2706	18.7	32.6	55.3	70.0	69.4	--
NuTech/G2 Genetics	6083	0.8	121.0	30.3	0.0	2626	18.6	34.6	56.1	69.1	--	--
NuTech/G2 Genetics	6084R2	0.8	122.3	35.5	0.0	2321	18.3	35.2	55.3	67.9	--	--
NuTech/G2 Genetics	7104	1.0	125.0	28.5	3.0	2470	18.8	35.1	55.2	61.9	--	--
NuTech/G2 Genetics	6112	1.1	125.0	30.3	1.3	2543	17.2	35.2	56.3	65.5	--	--
NuTech/G2 Genetics	6143	1.4	125.5	29.8	1.8	2647	17.2	35.1	56.0	64.5	--	--
NuTech/G2 Genetics	7157	1.5	124.5	31.8	1.5	2521	18.9	34.3	55.2	66.5	--	--
Thunder	3506 R2YN	0.6	122.5	33.0	0.0	2858	17.8	35.1	54.9	70.6	--	--
Thunder	3307 R2Y	0.7	123.3	26.8	0.5	2208	17.3	35.7	56.0	71.6	--	--
Thunder	3408 R2YN	0.8	124.5	28.0	1.5	2677	18.0	34.4	55.9	71.4	--	--
Thunder	3511 R2YN	1.1	126.0	24.3	5.0	2840	18.3	34.7	56.0	60.4	--	--
Thunder	3114 R2Y	1.4	127.3	30.8	5.3	2789	17.1	35.1	55.5	65.3	69.9	73.9
Channel	1108 R2	1.1	125.5	24.5	3.0	2924	18.4	34.8	55.6	57.3	--	--
Integra	20815N	0.8	124.5	26.3	2.0	2624	17.7	34.4	56.1	70.2	73.7	--
Integra	20915N	0.9	126.3	33.0	0.8	2906	17.8	34.3	55.4	73.7	--	--
Integra	21115N	1.1	124.8	25.5	0.8	2730	17.6	35.7	56.0	66.0	--	--
REA Hybrids	66G14	0.6	121.8	33.5	0.3	2992	17.8	34.7	55.0	63.2	64.5	--
REA Hybrids	R0815	0.8	123.5	25.8	1.0	2810	18.2	34.2	55.8	69.4		
REA Hybrids	69G13	0.9	123.3	34.0	0.5	2717	18.2	34.3	55.6	69.1	70.8	73.1
REA Hybrids	69G14	0.9	124.5	28.8	1.5	2631	18.1	34.1	55.7	68.8	74.2	--
REA Hybrids	71G14	1.1	125.8	26.8	2.0	2657	18.0	34.5	56.3	65.9	73.8	--
REA Hybrids	R1215	1.2	126.8	29.5	2.3	2990	17.1	35.5	55.3	65.8	--	--
Dyna-Gro	S09RY64	0.9	125.8	28.5	1.8	2865	17.6	34.4	55.9	67.4	71.0	--
Dyna-Gro	S12RY44	1.2	125.0	28.0	0.8	2701	17.7	35.5	56.0	68.5	70.1	--
Dyna-Gro	S14RY95	1.4	124.8	32.0	0.8	3103	18.4	34.0	55.8	65.8	--	--
Dairyland	DSR-0711/R2Y	0.7	122.3	34.8	0.3	2526	18.8	33.5	56.1	63.3	--	--
Dairyland	DSR-0904/R2Y	0.9	121.8	32.0	0.3	2653	18.3	34.3	55.6	69.6	72.3	73.7
Dairyland	DSR-1120/R2Y	1.1	126.5	30.0	4.3	2222	18.6	34.7	55.3	63.2	70.3	--
Dairyland	DSR-1340/R2Y	1.3	125.8	30.0	3.5	2797	17.5	34.1	55.2	67.7	--	--
Legacy Seeds	LS0634 NRR2	0.6	122.5	34.5	0.0	2881	17.8	35.3	54.9	66.3	--	--
Legacy Seeds	LS0833 NRR2	0.8	125.3	27.3	2.5	2672	18.0	34.2	56.1	70.6	--	--
Legacy Seeds	LS1134 NRR2	1.1	126.8	24.0	4.5	2801	18.4	34.5	55.6	59.4	--	--
Legacy Seeds	LS1314 NRR2	1.3	126.8	31.0	1.8	2908	18.0	33.9	54.9	68.2	--	--
	MEAN		124.5	29.8	1.5	2695	18	34.7	55.6	67.1		
	C.V. (%)		1.0	6.7	25.9	2.8	0.9	0.7	1.0	5.8		
	LSD 0.10		1.4	2.4	1.2	88	0.18	0.29	0.6	4.6		
	LSD 0.05		1.7	2.8	1.4	106	0.21	0.35	0.8	5.5		

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Table 1. Soybean variety trial (Roundup Ready) at the Oakes Irrigation Research Site in 2014.

Brand	Variety	Mat Group[1]	Days to PM	Plant Ht	Plant Lodge	Seeds/ Pound	Seed Oil	Seed Protein	Test Wt	Seed Yield 2014	Seed Yield 2-yr. Ave.	Seed Yield 3-yr. Ave.
				inch	0 to 9		%	%	lb/bu			
PFS	14R09N	0.9	126.8	27.3	2.5	2762	18	34.0	55.3	67.6	--	--
PFS	14R11N	1.1	125.0	28.8	1.5	2755	18	35.2	56.0	68.1	--	--
PFS	14R13	1.3	123.5	39	0.5	2420	18	34.5	56.0	67.6	68.2	--
Wensman Seed	W 3062NR2	0.6	121.0	24.5	0.0	2542	17	36.9	55.3	64.5	67.0	--
Wensman Seed	W 3080NR2	0.8	124.0	25.3	1.5	2932	18	34.1	55.3	68.4	--	--
Wensman Seed	W 3090NR2	0.8	123.3	36.8	0.0	2661	18	34.3	55.5	68.4	71.0	71.8
Wensman Seed	W 3102NR2	1.0	126.8	27.5	2.5	2845	18	34.0	55.2	72.9	75.2	--
Wensman Seed	W 3121NR2	1.2	125.3	29.3	1.0	2739	18	35.4	56.5	69.1	72.7	--
Proseed	P2 20-90	0.9	125.5	25.8	3.5	2376	18	35.0	55.8	62.6	68.8	69.2
Proseed	30-11	1.1	123.8	34.3	1.0	2458	18	35.0	55.5	70.5	--	--
Proseed	30-12	1.2	124.8	31.3	1.0	2615	18	35.2	55.3	67.7	--	--
	MEAN		124.5	29.8	1.5	2695	18	34.7	55.6	67.1		
	C.V. (%)		1.0	6.7	25.9	2.8	0.9	0.7	1.0	5.8		
	LSD 0.10		1.4	2.4	1.2	88	0.18	0.29	0.6	4.6		
	LSD 0.05		1.7	2.8	1.4	106	0.21	0.35	0.8	5.5		

Planting Date = May 21 Harvest Date = October 9; Previous Crop = Field corn

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

Soybean variety trial Roundup Ready @

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Early-season Weed Control in Onion Using Micro-rates

H. Hatterman-Valenti and C. Auwarter

This study was conducted at the Oakes Irrigation Research Site near Oakes, North Dakota, to compare early-season weed control of bromoxynil (Buctril and Broclean) and oxyfluorfen (GoalTender) applied at micro rates to standard pre-emergence treatment of DCPA (Dacthal) and ethofumesate (Nortron) in onion. 'Crockett', 'Patterson', 'Sedona', and 'Talon were planted April 25 with 16" centers and a planting population of 250,000 seeds/acre. PRE treatments included 1 and 2 lb/acre ethofumesate and 13.33 lb/acre DCPA and were applied 11 days after planting (DAP). Micro rate applications began between the flag-leaf and one-leaf stage, 27 DAP. Bromoxynil and oxyfluorfen were applied at the 0.25 and 0.13 times the lowest labeled rate and applied in four of five sequential applications when weeds and onions were in seedling growth stages. Petroleum oil-surfactant (Herbimax) (1 pt/acre) was tank mixed with the micro rate application. All treatments received bromoxynil at 0.25 lb/acre and oxyfluorfen at 0.50 lb/acre when onions were around the 5 and 9-leaf stages.

Table 1. Treatment application information.

Date:		5/6/14	5/22/14	5/29/14	6/4/14	6/13/14	6/20/14	6/30/14	7/23/14
Time:		A	B	C	D	E	F	G	H
Sprayer:	GPA:	20	20	20	20	20	20	20	20
	PSI:	40	40	40	40	40	40	40	40
	Nozzle:	8002	8002	8002	8002	8002	8002	8002	8002
Air Temperature (F):		48	72	87	81	59	69	75	79
Relative Humidity (%):		76	37	24	37	63	83	45	43
Wind (MPH):		4.6	7	10	9	7	7.5	11.1	7
Cloud Cover (%):		100	0	0	10	5	5	50	60
Onion Leaf Stage:		PRE	Flag	1-2	2	3	4	5	9

Early-season weed control in onions using micro-rates.

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Table 2. Treatment details.

Trt No.	Trt Name	Rate	Rate Unit	App Code
1	Buctril	4	fl oz/ac	B
	Buctril	4	fl oz/ac	C
	Goal Tender	2	fl oz/ac	D
	Goal Tender	2	fl oz/ac	E
2	Buctril	2	fl oz/ac	B
	Buctril	2	fl oz/ac	C
	Buctril	4	fl oz/ac	D
	Buctril	2	fl oz/ac	E
	Goal Tender	2	fl oz/ac	E
	Buctril	2	fl oz/ac	F
	Goal Tender	2	fl oz/ac	F
3	Buctril	2	fl oz/ac	B
	Goal Tender	1	fl oz/ac	B
	Buctril	2	fl oz/ac	C
	Goal Tender	1	fl oz/ac	C
	Buctril	2	fl oz/ac	D
	Goal Tender	1	fl oz/ac	D
	Buctril	2	fl oz/ac	E
	Goal Tender	1	fl oz/ac	E
	Buctril	2	fl oz/ac	F
	Goal Tender	1	fl oz/ac	F
	Buctril	4	fl oz/ac	B
	Buctril	4	fl oz/ac	C
4	Buctril	4	fl oz/ac	D
	Buctril	4	fl oz/ac	E
	Buctril	4	fl oz/ac	F
	Goal Tender	2	fl oz/ac	B
	Goal Tender	2	fl oz/ac	C
5	Goal Tender	2	fl oz/ac	D
	Goal Tender	2	fl oz/ac	E
	Goal Tender	2	fl oz/ac	F
	Dacthal	10	lb/ac	A
	Nortron	32	fl oz/ac	A
6	Nortron	64	fl oz/ac	A
7	Buctril	2	fl oz/ac	B
8	Buctril	2	fl oz/ac	C
9	Buctril	2	fl oz/ac	D
	Goal Tender	2	fl oz/ac	D
	Buctril	2	fl oz/ac	E
	Goal Tender	2	fl oz/ac	E
10	Buctril	4	fl oz/ac	B
	Buctril	4	fl oz/ac	C
	Buctril	4	fl oz/ac	D
	Goal Tender	2	fl oz/ac	D
	Buctril	4	fl oz/ac	E
	Goal Tender	2	fl oz/ac	E
11	Buctril	4	fl oz/ac	B
	Buctril	4	fl oz/ac	C
	Buctril	4	fl oz/ac	D
	Buctril	4	fl oz/ac	E
	Goal Tender	2	fl oz/ac	E
	Buctril	4	fl oz/ac	F
	Goal Tender	2	fl oz/ac	F
12	Check			
13	Broclean	2	fl oz/ac	B
	Broclean	2	fl oz/ac	C
	Broclean	2	fl oz/ac	D
	Broclean	2	fl oz/ac	E
	Goal Tender	2	fl oz/ac	E
	Broclean	2	fl oz/ac	F
	Goal Tender	2	fl oz/ac	F
14	Broclean	4	fl oz/ac	B
	Broclean	4	fl oz/ac	C
	Broclean	4	fl oz/ac	D
	Broclean	4	fl oz/ac	E
	Broclean	4	fl oz/ac	F
15	Nortron	32	fl oz/ac	A
16	Broclean	4	fl oz/ac	B
	Broclean	4	fl oz/ac	C
	Broclean	4	fl oz/ac	D
	Goal Tender	2	fl oz/ac	D
	Broclean	4	fl oz/ac	E
	Goal Tender	2	fl oz/ac	E

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Table 3. Stand counts, weed control and injury ratings.

Trt No.	Stand Counts 29 DAA[1]-A[2], 13 DAA-B[2], 6 DAA-C[2] in 3 row feet. Variety: Crockett	Sedona	Patterson	Talon	Weed Control and Injury 38 DAA-A. -----% Control----- Colq[3]	Pigw[4]	% Injury
1	12.8a[5]	12.8a	9.3a	7.8a	93.3a	100.0a	7.5ab
2	12.3a	10.5a	12.0a	11.0a	70.0a	81.3ab	1.3c
3	11.5a	12.5a	9.8a	9.0a	86.7a	100.0a	8.8a
4	10.3a	10.3a	10.8a	8.0a	85.0a	98.8a	3.8abc
5	12.0a	9.5a	8.8a	9.8a	81.7a	100.0a	6.3ab
6	12.8a	8.3a	10.8a	8.3a	80.0a	62.5b	0.0c
7	10.5a	13.3a	10.8a	9.5a	11.7b	100.0a	0.0c
8	12.0a	12.3a	12.0a	11.0a	38.3b	98.8a	0.0c
9	11.5a	10.8a	11.0a	9.3a	80.0a	100.0a	7.5ab
10	10.5a	7.8a	9.5a	9.0a	95.0a	100.0a	6.3ab
11	8.0a	8.5a	10.8a	9.3a	90.0a	98.8a	2.5bc
12	7.8a	10.3a	10.8a	7.5a	0.0c	0.0c	0.0c
13	13.8a	10.8a	11.8a	9.5a	86.7a	100.0a	6.3ab
14	9.8a	10.3a	9.8a	7.3a	86.7a	100.0a	5.0abc
15	12.3a	13.8a	11.8a	9.3a	15.0c	100.0a	0.0c
16	9.3a	11.5a	10.5a	9.5a	95.0a	100.0a	6.3ab
LSD (*P* = 0.05)	4.0	4.0	3.3	3.7	17.0	20.9	3.1

[1]DAA = Days after application.
[2]Time from table 1.
[3]Colq = Common lambsquarters.
[4]Pigw = Redroot pigweed.
[5]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

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Table 4. Crockett onion yield results.

Trt	----------Onion Bulb Counts in 6 row feet----------						----------CWT/A----------					
No.	<1"	1-2.25"	2.25-3"	3-4"	>4"	Total	<1"	1-2.25"	2.25-3"	3-4"	>4"	Total
1	0.7b[1]	4.7c	12.5abc	10.0ab	0a	0.0a	3.63a	34bcd	211abc	312a	0a	565abc
2	0.3b	15.3ab	16.5ab	1.0d	0a	33.5a	2.42a	95abc	264ab	29bc	0a	388bcd
3	0.1b	9.5abc	15.3abc	7.5abc	0a	32.8a	1.21a	62a-d	270ab	219a	0a	568abc
4	0.1b	6.8bc	14.3abc	6.8abc	0a	28.3ab	1.21a	46a-d	247abc	200a	0a	501abc
5	0.1b	20.0a	7.5cd	0.5d	0a	28.8ab	1.21a	125a	120cd	5c	0a	260de
6	0.0b	5.9bc	19.8a	8.3ab	0a	34.0a	0.0a	44a-d	340a	244a	0a	634a
7	0.1b	12.0abc	13.0abc	2.0cd	0a	27.8ab	1.21a	78a-d	207abc	42bc	0a	346cde
8	0.6b	3.5c	14.3abc	8.8ab	0a	27.5ab	3.63a	22cd	258ab	276a	0a	566abc
9	0.3b	19.2b	4.5de	0.0d	0a	24.3ab	2.42a	118ab	65de	0c	0a	184ef
10	0.1b	7.3bc	11.0bcd	6.8abc	0a	25.8ab	1.21a	56a-d	186bc	201a	0a	451abc
11	0.2b	6.7bc	10.3bcd	10.5ab	0a	28.5ab	1.21a	41a-d	184bc	322a	0a	558abc
12	3.6a	12.5abc	1.3e	0.3d	0a	18.8b	6.05a	52a-d	22e	3c	0a	88f
13	0.7b	10.5abc	13.5abc	5.0a-d	0a	30.8a	3.63a	69a-d	247abc	114ab	0a	471abc
14	0.4b	8.5abc	11.0bcd	7.5abc	0a	28.3ab	2.42a	59a-d	192bc	223a	0a	486abc
15	0.1b	11.7abc	12.0bc	4.3bcd	0a	28.5ab	1.21a	107ab	213abc	123ab	0a	473abc
16	0.1b	3.5c	12.8abc	10.8a	0a	27.5ab	1.21a	19d	225abc	346a	0a	594ab
LSD (P = 0.05)	0.5	1.0	4.7	3.8	0	6.2	3.32	3	81	5	0	138

[1]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

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Table 5. Patterson onion yield results.

Trt	----------Onion Bulb Counts in 6 row feet----------						----------CWT/A----------					
No.	<1"	1-2.25"	2.25-3"	3-4"	>4"	Total	<1"	1-2.25"	2.25-3"	3-4"	>4"	Total
1	0.4a[1]	14.0ab	9.5ab	0.0a	0a	24.3a	2.42a	97ab	133abc	0a	0a	232abc
2	0.3a	18.3ab	2.0c	0.0a	0a	20.8ab	2.42a	94ab	27d	0a	0a	123de
3	0.1a	17.5ab	9.0ab	0.3a	0a	27.0a	1.21a	115a	145ab	7a	0a	269ab
4	2.8a	19.8ab	2.0c	0.3a	0a	25.0a	4.84a	98ab	28d	8a	0a	139cde
5	0.1a	19.8ab	5.8abc	0.0a	0a	25.8a	1.21a	122a	85a-d	0a	0a	208a-d
6	0.0a	17.8ab	10.5ab	0.8a	0a	29.0a	0.0a	117a	156ab	19a	0a	293a
7	0.4a	16.8ab	5.3abc	0.5a	0a	23.3a	2.42a	81ab	76a-d	15a	0a	174bcd
8	0.3a	19.8ab	7.8abc	0.3a	0a	28.3a	2.42a	122a	121abc	8a	0a	254ab
9	0.0a	21.3a	4.8bc	0.0a	0a	26.0a	0.0a	120a	65bcd	0a	0a	185a-d
10	0.4a	12.5ab	8.5ab	1.3a	0a	23.0a	2.42a	85ab	136abc	35a	0a	258ab
11	0.1a	16.3ab	11.0a	0.3a	0a	27.8a	1.21a	107a	173a	8a	0a	289a
12	0.6a	9.3b	2.8c	0.0a	0a	13.3b	2.42a	35b	46cd	0a	0a	83e
13	0.3a	14.5ab	10.5ab	0.8a	0a	26.3a	2.42a	90ab	165ab	18a	0a	275ab
14	0.1a	16.5ab	4.5bc	0.5a	0a	21.8ab	1.21a	91ab	76a-d	13a	0a	182a-d
15	0.1a	14.3ab	6.5abc	0.8a	0a	21.8ab	1.21a	79ab	100a-d	21a	0a	201a-d
16	0.1a	12.0ab	9.3ab	0.8a	0a	22.3ab	1.21a	74ab	146ab	22a	0a	243ab
LSD (P = 0.05)	0.5	6.4	3.6	0.9	0	6.5	3.38	41	58	24	0	66

[1]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

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Table 6. Sedona onion yield results.

Trt	----------Onion Bulb Counts in 6 row feet----------						----------CWT/A----------					
No.	<1"	1-2.25"	2.25-3"	3-4"	>4"	Total	<1"	1-2.25"	2.25-3"	3-4"	>4"	Total
1	0.2a[1]	6.8cd	12.0a	7.4ab	0.0a	27.0a	1.21a	44bc	215a	258ab	0a	524a-d
2	0.3a	15.8ab	13.5a	1.0c	0.0a	31.0a	2.42a	107a	208a	21c	0a	353cde
3	0.1a	7.0cd	12.3a	10.1a	0.1a	30.0a	1.21a	41bc	229a	317a	15a	609ab
4	0.7a	14.3abc	9.8a	2.4bc	0.0a	27.8a	3.63a	82abc	172a	69bc	0a	341cde
5	0.1a	7.8cd	13.5a	2.6bc	0.0a	25.0a	1.21a	57abc	217a	69bc	0a	378b-e
6	0.0a	4.0d	13.0a	9.7a	0.0a	26.8a	0.00a	33c	246a	332a	0a	611ab
7	0.1a	10.8a-d	17.3a	2.8bc	0.0a	31.5a	1.21a	84abc	306a	74bc	0a	488a-d
8	0.0a	4.5d	13.8a	9.7a	0.1a	28.5a	0.00a	35bc	243a	323a	13a	623a
9	0.4a	17.5a	11.5a	0.4c	0.0a	30.3a	2.42a	113a	180a	5c	0a	310de
10	0.1a	3.3d	12.0a	7.6ab	0.0a	23.3a	1.21a	39bc	223a	235ab	0a	515a-d
11	0.1a	6.3d	11.8a	8.1ab	0.1a	27.0a	1.21a	50bc	225a	272ab	17a	570abc
12	0.7a	16.3ab	5.8a	0.4c	0.0a	23.5a	3.63a	97ab	86a	9c	0a	201e
13	0.3a	9.8bcd	12.3a	6.1ab	0.1a	29.0a	2.42a	71abc	218a	193ab	13a	508a-d
14	0.4a	8.8cd	9.8a	5.4ab	0.1a	25.3a	2.42a	58abc	177a	169ab	15a	434a-d
15	0.1a	6.3d	14.5a	5.8ab	0.0a	27.0a	1.21a	46bc	267a	181ab	0a	502a-d
16	0.1a	4.0d	10.3a	12.2a	0.1a	27.0a	1.21a	36bc	199a	416a	15a	667a
LSD (P = 0.05)	0.5	4.9	5.0	7.9	0.2	6.2	3.45	36	92	90	25	143

[1]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

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Table 7. Talon onion yield results.

Trt	----------Onion Bulb Counts in 6 row feet----------						----------CWT/A----------					
No.	<1"	1-2.25"	2.25-3"	3-4"	>4"	Total	<1"	1-2.25"	2.25-3"	3-4"	>4"	Total
1	0.0a[1]	5.0a	9.0a	5.8a-d	0.1a	20.0ab	0.00a	36a	153a	186a-d	17a	392abc
2	0.0a	10.5a	5.7a	2.5bcd	0.0a	18.8ab	0.00a	62a	88a	81bcd	0a	231cd
3	0.0a	5.8a	10.1a	5.8a-d	0.1a	22.3ab	0.00a	34a	173a	172a-d	18a	397abc
4	0.0a	10.5a	6.7a	2.8a-d	0.0a	20.8ab	0.00a	61a	113a	82bcd	0a	255bcd
5	0.0a	7.0a	8.2a	4.8a-d	0.0a	20.0ab	0.00a	50a	130a	137a-d	0a	316a-d
6	0.0a	7.8a	7.7a	6.5abc	0.1a	22.3ab	0.00a	47a	125a	221abc	15a	408abc
7	0.0a	12.0a	6.8a	3.8a-d	0.0a	23.3ab	0.00a	64a	130a	115a-d	0a	309a-d
8	0.0a	6.8a	10.5a	5.3a-d	0.1a	23.3ab	0.00a	42a	176a	185a-d	16a	419abc
9	0.0a	9.5a	13.4a	3.0a-d	0.0a	26.0a	0.00a	59a	215a	88bcd	0a	363abc
10	0.3a	7.0a	9.1a	7.3ab	0.1a	24.0a	1.21a	51a	146a	237ab	15a	450ab
11	0.0a	8.8a	9.4a	7.8a	0.0a	26.0a	0.00a	54a	166a	263a	0a	483a
12	0.3a	6.8a	4.1a	1.3d	0.0a	12.5b	1.21a	36a	68a	42d	0a	148d
13	0.0a	7.8a	8.7a	6.3a-d	0.0a	23.0ab	0.00a	52a	151a	209a-d	0a	413abc
14	0.0a	7.8a	7.9a	5.5a-d	0.1a	21.5ab	0.00a	48a	131a	197a-d	15a	391abc
15	0.5a	8.5a	6.3a	2.0cd	0.0a	17.5ab	2.42a	53a	108a	59cd	0a	223cd
16	0.3a	5.0a	7.0a	7.3ab	0.1a	20.0ab	1.21a	35a	121a	236ab	12a	405abc
LSD (*P* = 0.05)	0.4	4.4	7.8	3.0	0.3	6.5	1.77	28	77	98	30	126

[1]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

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RESULTS

The pre-applications of DCPA and ethofumesate didn't injure onion (37 DAA), while the post-applications all had some injury after the third application. Micro-rate treatments without oxyfluorfen at third application had less injury and bromoxynil at 0.031 lb/acre had less injury than 0.062 lb/acre. The Buctril treatments had less injury than the Broclean treatments. When comparing treatment 2 (Buctril) versus treatment 13 (Broclean), treatment 4 (Buctril) vs. treatment 14 (Broclean), treatment 7 (Buctril) vs. treatment 15 (Broclean) and treatment 10 (Buctril) vs. treatment 16 (Broclean); the biggest difference in injury was shown between treatments 2 and 13. Both received 0.031 lb/ acre bromoxynil for two applications, followed by (fb) 0.0625 lb/acre with 6.3% onion injury for Broclean and only 1.3% onion injury for Buctril. DCPA controlled COLQ better than ethofumesate, while ethofumesate had better control of RRPW than DCPA 37 DAA. Stand counts were taken 40 DAP, just prior to the third application. No differences were observed.

Sedona onions had the highest yield among the four cultivars fb Crockett, Talon, and Patterson. Even though there was more onion injury in the Broclean treatments, these treatments had a higher yield overall than the Buctril treatments. The highest yielding treatment over all four cultivars was treatment 16 with Sedona onions at 666 cwt/acre. This treatment consisted of bromoxynil (Broclean) at 0.0625 lb/acre applied twice fb bromoxynil (Broclean) at 0.0625 lb/acre and oxyfluorfen at 0.0625 lb/acre applied twice. This treatment resulted in a top seven yield among the four cultivars of onion. In comparison, the Buctril treatment 10 ranked in the middle among all treatments for total onion yield averaged over all cultivars. The most consistent treatment was treatment 6; pre-application of DCPA and two additional applications of the grower standard use rate of bromoxynil and oxyfluorfen at the 5- and 9-leaf stages. The untreated consistently yielded at the bottom even though it received the two standard bromoxynil and oxyfluorfen applications at the 5- and 9-leaf stages, because the weeds were too big to fully control.

Having oxyfluorfen mixed with bromoxynil in the first three applications compared to only bromoxynil increased yields with all four cultivars (treatments 3 vs. 2). Comparing treatments 10 and 11, where an application of bromoxynil at 0.0625 lb/acre was added for treatment 11, showed a yield increase with all four cultivars. Treatment 10 had two applications of bromoxynil at 0.0625 lb/ acre and 2 applications of bromoxynil at 0.0625 lb/acre plus oxyfluorfen at 0.0625 lb/acre. Treatment 11 added a third application of bromoxynil at 0.0625 lb/acre in the middle fb two applications of bromoxynil at 0.0625 lb/acre plus oxyfluorfen at 0.0625 lb/acre.

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Mosaic Corn Study

K. Mann, L. Besemann and H. Eslinger

MATERIALS AND METHODS

Soil:	Maddock sandy loam; pH = 7.4; 1.5% organic matter; soil N 18 lbs/acre; soil P and soil K were very high; soil S was medium.
Previous crop:	2013 – edible bean, sugarbeet, wheat.
Seedbed preparation:	Spring conventional tillage.
Hybrid:	Croplan 3899VT
Planting:	May 16 in 30-inch rows.
Plots:	Plots were 40 ft long by 15 ft (6 rows) wide. The study had four replications.
Fertilizer:	Broadcast and incorporated treatments (see treatments in table 1) May 16, stream bar 20 lbs N/acre as 28-0-0 May 27 and sidedress N as urea June 17 to all treatments except # 1 to bring the total N (applied + soil) to 215 lbs/acre.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Harness (2 pt/acre) May 22, Laudis (3 oz/acre) + AAtrex 9-0 (0.5 lb ai/acre) + Destiny (0.05 % v/v) + AMS (1½ lb/acre) June 3, Roundup Power Max (20 oz/acre) + AMS (1 lb/10 gal) June 4.
Remote sensing:	Remote sensing was achieved with an Opti-Sciences CCM 200 Plus chlorophyll meter and a Holland Crop Circle ACS active canopy sensor (normalized difference red edge – NDRE).
Harvest:	November 13 with a plot combine. Harvest area was the center two rows, 37 feet long.

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Table 1. Specific details associated with fertilizier treatments within the Mosaic corn fertilizer study.

Entry No.	Fertility Treatment	Formulation	Product	Formulation
				lb nutrient/acre
1	Check (no fertilizer)	NA	NA	NA
2	MOP	60% K_2O	0-0-60	60
3	MAP/DAP	52% P_2O_5	11-52-0	80
3	MOP	60% K_2O	0-0-60	60
4	MAP/DAP	52% P_2O_5	11-52-0	80
4	AS	24%	21-0-0-24S	20
4	ZnSO4	36%	0-0-0-16.5S-36Zn	5
4	MOP	60% K_2O	0-0-60	60
5	MAP/DAP	52% P_2O_5	11-52-0	80
5	AS	24%	21-0-0-24S	20
5	ZnSO4	36%	0-0-0-16.5S-36Zn	2
5	MOP	60% K_2O	0-0-60	60
6	MES10	40% P_2O_5	12-40-0-10S	80
6	MOP	60% K_2O	0-0-60	60
7	MESZ	40% P_2O_5	12-40-0-10S-1Zn	80
7	MOP	60% K_2O	0-0-60	60
8	MES15	33% P_2O_5	13-33-0-15S	80
8	MOP	60% K_2O	0-0-60	60
9	MAP/DAP	52% P_2O_5	11-52-0	80
9	Aspire	58% K_2O	0-0-58-0.5B	60
10	MESZ	40% P_2O_5	12-40-0-10S-1Zn	80
10	Aspire	58% K_2O	0-0-58-0.5B	60

Total N (applied + soil) was 215 lb/acre except trt #1 which received no applied N.

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Table 2. Corn grain yield, crop agronomics and selected quality traits as influenced by Mosaic fertility treatments.

Treatment Entry No.	Grain Yield	Harvest Moisture	Test Weight	Days to Silk	Ear Height	Plant Height	Final Plant Population	Grain Protein	Starch Content
*see table 1.	bu/ac	%	lb/bu	Mean	inch	inch		%	%
1	125.5	15.4	51.5	205.8	37.4	78.2	33,376	6.7	73.5
2	228.7	15.5	55.1	203.8	44.4	90.5	33,847	8.7	73.2
3	234.9	16.7	55.5	203.3	44.3	91.7	34,142	8.8	72.8
4	234.8	15.5	55.4	202.8	44.5	90.1	33,494	8.8	73.1
5	233.4	15.4	55.3	202.8	44.5	91.8	33,200	8.9	72.7
6	225.9	17.2	54.7	203.0	44.7	91.3	33,788	8.6	73.0
7	228.0	16.6	54.9	202.8	44.7	90.3	33,553	8.9	72.8
8	228.7	15.8	54.9	202.8	44.4	89.7	33,435	8.9	72.7
9	232.2	16.5	55.1	203.3	45.0	90.4	33,435	8.8	73.1
10	217.9	16.4	55.2	203.3	44.0	89.9	32,376	8.8	73.0
MEAN	219.0	16.1	54.8	203.3	43.8	89.4	33,465	8.6	73
C.V.(%)	5.4	7.8	0.9	0.3	4.6	3.3	2.0	2.3	0.4
LSD 0.10	14.4	NS	0.6	0.7	2.4	3.5	824	0.2	0.4
LSD 0.05	17.3	NS	0.7	0.9	2.9	4.2	NS	0.3	0.5
LSD 0.01	23.4	NS	1.0	1.2	4.0	5.7	NS	0.4	NS

Planting Date = May 16; Harvest Date = November 13
Yield adjusted and reported at 15.5% moisture.

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Table 3. Corn tissue analysis, selected quality traits and canopy color as influenced by Mosaic fertility treatments.

Treatment	Grain Oil	V6 Plant Tissue Samples (June 17)					Chlorophyll	
Entry No.	Content	N	P	K	S	ZN	Reading	NDRE
*see table 1.	%	%	%	%	%	ppm	4-Aug	5-Aug
1	3.4	4.10	0.57	4.97	0.26	35.3	14.6	0.2414
2	3.1	4.48	0.55	5.48	0.25	34.5	42.5	0.3664
3	3.2	4.60	0.58	5.33	0.25	38.3	44.4	0.3649
4	2.9	4.80	0.51	4.76	0.22	31.8	45.2	0.3608
5	3.2	4.68	0.57	5.13	0.27	37.3	42.9	0.3649
6	3.2	4.58	0.57	5.43	0.26	34.0	44.0	0.3726
7	3.2	4.85	0.57	5.36	0.27	40.0	42.6	0.3655
8	3.2	4.55	0.56	5.13	0.26	38.3	44.0	0.3694
9	3.1	4.50	0.56	5.01	0.25	35.0	44.2	0.3595
10	3.1	4.60	0.57	5.31	0.26	36.8	43.7	0.3585
MEAN	3.1	4.57	0.56	5.19	0.26	36.1	40.8	0.3524
C.V.(%)	4.9	3.5	12.0	10.8	11.3	13.7	5.4	4.5
LSD 0.10	0.2	0.19	NS	NS	NS	NS	2.7	0.0189
LSD 0.05	NS	0.23	NS	NS	NS	NS	3.2	0.0228
LSD 0.01	NS	0.31	NS	NS	NS	NS	4.3	0.031

Chlorophyll meter = Opti-Science CCM 200

Infratec 1229 Grain Analyzer at James Valley Grain was used to obtain the data for oil, protein, starch and moisture.

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Weed Control and Crop Response on Russet Burbank Potato

H. Hatterman-Valenti and C. Auwarter

Field research was conducted in 2014 at the Oakes Irrigation Research Site south of Oakes, ND, to evaluate different rates of F9312-3 alone and tank mixed with Sencor and Matrix. We also looked at F9314-3 at two rates and F9350-1 compared to standard grower recommended herbicide applications. Russet Burbank potato seed pieces (2 oz) were planted on May 16 with 36" rows and 12" spacing using a Harriston Double Row planter. On June 2, we hilled and sprayed treatments with a CO_2 backpack sprayer at 40 psi using 8002 flat-fan nozzles and 20 gpa. Potatoes were harvested on September 19 and graded December 10.

Table 1. Tuber count.

Trt		Rate	Tuber Counts in 20'					
Name	Rate	Unit	< 4 oz	4-6 oz	6-12 oz	> 12 oz	Total	> 4 oz
F9312-3	0.122	lb ai/a	82.0 a[1]	47.5 a	51.8 a	8.8 a	190.0 a	108.0 a
F9312-3	0.144	lb ai/a	69.5 a	49.0 a	55.5 a	9.3 a	183.3 a	113.8 a
F9312-3	0.191	lb ai/a	72.0 a	44.5 a	60.5 a	12.0 a	189.0 a	117.0 a
F9312-3	0.29	lb ai/a	83.0 a	52.8 a	48.8 a	7.5 a	192.0 a	109.0 a
F9312-3 +	0.122	lb ai/a	72.3 a	43.8 a	63.8 a	11.5 a	191.3 a	119.0 a
Sencor 75DF	0.375	lb ai/a						
F9312-3 +	0.144	lb ai/a	77.5 a	44.5 a	55.5 a	10.3 a	187.8 a	110.3 a
Sencor 75DF	0.375	lb ai/a						
F9312-3 +	0.122	lb ai/a	98.8 a	56.3 a	58.3 a	6.0 a	219.3 a	120.5 a
Matrix	0.016	lb ai/a						
F9314-3	0.2	lb ai/a	75.5 a	41.0 a	58.8 a	11.5 a	186.8 a	111.3 a
F9314-3	0.258	lb ai/a	89.0 a	42.3 a	54.5 a	10.5 a	196.3 a	107.3 a
F9350-1	2.7	oz/a	86.0 a	42.8 a	55.5 a	10.0 a	194.3 a	108.3 a
Sencor 75DF	0.375	lb ai/a	83.3 a	49.8 a	64.8 a	7.5 a	205.3 a	122.0 a
Boundary	2.68	lb ai/a	101.3 a	55.8 a	51.3 a	6.5 a	214.8 a	113.5 a
Matrix	0.016	lb ai/a	82.5 a	50.0 a	63.0 a	5.5 a	201.0 a	118.5 a
Fierce	0.166	lb ai/a	79.3 a	37.8 a	44.5 a	12.5 a	174.0 a	94.8 a
	LSD (P = 0.05)		32.4	14.3	13.2	5.6	32.7	17.0

[1]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

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Table 2. Tuber weight.

Trt Name	Rate	Rate Unit	Row A CWT/ac	Row B CWT/ac < 4 oz	4-6 oz	6-12 oz	> 12 oz	Total	> 4 oz
F9312-3	0.122	lb ai/a	534.0 a[1]	84.9 a	107.8 a	189.5 a	59.3 a	441.4 a	356.6 a
F9312-3	0.144	lb ai/a	560.5 a	71.9 a	112.4 a	204.6 a	61.2 a	450.1 a	378.1 a
F9312-3	0.191	lb ai/a	519.5 a	67.0 a	101.2 a	229.3 a	83.2 a	480.8 a	413.7 a
F9312-3	0.29	lb ai/a	547.9 a	90.1 a	118.3 a	183.6 a	51.7 a	443.8 a	353.7 a
F9312-3 +	0.122	lb ai/a	561.8 a	72.5 a	101.4 a	241.9 a	82.2 a	498.0 a	425.5 a
Sencor 75DF	0.375	lb ai/a							
F9312-3 +	0.144	lb ai/a	538.8 a	74.4 a	101.4 a	205.8 a	65.9 a	447.4 a	373.0 a
Sencor 75DF	0.375	lb ai/a							
F9312-3 +	0.122	lb ai/a	574.8 a	101.0 a	127.2 a	214.8 a	38.5 a	481.6 a	380.5 a
Matrix	0.016	lb ai/a							
F9314-3	0.2	lb ai/a	596.4 a	76.5 a	91.6 a	222.4 a	72.0 a	462.5 a	386.0 a
F9314-3	0.258	lb ai/a	589.9 a	89.2 a	96.6 a	202.0 a	73.4 a	461.2 a	372.0 a
F9350-1	2.7	oz/a	530.6 a	88.7 a	97.9 a	211.1 a	66.8 a	464.5 a	375.8 a
Sencor 75DF	0.375	lb ai/a	554.3 a	83.4 a	112.1 a	238.5 a	54.2 a	488.2 a	404.8 a
Boundary	2.68	lb ai/a	551.8 a	106.2 a	123.4 a	190.2 a	43.4 a	463.2 a	357.0 a
Matrix	0.016	lb ai/a	560.9 a	82.9 a	115.1 a	232.2 a	37.8 a	467.9 a	385.0 a
Fierce	0.166	lb ai/a	482.8 a	84.4 a	84.4 a	163.8 a	80.2 a	412.8 a	328.4 a
	LSD (P = 0.05)		82.5	32.6	32.6	51.9	38.1	55.6	67.4

[1]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

All treatments had sufficient weed control. Increasing the rate of F9312-3 or tank mixed with metribuzin or rimsulfuron did not show any benefits for controlling redroot pigweed, common lambsquarter, nightshade (hairy and eastern black) and foxtail (green and yellow) 17 and 36 DAA. Weed average counts in border rows that were not sprayed in one square foot were eight redroot pigweed, 10 common lambsquarter, two foxtail, and one nightshade. No potato injury was observed.

Potato yields were not affected by any of the treatments. Yields varied from 413 to 575 cwt/acre with the lowest in both the A and B rows when Fierce was applied at 0.17 lb/acre with 483 and 413 cwt/acre, respectively. F9312-3 tank mixed with Matrix had the highest yield in row A with 575 cwt/acre. Stand counts 9 DAE showed row A had a slightly higher stand than row B. Row B's highest yielding treatment was F-9312-3 (0.122 lb ai/acre) tank mixed with Sencor with a yield of 498 cwt/acre.

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Evaluation of Partial Host Resistance and Row Spacing for Management of Sclerotinia on Soybeans

Leonard Besemann, Michael Schaefer, and Michael Wunsch

METHODS

General Agronomics: The study was on a Hecla sandy loam and Maddock sandy loam soil type. The soil fertility from the 2013 fall soil test was: pH = 7.1; 1.7% organic matter; soil N 12 lbs/acre; soil P = 34 ppm, soil K = 217 ppm, soil S 20 lb/acre and Zn = 3.60 ppm. The previous crop was spring wheat and the tillage operation consisted of disking twice followed by two passes with a multiweeder to smooth the seedbed and incorporate the herbicide. The Cell-Tech granular inoculate was mixed with the seed and applied in-furrow with the seed at an application rate of 0.1 grams per square foot. The maintenance herbicide applications were Trust (1 pt/acre) preplant incorporated on May 22 and two applications of Roundup Power Max (20 oz/acre) on June 20 and July 9.

Experimental design: A completely randomized block with a split-plot arrangement with six replicates; main factor = row spacing, sub-factor = variety. The seeded plot size was 5 feet (center to center) by 20 feet long. The harvested plot size was 5 feet (center to center) and approximately 17 feet long. Untreated buffer plots were established between treatment plots, and guard plots were established on the edges of the trial.

Planting details: The seeding rate was 165,000 pure live seeds/acre. Row spacing was 14 inches (with 4 rows per plot) in the first experiment and 28 inches (with two rows per plot) in the second experiment. The study was planted on May 26, 2014. Seed treatment was Apron Maxx RTA (5.0 fl oz/100 lbs seed) + Cruiser (1.28 fl oz/100 lbs seed).

Agronomic and disease assessments: Bloom initiation was assessed on the date that 80-90% of the plants had an open blossom. Within each plot, 20 plants (ten plants at each of two locations per plot) were evaluated. Canopy closure was assessed as the date that the soybean canopy fully covered the ground between rows. Canopy height was assessed at two locations per plot on July 24 or July 28 when the soybeans were at the R3 growth stage (pods 3/16 inch long at one of the four uppermost nodes). The number of nodes were assessed by counting the number of nodes per plant on July 24 or July 28 when the soybeans were at the R3 growth stage. Within each plot six plants were assessed (three plants at each of two locations per plot). Lodging was assessed shortly before maturity on September 16 as the percent of the canopy showing lodging.

Sclerotinia incidence and severity was assessed on September 11 at the R7 growth stage (at least one normal pod on the main stem had reached its mature pod color) using the 0 to 3 scale developed by Craig Grau (Grau and Radke 1984; Plant Disease 68: 56-58): 0 = no symptoms, 1 = lesions on lateral branches only, 2 = lesions on main stem, no wilt, and normal pod development, 3 = lesions on main stem resulting in wilting, poor pod fill, and plant death. In each plot, 90 plants were evaluated (30 plants in each of three locations per plot).

Disease establishment and irrigation: The trial was established on a site with a previous history of Sclerotinia epidemics. To promote apothecia development and disease establishment, supplementary overhead irrigation was applied to this trial through a linear irrigator.

Harvest and seed yield and quality assessment: The trial was harvested on October 9. To facilitate accurate yield assessment, plot lengths were measured shortly before harvest. Yields were calculated on the basis of a 5-ft plot width and the measured plot length. Seed moisture was assessed after the grain was cleaned. Seed yield and quality results were adjusted from the grain actual moisture to a standard 13% moisture level.

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Statistical analysis: Data were evaluated with analysis of variance. *Assumptions of ANOVA*: (1) The assumption of constant variance was assessed with Levene's test for homogeneity of variances and visually confirmed by plotting residuals against predicted values. (2) The assumption of normality was assessed with the Shapiro-Wilk test and visually confirmed with a normal probability plot. (3) The assumption of additivity of main-factor effects across replicates (no replicate-by-treatment interaction) was evaluated with Tukey's test for nonadditivity. All data met model assumptions except the Sclerotinia incidence and disease severity index data in soybeans planted to wide (28-inch) rows. For data that violated model assumptions, a systematic natural-log transformation [LN(x+1) for data sets with values less than 1, otherwise LN(x)] corrected the distributional problems and was applied. For soybeans planted to narrow rows, the number of days before or after bloom that the canopy closed: To facilitate proper calculation of the coefficient of variation in this data set, analysis of variance was conducted on data transformed by addition of an integer that made all data points equal to or greater than zero; the transformation did not affect F-test results or pair-wise treatment comparisons. *Assessment of the effects of irrigation intensity on disease and agronomic outcomes:* Analyses were conducted with replicate, main factor, main factor by replicate interaction, sub-factor, and sub-factor by main-factor interaction in the model, with F-tests for replicate and the main factor (row spacing) utilizing replicate-by-row spacing interaction for the error term. *Assessment of the effects of variety on disease and agronomic outcomes:* Analyses were conducted with replicate and treatment as main factor effects. Single-degree-of-freedom contrasts were performed for all pairwise comparisons of isolates; to control the Type I error rate at the level of the experiment, the Tukey multiple comparison procedure was employed. Analyses were implemented in PROC UNIVARIATE and PROC GLM of SAS (version 9.3; SAS Institute, Cary, NC).

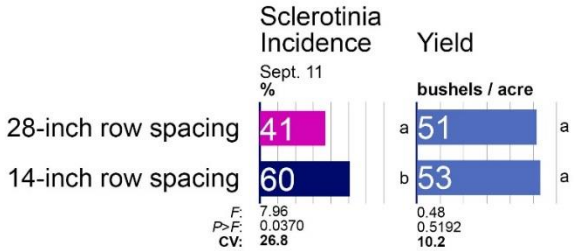
Results and Discussion

Performance of six varieties under high Sclerotinia disease pressure

Analysis of individual varieties under narrow (14-inch) and wide (28-inch) row spacing: Varieties differed sharply in their susceptibility to Sclerotinia, and yield gains associated with use of the most resistant variety were high. The disease susceptibility and yield performance of the varieties was highly correlated across row spacing, but the yield gain associated with using a partially-resistant variety was greatest in the narrow row spacing.

Impact of row spacing on Sclerotinia incidence and seed yield

Analysis of combined results across all varieties under narrow (14-inch) and wide (28-inch) row spacing: Increasing soybean row spacing from 14 to 28 inches conferred a sharp reduction in Sclerotinia incidence but only a slight increase in seed yield. The use of wide row spacing carries a yield penalty, and the yield gains associated with lower Sclerotinia disease pressure in the wide rows only slightly outweighed the yield loss conferred by the reduced capture of sunlight associated with use of the wide rows.



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Role of agronomic traits at promoting disease escape

Strongly correlated with susceptibility to Sclerotinia: Plant height (at R3 growth stage).
Moderately correlated with susceptibility to Sclerotinia: Plant density (assessed as the number of nodes per plant at R3 growth stage); timing of canopy closure relative to bloom initiation; length of the bloom and pod-fill period.
Weakly correlated with susceptibility to Sclerotinia: Susceptibility to lodging.

Partial funding for this project was provided by the North Dakota Soybean Council.

Soybean Sclerotinia canopy coverage.

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14-INCH ROWS

AGRONOMIC ASSESSMENTS

	Company	Variety (resistance rating) [z]	Plant Population [v] June 13 plants/ac	Bloom initiation days from planting	Canopy closure [t] days from planting	Canopy height [s] R3 growth stage (Jul. 24 & 28) cm	Number of nodes [r] number	Canopy closure [q §] Days before or after bloom	Lodging [q] Sept. 16 % of canopy	Maturity [p] bloom/canopy closure, whichever later	Maturity [o] days after bloom initiation
1	**Mycogen**	**5B080R2 (R)**	**173236** ab*	**52** c*	**49** a*	**70.7** b*	**10.1** ab*	**-3.5** a*	**65** c*	**62** a*	**62** a*
2	**Mycogen**	**5B065R2 (S)**	**171024** ab	**49** b	**48** a	**73.2** ab	**10.6** a	**-0.8** b	**98** d	**67** b	**67** b
3	**Pioneer**	**90Y90 (R)**	**194101** a	**49** b	**48** a	**80.4** a	**9.3** b	**-1.2** ab	**3** a	**68** b	**68** b
4	**Pioneer**	**90M80 (S)**	**191256** ab	**44** a	**47** a	**77.0** ab	**9.8** ab	**2.5** c	**100** d	**71** c	**74** c
5	**Kruger**	**K2-0901 (R)**	**161856** b	**49** b	**48** a	**73.7** ab	**10.2** ab	**-0.5** b	**31** b	**67** b	**67** b
6	**Kruger**	**K2-0801 (S)**	**185565** ab	**49** b	**47** a	**74.5** ab	**10.0** ab	**-1.5** ab	**41** bc	**65** b	**66** b
		F:	3.02	101.87	1.97	3.57	3.01	12.23	40.49	23.80	49.31
		P>F:	0.0288	< 0.0001	0.1190	0.0142	0.0293	< 0.0001	< 0.0001	< 0.0001	< 0.0001
		CV:	10.0	1.3	2.7	5.9	6.1	26.3	26.3	2.2	1.9

28-INCH ROWS

AGRONOMIC ASSESSMENTS

	Company	Variety (resistance rating) [z]	Plant Population [v] June 13 plants/ac	Bloom initiation days from planting	Canopy closure [t] days from planting	Canopy height [s] R3 growth stage (Jul. 24 & 28) cm	Number of nodes [r] number	Canopy closure [q] Days before or after bloom	Lodging [q] Sept. 16 % of canopy	Maturity [p] bloom/canopy closure, whichever later	Maturity [o] days after bloom initiation
1	**Mycogen**	**5B080R2 (R)**	**129137** a*	**52** c*	**57** a*	**75.6** abc*	**9.5** bc*	**5.3** a*	**55** c*	**57** ab*	**63** a*
2	**Mycogen**	**5B065R2 (S)**	**139032** a	**49** b	**58** ab	**73.2** bc	**10.1** ab	**8.8** ab	**80** d	**58** ab	**67** b
3	**Pioneer**	**90Y90 (R)**	**128979** a	**50** b	**61** c	**79.0** a	**8.8** a	**11.7** bc	**1** a	**55** a	**67** b
4	**Pioneer**	**90M80 (S)**	**127398** a	**44** a	**58** ab	**77.0** ab	**9.4** bc	**13.7** c	**100** e	**61** b	**74** c
5	**Kruger**	**K2-0901 (R)**	**137040** a	**50** b	**61** bc	**74.5** bc	**10.4** a	**11.2** bc	**15** ab	**56** a	**67** b
6	**Kruger**	**K2-0801 (S)**	**126924** a	**49** b	**60** abc	**72.8** c	**10.0** ab	**10.5** bc	**21** b	**57** ab	**68** b
		F:	0.17	77.18	5.92	5.61	8.63	12.18	90.23	5.00	51.93
		P>F:	0.9722	< 0.0001	< 0.0001	0.0015	< 0.0001	< 0.0001	< 0.0001	0.0028	< 0.0001
		CV:	25.9	1.5	3.0	3.1	4.9	19.7	22.6	3.8	1.9

PERFORMANCE OF EACH VARIETY BY ROW SPACING, 14- vs. 28-inch row spacing

YIELD (bushels per acre, 13% grain moisture)

	Mycogen '5B080R2'	Mycogen '5B065R2'	Pioneer '90Y90'	Pioneer '90M80'	Kruger 'K2-0901'	Kruger 'K2-0801'	Average all varieties
14-inch row spacing	**46** a*	**51** a*	**60** a*	**49** a*	**57** a*	**45** a*	**51** a*
28-inch row spacing	**49** a	**52** a	**60** a	**52** a	**57** a	**49** a	**53** a
F:	0.40	0.35	0.00	0.56	0.03	0.90	0.48
P>F:	0.5563	0.5857	0.9754	0.4869	0.8765	0.3874	0.5192
CV:	17.0	11.4	10.3	12.0	10.6	14.0	10.2

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[z] **Varieties differed in their Sclerotinia stem rot resistance ratings:** "R" denotes reduced susceptibility to Sclerotinia stem rot; "S" denotes heightened susceptibility to Sclerotinia stem rot.
On a 0 to 9 scale (where 9 is good), Mycogen assigned '5B080R2' a white mold resistance rating of 8 and '5B065R2' a white mold resistance rating of 6.
On a 0 to 10 scale (where 10 is excellent), Kruger assigned 'K2-0901 a white mold resistance rating of 6 and 'K2-0801' a white mold resistance rating of 4.
On a 1 to 9 scale (where 9 is best), Pioneer assigned '90Y90' a white mold resistance rating of 6 and '90M80' a white mold resistance rating of 3.

[y] **Sclerotinia stem rot incidence** was assessed by evaluating 90 plants in each plot (30 plants in each of three locations per plot). Assessed on Sept. 11 at the R7 growth stage.

[x] **Sclerotinia severity:** Average disease severity among plants expressing Sclerotinia stem rot. A 1 to 3 scale was employed: 1 = lesions on lateral branches only, 2 = lesions on main stem, no wilt, and normal pod development, 3 = lesions on main stem resulting in wilting, poor pod fill, and plant death. In each plot, 90 plants in each plot (30 plants in each of three locations per plot). Assessed on Sept. 11 at the R7 growth stage.

[w] **Sclerotinia disease severity index:** Average disease severity across all plants, including those without any disease. A 0 to 3 scale was employed: 0 = no symptoms, 1 = lesions on lateral branches only, 2 = lesions on main stem, no wilt, and normal pod development, 3 = lesions on main stem resulting in wilting, poor pod fill, and plant death. In each plot, 90 plants in each plot (30 plants in each of three locations per plot). Assessed on Sept. 11 at the R7 growth stage.

[v] **Plant population:** Plants per acre; assessed at the V1 growth stage by counting the number of plants along 6 meters of row.

[u] **Bloom initiation:** Number of days after planting that 80-90% of the plants had an open blossom.

[t] **Canopy closure:** Days after planting that the canopy fully covered the ground between rows.

[s] **Canopy height:** Height of the canopy at the R3 growth stage; assessed at two locations per plot.

[r] **Number of nodes:** Number of nodes per plant at the R3 growth stage within each plot, six plants were assessed (three plants at each of two locations per plot).

[q] **Lodging:** Percent of the canopy exhibiting lodging on Sept. 16 shortly before maturity.

[p] **Physiological maturity:** Number of days after bloom/canopy closure when plants reached maturity (R8 growth stage), where maturity is defined as 95-100% of the pods brown and senesced.

[o] **Physiological maturity:** Number of days after bloom/canopy closure when plants reached maturity (R8 growth stage), where maturity is defined as 95-100% of the pods brown and senesced.

[*] **Within-column means followed by different letters are significantly different** ($P < 0.05$; Tukey multiple comparison procedure).

[‡] To meet model assumption of homoskedasticity, analysis of variance was conducted on data subjected to a systematic natural-log transformation. For ease of interpretation, treatment means of the untransformed data are presented.

[§] To facilitate proper calculation of the coefficient of variation, analysis of variance was conducted on data transformed by addition of an integer that made all data points equal to or greater than zero. The transformation did not affect F-test results or pair-wise treatment comparisons. Treatment means of the untransformed data are presented.

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ANOVA RESULTS

	Sclerotinia Incidence [y]	Sclerotinia Severity [x]	Sclerotinia DSI [w]	Yield	Test weight	Seeds per pound	Protein	Oil
	R7 growth stage (Sept. 11)			13% grain moisture				
	%	1 to 3	0 to 3	bu/ac	lbs/bu	seeds	percent	percent
Did results significantly differ across row spacings?								
df:	1	1	1	1	1	1	1	1
SS:	6004.8	0.028	4.31	54.5	0.02	4784	0.01	0.01
MS:	6004.8	0.028	4.31	54.5	0.02	4784	0.01	0.01
F:	7.96	0.25	6.34	0.48	0.55	0.43	0.17	0.15
P>F:	0.0370	0.6410	0.0533	0.5192	0.4922	0.5404	0.6977	0.7022
Did results significantly differ across varieties?								
df:	5	5	5	5	5	5	5	5
SS:	11916	0.47	8.82	1248.0	2.59	3561850	76.92	15.51
MS:	2383.2	0.09	1.76	249.6	0.52	712370	15.38	3.10
F:	12.88	4.23	12.97	9.24	4.84	43.52	73.99	37.53
P>F:	<.0001	0.0028	<.0001	<.0001	0.0011	<.0001	<.0001	<.0001
Did the impact of row spacing differ by variety? Is there an interaction effect between row spacing and variety?								
df:	5	5	5	5	5	5	5	5
SS:	450.6	0.14	0.32	32.2	0.39	205064	2.41	0.91
MS:	90.1	0.03	0.06	6.4	0.08	41013	0.48	0.18
F:	0.49	1.29	0.48	0.24	0.73	2.51	2.32	2.20
P>F:	0.7842	0.2853	0.7923	0.9436	0.6015	0.0425	0.0573	0.0690

CORRELATION OF RESULTS ACROSS ROW SPACINGS

	Sclerotinia Incidence [y]	Sclerotinia Severity [x]	Sclerotinia DSI [w]	Yield	Test weight	Seeds per pound	Protein	Oil	Plant Population [v]
	R7 growth stage (Sept. 11)			13% grain moisture					June 13
	%	1 to 3	0 to 3	bu/ac	lbs/bu	seeds	percent	percent	plants/ac
Pearson correl. coeff., 14 vs 28 inch rows	0.9295	0.5640	0.9306	0.9745	0.8468	0.9085	0.9440	0.943970079	-0.7787

CORRELATION OF RESULTS ACROSS ROW SPACINGS

	Bloom initiation [u]	Canopy closure [t]	Canopy height [s]	Number of nodes [r]	Canopy closure [q §]	Lodging [q]	Maturity [p]	Maturity [o]
			R3 growth stage (Jul. 24 & 28)			Sept. 16	bloom/ canopy closure, whichever later	
	days from planting	days from planting	cm	number	Days before or after bloom	% of canopy		days after bloom initiation
	0.9864	0.2140	0.7096	0.9440	0.8701	0.9772	0.4204	0.9864

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Optimizing Fungicide Application Timing for Sclerotinia Control in Soybeans

Leonard Besemann, Michael Schaefer, and Michael Wunsch

METHODS

General agronomics: The study was on an Embden sandy loam soil type. The soil fertility from the fall soil test: pH = 6.9; 2.0% organic matter; soil N 44 lbs/acre; soil P = 32 ppm, soil K = 208 ppm, soil S 18 lb/acre and Zn = 4.48 ppm. The previous crop was pinto bean and the tillage operation consisted of disking twice followed by two passes with a multiweeder to smooth the seedbed and incorporate the herbicide. Rhizo-Flo granular inoculant for soybeans (*Bradyrhizobium japonicum*; Becker Underwood / BASF Corp.) was mixed with the seed immediately before planting and applied in-furrow with the seed at 170 grams per 1000 feet of row. The maintenance herbicide applications were Trust (1 pt/acre) preplant incorporated on May 22 and two applications of Roundup Power Max (20 oz/acre) on June 20 and July 9.

Experimental design: A completely randomized block design with six replicates. The seeded plot size was 5 feet (center to center) by 20 feet long. The harvested plot size was 5 feet (center to center) and approximately 17 feet long. Untreated buffer plots were established between treatment plots, and guard plots were established on the edges of the trial.

Planting details: Mycogen '5B005R2' was seeded at the rate of 165,000 pure live seeds/acre. Row spacing was 14 inches (with 4 rows per plot) and 28 inches (with two rows per plot). The study was planted on May 26, 2014. Seed treatments used were Apron Maxx RTA (5.0 fl oz/100 lbs seed) + Cruiser (1.28 fl oz/100 lbs seed).

Fungicide applications: At the R1 growth stage, fungicides were applied July 16 at 3:37-3:45 PM when 80-90% of plants had an open blossom; wind = ESE @ 3 MPH; RH 45%; 78° F; Canopy closure: Fourteen inch = 100%; 28 inch = 60%. At the R2 growth stage fungicides were applied July 21 at 10:37-10:48 AM; approximately 90% of plants had an open blossom at one of the two nodes (90% at R2); wind = E @ 6 MPH; RH 79%; 86° F; Canopy closure: 14 inch = 100%; 28 inch = 90%. In 30-inch rows, 90% canopy closure: fungicides were applied concurrently with the R2 application timing on July 21 from 10:50-10:53 AM approximately 90% of the plants were at R2 growth stage (open blossom at one of the top two node); wind = E @ 7 MPH; RH 79%; 86° F. In 30-inch row, 95% canopy closure: Fungicides were applied July 22 from 1:22-1:24 PM; R2 growth stage; wind = N @ 7 MPH; RH 79%; 77° F.
In 30-inch row, 100% canopy closure: fungicides were applied July 25 from 11:22-11:25 AM at the late R2 to early R3 growth stage; wind = N @ 9 MPH; RH 93%; 67° F.

Notes and disease establishment: The trial was established on a site with a previous history of Sclerotinia epidemics. To promote apothecia development and disease establishment, supplementary overhead irrigation was applied to this trial via a linear irrigator. Sclerotinia incidence and severity were assessed on Sept. 11 at the R7 growth stage using the 0 to 3 scale developed by Craig Grau (Grau and Radke 1984; Plant Disease 68: 56-58): 0 = no symptoms, 1 = lesions on lateral branches only, 2 = lesions on main stem, no wilt, and normal pod development, 3 = lesions on main stem resulting in wilting, poor pod fill, and plant death. In each plot, 90 plants were evaluated (30 plants in each of three locations per plot).

Harvest, seed yield and quality assessment: The trial was harvested on October 9. To facilitate accurate yield assessment, plot lengths were measured shortly before harvest. Yields were calculated on the basis of a 5-ft plot width and the measured plot length. Seed moisture was assessed after the grain was cleaned. Seed yield and quality results were adjusted from the grain actual moisture to a standard 13% moisture level.

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Statistical analysis: Data were evaluated with analysis of variance. Assumptions of ANOVA: (1) The assumption of constant variance was assessed with Levene's test for homogeneity of variances and visually confirmed by plotting residuals against predicted values. (2) The assumption of normality was assessed with the Shapiro-Wilk test and visually confirmed with a normal probability plot. (3) The assumption of additivity of main-factor effects across replicates (no replicate-by-treatment interaction) was evaluated with Tukey's test for nonadditivity. All data met model assumptions. Assessment of fungicide treatment effects: Analyses were conducted with replicate and treatment as main factor effects. Single-degree-of-freedom contrasts were performed for all pairwise comparisons of isolates; to control the Type I error rate at the level of the experiment, the Tukey multiple comparison procedure was employed. Analyses were implemented in PROC UNIVARIATE and PROC GLM of SAS (version 9.3; SAS Institute, Cary, NC).

14-INCH ROW SPACING

		Sclerotinia incidence: [y]	Sclerotinia severity: [x]	Sclerotinia dis. index: [w]	Yield:	Test weight:	per pound:
		Sept. 11	Sept. 11	Sept. 11	13% grain moisture		
	Treatment (application timing) [z]	percent	1 to 3	0 to 3	bu/ac	lbs/bu	seeds/lb
1	**Non-treated check**	**64** a*	**2.82** b*	**1.82** a*	**45.5** b*	**56.8** a*	**3029** a*
2	**Endura 70WG** 8 oz/ac **(R1 growth stage**; July 16**)**	**56** a	**2.69** a	**1.51** a	**54.7** a	**56.7** a	**2964** a
3	**Endura 70WG** 8 oz/ac **(early R2 growth stage**; July 21**)**	**54** a	**2.67** a	**1.43** a	**53.6** a	**56.9** a	**2946** a
	F:	2.05	6.63	3.39	8.32	0.4	0.58
	P > *F*:	0.1790	0.0147	0.0751	0.0075	0.6782	0.5778
	CV:	16.6	2.9	17.1	8.3	0.6	4.7

[z] **Fungicide application timing:**

R1 growth stage: fungicides were applied July 16 at 3:37-3:45 PM when 80-90% of plants had an open blossom and 100% of the ground was covered by the canopy (closed canopy); wind = ESE @ 3 MPH; RH 45%; air temperature = 78° F

Early R2 growth stage: fungicides were applied July 21 at 10:37-10:48 AM; approximately 90% of plants had an open blossom at one of the top two nodes (90% at R2) and the canopy was closed (100% canopy closure); wind = E @ 6 MPH; RH 79%; air temperature = 86° F

[y] **Sclerotinia stem rot incidence:** assessed by evaluating 90 plants in each plot (30 plants in each of three locations per plot). Evaluated on September 11 at the R7 growth stage (at least one pod on the main stem had reached its mature pod color).

[x] **Sclerotinia severity:** Average disease severity among plants expressing Sclerotinia stem rot. A 1 to 3 scale was employed: 1 = lesions on lateral branches only, 2 = lesions on main stem, no wilt, and normal pod development, 3 = lesions on main stem resulting in wilting, poor pod fill, and plant death. Evaluated on September 11 at the R7 growth stage (at least one pod on the main stem had reached its mature pod color).

[w] **Sclerotinia disease severity index:** Average disease severity across all plants, including those without any disease. A 0 to 3 scale was employed: 0 = no symptoms, 1 = lesions on lateral branches only, 2 = lesions on main stem, no wilt, and normal pod development, 3 = lesions on main stem resulting in wilting, poor pod fill, and plant death. In each plot, 90 plants were evaluated (30 plants in each of three locations per plot). Evaluated on September 11 at the R7 growth stage (at least one pod on the main stem had reached its mature pod color).

[*] **Within-column means followed by different letters are significantly different** ($P < 0.05$; Tukey multiple comparison procedure).

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28-INCH ROW SPACING

	Treatment (application timing) [z]	Sclerotinia incidence: [y]	Sclerotinia severity: [x]	Sclerotinia dis. index: [w]	Yield:	Test weight:	per pound:
		Sept. 11	Sept. 11	Sept. 11	13% grain moisture		
		percent	1 to 3	0 to 3	bu/ac	lbs/bu	seeds/lb
1	**Non-treated check**	**55** b*	**2.69** a*	**1.47** b*	**51.4** b*	**56.9** a*	**2985** a*
2	**Endura 70WG** 8 oz/ac **(R1 growth stage;** July 16**)**	**47** ab	**2.68** a	**1.25** ab	**56.6** ab	**56.9** a	**2962** a
3	**Endura 70WG** 8 oz/ac **(early R2 growth stage;** July 21**)**	**36** a	**2.63** a	**0.94** a	**59.2** a	**56.7** a	**2891** a
4	**Endura 70WG** 8 oz/ac **(R2; 95% canopy closure;** July 22**)**	**34** a	**2.57** a	**0.87** a	**59.4** a	**56.8** a	**2868** a
5	**Endura 70WG** 8 oz/ac **(R2 to R3; 100% canopy closure;** July 25**)**	**34** a	**2.62** a	**0.89** a	**59.3** a	**56.9** a	**2840** a
	F:	5.94	0.91	5.54	4.63	0.73	0.77
	P > *F*:	0.0026	0.4793	0.0036	0.0083	0.6052	0.5566
	CV:	23.5	4.8	25.6	6.8	0.6	0.5

[z] **Fungicide application timing:**

R1 growth stage: fungicides were applied July 16 at 3:37-3:45 PM when 80-90% of plants had an open blossom and 100% of the ground was covered by the canopy (closed canopy); wind = ESE @ 3 MPH; RH 45%; air temperature = 78° F.

R2 growth stage: fungicides were applied July 21 at 10:37-10:48 AM; approximately. 90% of plants had an open blossom at one of the top two nodes (90% at R2) and 90% of the ground was covered by canopy (90% canopy closure); wind = E @ 6 MPH; RH 79%; air temperature = 86° F.

R2, 95% canopy closure: fungicides were applied July 22 from 1:22-1:24 PM; R2 growth stage; wind = N @ 7 MPH; RH 65%; air temperature = 77° F.

R2 to R3, 100% canopy closure: fungicides were applied July 25 from 11:22-11:25 AM at the late R2 to early R3 growth stage; wind = N @ 9 MPH; RH 93%; air temperature = 67° F.

[y] **Sclerotinia stem rot incidence:** assessed by evaluating 90 plants in each plot (30 plants in each of three locations per plot). Evaluated on September 11 at the R7 growth stage (at least one pod on the main stem had reached its mature pod color).

[x] **Sclerotinia severity:** Average disease severity among plants expressing Sclerotinia stem rot. A 1 to 3 scale was employed: 1 = lesions on lateral branches only, 2 = lesions on main stem, no wilt, and normal pod development, 3 = lesions on main stem resulting in wilting, poor pod fill, and plant death. Evaluated on September 11 at the R7 growth stage (at least one pod on the main stem had reached its mature pod color).

[w] **Sclerotinia disease severity index:** Average disease severity across all plants, including those without any disease. A 0 to 3 scale was employed: 0 = no symptoms, 1 = lesions on lateral branches only, 2 = lesions on main stem, no wilt, and normal pod development, 3 = lesions on main stem resulting in wilting, poor pod fill, and plant death. In each plot, 90 plants were evaluated (30 plants in each of three locations per plot). Evaluated on September 11 at the R7 growth stage (at least one pod on the main stem had reached its mature pod color).

[*] **Within-column means followed by different letters are significantly different** ($P < 0.05$; Tukey multiple comparison procedure).

Partial funding for this project was provided by the North Dakota Soybean Council.

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Strip-Till, Corn on Corn, Nitrogen Rate Study

L. Besemann and H. Eslinger

MATERIALS AND METHODS

Soil:	Embden sandy loam and Hecla sandy loam; pH = 6.9; 2.1% organic matter; soil N average 8 lbs/acre; soil P and soil K were very high; soil S was low.
Previous crop:	2013 - field corn.
Seedbed preparation:	Strip-till May 7 with an Orthman strip-till machine.
Hybrid:	Pioneer P9917 AMI.
Planting:	Planted May 10 in 30-inch rows @ 33,000 seeds/acre.
Plots:	Plots were 140 ft long by 20 ft (8 rows) wide. There were four replications.
Fertilizer:	All plots received 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 via strip-till May 7. Stream-bar all plots 10 lbs N/acre and 23 lbs S/acre as 12-0-0-26 May 22. Stream-bar 78 lbs N/acre as 28-0-0 to the 100 and 150 lb treatments and 44 lbs N/acre as 28-0-0 to the 150d and 200 lb treatments May 22. Sidedress N treatments as 28-0-0 (three inches deep) June 13; the 150 lb treatments received 50 lbs N/acre, the 150d received 85 lbs N/acre and the 200 lb treatments received 135 lbs N/acre.
Irrigation:	Hand move sprinkler irrigation as needed.
Pest control:	Harness (2 pt/acre) May 22, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05%v/v) + AMS (1½ lbs/acre) June 3.
Remote sensing:	Sensing was achieved with an Opti-Sciences CCM 200 Plus chlorophyll meter and a Holland Crop Circle ACS active canopy sensor (normalized difference red edge - NDRE).
Harvest:	October 24 with a JD 4400 combine. Harvest area was the middle four rows of each plot, 133 feet long.

RESULTS

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 an Opti-Science CCM 200 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.

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Table 1. Strip-till, corn on corn nitrogen rate study at the Oakes Irrigation Research Site in 2014.

Fertilizer N Rate	Grain Yield[1]	Grain Yield 2009-14	Harvest Moisture	Test Weight	Chlorophyll Meter Reading[2]	NDRE[3]	Nitrate-N		Seed Protein	Seed Starch	Seed Oil	Emerge Date	Silk Date	Mature Date
							Stalk	Fall Soil						
lb/acre	bu/ac		%	lb/bu	4-Aug	4-Aug	ppm	lbs/ac	----------%----------					
22	80.0	83.4	15.1	54.3	13.4	0.2128	16	8	6.8	75.1	2.8	25-May	24-Jul	21-Sep
100	157.5	170.5	15.0	54.9	38.1	0.2927	56	12	7.3	75.0	2.6	25-May	23-Jul	20-Sep
150	184.1	190.0	15.3	55.2	51.0	0.3141	51	13	8.2	74.2	2.7	26-May	23-Jul	19-Sep
150d	194.6	202.4	15.5	55.3	50.6	0.2913	83	13	8.3	74.2	2.7	26-May	23-Jul	20-Sep
200	197.0	212.6	15.7	55.7	57.9	0.3277	1420	49	9.0	73.8	2.5	27-May	23-Jul	20-Sep
Mean	162.6		15.3	55.1	42.2	0.3	325.1	19.0	7.9	74.4	2.7	25-May	23-Jul	20-Sep
C.V. (%)	4.8		5.7	0.6	3.9	6.6	50.0	31.5	4.1	0.5	3.9	0	0	0.4
LSD 0.10	9.8		NS	0.4	2.1	0.0240	205	7.6	0.4	0.4	0.1	0.73	0.6	0.7
LSD 0.05	12.0		NS	0.5	2.6	0.0293	250	9.2	0.5	0.5	0.2	0.74	0.9	0.8

Planting Date = May 10; Harvest Date = October 24; Previous Crop = Corn

[1] Yield adjusted to 15.5% moisture.

[2] Opti-Science CCM 200.

[3] Holland Crop Circle ACS active canopy sensor (normalized difference red edge) - NDRE.

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Strip-Till, Corn on Soybean, Nitrogen Rate Study

L. Besemann and H. Eslinger

The objective of this study was 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 no-till rotations, utilizing strip-till.

MATERIALS AND METHODS

Soil:	Embden sandy loam, Embden loam, Gardena loam and Maddock sandy loam; pH = 7.1; 1.6% organic matter; Soil N average 12 lbs/acre; soil P and soil K were very high; soil S was medium.
Previous crop:	2013 – soybean.
Seedbed preparation:	Strip-till May 9 with an Orthman strip-till machine.
Hybrid:	Pioneer P9917AMX
Planting:	Planted May 18 @ 33,000 plants per acre in 30-inch rows.
Plots:	Plots were 37 ft long by 15 ft (6 rows) wide. There were four replications.
Fertilizer:	All plots received 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 via strip-till May 9. Stream-bar all plots with 10 lbs N/acre and 23 lbs S/acre as 12-0-0-26 May 22. Stream-bar 78 lbs N/acre as 28-0-0 to the 100 lb treatment and 44 lbs N/acre as 28-0-0 to the 100d, 150 and 200 lb treatments May 23. Sidedress N treatments as 28-0-0 (three inches deep) June 17; 200 lb treatment received 135 lbs N/acre, the 150 lb treatment received 85 lbs N/acre and the 100d received 34 lbs N/acre.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Harness (2 pt/acre) May 22, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05%v/v) + AMS (1½ lbs/acre) June 3.
Remote sensing:	Remote sensing was achieved with an Opti-Sciences CCM 200 Plus chlorophyll meter and a Holland Crop Circle ACS active canopy sensor (normalized difference red edge – NDRE).
Harvest:	Hand harvest October 16. Harvest area was the two center rows from each plot (72 feet of total row).

RESULTS

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 an Opti-Science CCM 200 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.

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Table 1. Strip-till, corn on soybean nitrogen rate study at the Oakes Irrigation Research Site in 2014.

Fertilizer N Rate	Grain Yield[1]	Grain Yield 2009-14	Harvest Moisture	Test Weight	Chlorophyll Meter Reading[2]	NDRE[3]	Nitrate-N		Population	Seed			Emerge Date	Silk Date	Mature Date
							Stalk	Fall Soil		Protein	Oil	Starch			
lb/acre	bu/ac	bu/ac	%	lb/bu	4-Aug	4-Aug	ppm	lbs/ac	plants/ac	----------%		----------			
22	108.3	125.9	16.3	53.0	11.7	0.1859	35	11	35142	6.4	2.3	75.7	25-May	23-Jul	21-Sep
100	141.9	177.8	15.9	52.5	21.6	0.2719	52	11	35025	6.7	2.1	75.6	25-May	22-Jul	19-Sep
100d	179.5	192.3	16.5	53.5	34.6	0.2942	14	11	35436	7.4	2.1	75.3	25-May	21-Jul	19-Sep
150	207.2	223.7	17.0	54.3	43.9	0.3052	100	11	35967	8.2	2.3	74.6	25-May	21-Jul	19-Sep
200	226.6	234.5	15.8	54.7	49.7	0.3332	258	15	35849	8.5	2.3	74.2	25-May	21-Jul	18-Sep
Mean	172.7		16.3	53.6	32.3	0.2781	91.7	11.8	35484	7.4	2.2	75.1	25-May	21-Jul	19-Sep
C.V.(%)	4.6		8.2	1.0	8.9	9.96	137.8	25.5	2.0	3.4	10.1	0.6		0.7	0.0
LSD 0.10	10.1		NS	0.7	3.6	0.0349	NS	NS	NS	0.3	NS	0.6		0.6	0.5
LSD 0.05	12.4		NS	0.9	4.5	0.0427	NS	NS	NS	0.4	NS	0.7		0.8	0.6

Planting Date = May 10; Harvest Date = October 16; Previous Crop = Soybean

[1] Yield adjusted to 15.5% moisture.

[2] Opti-Science CCM 200.

[3] Holland Crop Circle ACS active canopy sensor (normalized difference red edge) - NDRE.

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Strip-Till, Soybean on Corn Study

L. Besemann and H. Eslinger

MATERIALS AND METHODS

Soil:	Embden sandy loam, Hecla sandy loam and Maddock sandy loam; pH = 7.0; 1.8% organic matter; soil N 23 lb/acre; soil P and soil K was very high; soil S was medium.
Previous crop:	2013 – field corn.
Seedbed preparation:	Strip-till May 9 with an Orthman strip-till machine.
Hybrid:	Pioneer 90Y90.
Planting:	May 27 @ 205,000 plants per acre in 30-inch rows.
Plots:	Plots were 37 ft long by 15 ft (6 rows) wide. There were four replications.
Fertilizer:	All plots received 10 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 via strip-till May 9.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Roundup Power Max (30 oz/acre) + AMS (1 lb/10 gal) June 7 and (20 oz/acre) + AMS (1 lb/10 gal) July 9 for weed control. Endura (8 oz/acre) July 17 and July 24 for disease control. Kendo (3 oz/acre) July 17 for insect control.
Harvest:	October 8 with a JD 4400 combine (60 rows 74 feet long, recorded with a weigh wagon).

RESULTS

All soybean plots were combine harvested and bulked. The soybean yield was 55.5 bu/acre at 13.0% moisture with a test weight of 56.6 lbs/bu.

Strip-till soybean on corn.

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Field Evaluation of Sunflower Hybrids and Breeding Lines for Susceptibility to Sclerotinia Head Rot Oakes, ND (2014)

Leonard Besemann and Michael Wunsch

Methods

General agronomics: The study was on a Hecla sandy loam/Maddock sandy loam soil type. The soil fertility results from the fall soil test: pH = 6.8; 2.0% organic matter; soil N 21 lbs/acre; soil P = 20 ppm, soil K = 181 ppm, soil and S 32 lb/acre. The previous crop was field corn and the tillage operation consisted of disking twice followed by two passes with a multiweeder to smooth the seedbed and incorporate the herbicide.

Experimental design: A completely randomized block design with four replicates. The seeded plot size was 2.5 feet (center to center) by 20 feet long. There was one row per plot and the row spacing was 30 inches. Guard plots (10 feet wide) were established along all perimeters of the trial.

Planting details: The sunflowers were planted on May 29 using a cone seeder. The seeding rate was 3.83 seeds/linear foot of row = 60,000 seeds /acre (when sufficient seed was available). The final plant population was 1 plant every 10 inches of row = 21,000 plants/acre. The final population was established by manual thinning the sunflowers at the V2 to V4 growth stage (two to four true leaves).

Disease establishment: Inoculations were conducted over multiple days such that every head was inoculated twice - once at approximately R5.4 to R5.6 (40 to 60% of the disk flowers blooming or already bloomed) and once at approximately R5.5 to R5.9 (50 to 90% of the disk flowers blooming or already bloomed). To ensure that every plant was inoculated twice, plants were given a dot of spray paint on an upper leaf at each inoculation; once a plant received two dots of spray paint, the plant received no additional inoculations.

Spore solutions were prepared by adding laboratory-grown ascospores of Sclerotinia sclerotiorum to non-chlorinated water and adding one to two drops of Tween 20. Hand-held spray bottles were calibrated to determine how much liquid was released through each squirt of the bottle, and the spore solution was adjusted so that 5,000 spores were delivered through 3 squirts of the spray bottle. At each inoculation, 5,000 spores were applied to the front of each head (each head received a total of 10,000 spores over two inoculations).

Supplemental overhead irrigation was applied to this trial through a micro-sprinkler misting system, with the frequency and intensity of irrigation adjusted relative to weather conditions.

Agronomic notes: The flowering date for each plot was the date that 50% of the plants entered bloom.

Disease notes: Within each plot, disease assessments were conducted three times: at the R7 growth stage (back of the head has started to turn a pale yellow color), at the R8 growth stage (back of the head is yellow but the bracts remain green), and at the R9 growth stage (bracts yellow and brown, and heads ready for harvest; physiological maturity). Plants exhibiting damage from sunflower midge were excluded from the analysis; otherwise, all plants in each row were evaluated. A 0 to 5 scale was utilized: 0 = no Sclerotinia head rot, 1 = 1 to 25% of head exhibiting symptoms of Sclerotinia head rot, 2 = 26 to 50% of head exhibiting symptoms of Sclerotinia head rot, 3 = 51 to 75% of head exhibiting symptoms of Sclerotinia head rot, 4 = 76 to 99% of head exhibiting symptoms of Sclerotinia head rot, and 5 = 100% of head exhibiting Sclerotinia head rot. Disease assessments were taken as plots reached the target growth stage; R7 assessments were taken August 25 to September 19, R8 assessments were taken September 5 to 30, and R9 assessments were taken September 10 to October 6.

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rAUDPC: The progression of disease over time relative to maximum disease; a rating of 100 equals 100% of plants with heads fully diseased with Sclerotinia head rot from bloom initiation until the R9 growth stage, and a rating of 0 equals 0% of plants showing symptoms of Sclerotinia head rot over the same interval. Calculated with the following formula:

$$\text{Relative AUDPC} = \left\{\sum_{i=1}^{n}\left[\left(\frac{x_i+x_{i+1}}{2}\right)*(t_{i+1}-t_i)\right]\right\}\Big/(t_n-t_i)$$

where xi = disease severity index at the ith observation, ti = time in days at the ith observation, and n = number of observations.

Shattered heads: The incidence and severity of head shattering caused by Sclerotinia head rot was assessed on September 10 to October 6 as plots reached the R9 growth stage (bracts yellow and brown, and heads ready to harvest; physiological maturity). Severity was assessed on a 0 to 5 scale, with 0 = no shattering, 1 = 1 to 25% of head shattered, 2 = 26 to 50% of the head shattered, 3 = 51 to 75% of the head shattered, 4 = 76 to 99% of the head shattered, and 5 = 100% of the head shattered. Results were reported as shattering incidence and severity, where SHATTERING INCIDENCE denotes the percentage of heads exhibiting Sclerotinia head rot that were partially or fully shattered when heads reached the R9 growth stage and SHATTERING SEVERITY denotes the average severity of shattering (1 to 5 scale) observed in heads exhibiting Sclerotinia head rot.

This trial was not harvested.

Statistical analysis: Data were evaluated with analysis of variance. Assumptions of ANOVA: (1) The assumption of constant variance was assessed with Levene's test for homogeneity of variances and visually confirmed by plotting residuals against predicted values. (2) The assumption of normality was assessed with the Shapiro-Wilk test and visually confirmed with a normal probability plot. (3) The assumption of additivity of main-factor effects across replicates (no replicate-by-treatment interaction) was evaluated with Tukey's test for nonadditivity. To meet model assumptions, a systematic natural-log transformation was applied to the R7 Sclerotinia head rot incidence data; the R7, R8, and R9 disease severity index data; and the relative area-under-the-disease-progress-curve data. Analysis of variance was conducted on the transformed data. The shattering data exhibited moderate deviations from model assumptions, but a systematic transformation could not be found that addressed the problem, and the untransformed data were analyzed. All other data met model assumptions. Assessment of treatment differences: Analyses were conducted with replicate and treatment as main factor effects. Single-degree-of-freedom contrasts were performed for all pairwise comparisons of isolates; to control the Type I error rate at the level of the experiment, the Tukey multiple comparison procedure was employed. Analyses were implemented in PROC UNIVARIATE and PROC GLM of SAS (version 9.3; SAS Institute, Cary, NC).

FUNDED BY THE USDA NATIONAL SCLEROTINIA INITIATIVE AND SYNGENTA, NUSEED, NUSEED GLOBAL, GENOSYS, MYCOGEN, AND RED RIVER COMMODITIES.

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OAKES, ND

SCLEROTINIA HEAD ROT

Aug. 25 - Sept. 19 (depending on hybrid) | **R7 growth stage**

	Company	Entry	Type	Status	Flowering date[z] days after planting	Sample size[y] plants	Incidence:[x ‡] percent	Severity:[w] 1 to 5	Sev. index:[v ‡] 0 to 5
1	**Syngenta**	**7717 HO/CL/DM**	**Oil**	**Commercially available**	66	*76*	**52** d-g *	**3.9**	**2.0** c-h *
2	**Syngenta**	**NX34240**	**Oil**	**Commercially available**	68	*79*	**8** abc	**2.0**	**0.2** a
3	**NuSeed**	**NSKN43623 MED**	**Confection**	**Experimental**	73	*72*	**34** b-g	**2.4**	**0.7** a-e
4	**NuSeed**	**NSKN43525 MED**	**Confection**	**Experimental**	68	*72*	**68** fg	**4.1**	**2.8** gh
5	**NuSeed**	**NSK12014**	**Oil**	**Experimental**	65	*79*	**54** d-g	**3.4**	**1.9** c-h
6	**NuSeed**	**NSK12015**	**Oil**	**Experimental**	68	*79*	**42** b-g	**3.2**	**1.6** b-g
7	**NuSeed**	**NSK12016**	**Oil**	**Experimental**	70	*82*	**5** ab	**1.3**	**0.1** a
8	**NuSeed Global**	**NHW11915**	**Confection**	**Experimental**	77	*81*	**4** a	**1.5**	**0.1** a
9	**NuSeed Global**	**NHW12706**	**Confection**	**Experimental**	74	*79*	**23** b-g	**2.8**	**0.7** a-e
10	**NuSeed Global**	**NHW10453**	**Confection**	**Experimental**	71	*75*	**11** a-f	**2.6**	**0.3** ab
11	**NuSeed Global**	**NHW130515**	**Confection**	**Experimental**	72	*66*	**14** a-e	**2.7**	**0.5** ab
12	**Mycogen**	**416321**	**Oil**	**Experimental**	68	*76*	**25** b-g	**3.5**	**0.9** a-f
13	**Mycogen**	**915321**	**Oil**	**Experimental**	69	*77*	**16** a-g	**2.1**	**0.3** ab
14	**Genosys**	**M14-239R**	**Oil**	**Experimental**	71	*67*	**26** a-g	**2.1**	**0.6** abc
15	**Genosys**	**M14-240R**	**Oil**	**Experimental**	70	*73*	**44** c-g	**1.8**	**0.8** a-e
16	**Genosys**	**M14-243R**	**Oil**	**Experimental**	67	*76*	**67** efg	**3.4**	**2.2** d-h
17	**Genosys**	**M14-269R**	**Oil**	**Experimental**	66	*73*	**96** g	**4.4**	**4.2** h
18	**Genosys**	**M14-241R**	**Oil**	**Experimental**	65	*61*	**82** fg	**3.2**	**2.6** fgh
19	**Genosys**	**M14-242R**	**Oil**	**Experimental**	69	*72*	**8** ab	**2.7**	**0.2** ab
20	**Genosys**	**M14-244R**	**Oil**	**Experimental**	67	*74*	**50** d-g	**3.7**	**1.9** c-h
21	**Red River Commodities**	**2215**	**Confection**	**Commercially available**	69	*73*	**55** c-g	**4.2**	**2.5** c-h
22	**Red River Commodities**	**2217 CP**	**Confection**	**Commercially available**	75	*77*	**8** a-d	**3.4**	**0.3** ab
23	**Genosys**	**12GCF05**	**Confection**	**resistant check**	75	*72*	**5** ab	**2.8**	**0.2** a
24	**Genosys**	**12GCF12**	**Confection**	**susceptible check**	73	*75*	**16** a-g	**3.8**	**0.6** a-d
25	**Croplan**	**343 DRM HO**	**Oil**	**resistant check**	67	*79*	**15** a-g	**3.1**	**0.4** ab
26	**Croplan**	**305 DMR NS**	**Oil**	**susceptible check**	65	*81*	**69** fg	**3.2**	**2.2** e-h
				F:			7.49		13.04
				F > *P*:			< 0.0001		< 0.0001
				CV:			25.2		40.0

[z] **Flowering date:** The number of days after planting when 50% of the plants had an open blossom.

[Y] **Sample size:** The number of plants evaluated for Sclerotinia head rot.

[x] **Sclerotinia head rot incidence:** The percent of plants exhibiting Sclerotinia head rot. Plants exhibiting damage from sunflower midge were excluded from the analysis.

[w] **Sclerotinia head rot severity:** Average Sclerotinia head rot severity across those plants exhibiting the disease. Plants exhibiting damage from sunflower midge were excluded from the analysis. Disease assessments were conducated on a 1 to 5 scale: 1 = 1 to 25% of head exhibiting symptoms of Sclerotinia head rot, 2 = 26 to 50% of head exhibiting symptoms of Sclerotinia head rot, 3 = 51 to 75% of head exhibiting symptoms of Sclerotinia head rot, 4 = 76 to 99% of head exhibiting symptoms of Sclerotinia head rot, and 5 = 100% of head exhibiting Sclerotinia head rot.

[v] **Sclerotinia head rot severity index:** Average Sclerotinia head rot severity across all plants, including those not exhibiting disease. Plants exhibiting damage from sunflower midge were excluded from the analysis. Disease assessments were conducated on a 0 to 5 scale: 0 = no Sclerotinia head rot, 1 = 1 to 25% of head exhibiting symptoms of Sclerotinia head rot, 2 = 26 to 50% of head exhibiting symptoms of Sclerotinia head rot, 3 = 51 to 75% of head exhibiting symptoms of Sclerotinia head rot, 4 = 76 to 99% of head exhibiting symptoms of Sclerotinia head rot, and 5 = 100% of head exhibiting Sclerotinia head rot.

[u] **rAUDPC:** relative area under the disease progress curve; a measure of disease progress over time.

[t] **Shattered heads:** The incidence and severity of head shattering caused by Sclerotinia head rot was asssessed as lines reached the R9 growth stage (maturity).

SHATTERING INCIDENCE: the percentage of heads exhibiting Sclerotinia head rot that were partially or fully shattered when heads reached the R9 growth stage.

SHATTERING SEVERITY: the average severity of shattering (1 to 5 scale) observed in heads exhibiting Sclerotinia head rot. Severity was assessed on the same 0 to 5 scale as disease assessments, with 0 = no shattering, 1 = 1 to 25% of head shattered, 2 = 26 to 50% of the head shattered, 3= 51 to 75% of the head shattered, 4 = 76 to 99% of the head shattered, and 5 = 100% of the head shattered.

* **Within-column means followed by different letters are significantly different** ($P < 0.05$; Tukey multiple comparison procedure).

‡ **To meet model assumptions of normality, homoskedasticity, and/or normality, a systematic natural-log transformation was applied to these data for analysis of variance.** For ease of interpretation, treatment means of the untransformed data are presented in this table.

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under agreement No. 58-5442-4-018. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

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Optimum Corn Stover Removal for Biofuels and the Environment

L. Besemann and H. Eslinger

The 2007 U.S. energy bill calls for 36 billion gallons of ethanol to be produced by 2020. In 2007 the U.S. produced 6.5 billion gallons of ethanol. If corn grain was able to supply 15 billion gallons of ethanol, 21 billion gallons of 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 U.S. 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 a renewable energy source.

MATERIALS AND METHODS

Rotations:	Block I: 2014 - field corn, 2013 - field corn, 2012 - field corn, 2011 - field corn, 2010 - field corn, 2009 - field corn, 2008 – field corn, 2007 - field corn.
	Block II: 2014 - soybean, 2013 - field corn, 2012 - soybean, 2011 - field corn, 2010 -- soybean, 2009 - field corn, 2008 - soybean, 2007 - field corn.
	Block III: 2014 - field corn, 2013 - soybean, 2012 - field corn, 2011 - soybean, 2010 - field corn, 2009 - soybean, 2008 - field corn, 2007 - onion.
Soil:	Embden sandy loam, Hecla sandy loam and Maddock sandy loam.
	Block I: pH = 6.1; 2.1% organic matter; soil N 24 lbs/acre; soil P and soil K were very high; soil S was very low.
	Block II: pH = 6.0; 2.1% organic matter; soil N 32 lbs/acre; soil P and soil K were very high; soil S was low.
	Block III: pH = 6.7; 1.1% organic matter; soil N 27 lbs/acre; soil P and soil K were very high; soil S was low.
Seedbed preparation:	Strip-till May 9 with an Orthman strip-till machine.
Hybrid: Variety:	Corn: Peterson 88A97SS RIB. Soybean: Peterson 14R11 RR2Y.
Planting:	Block I: Corn May 10 in 30-inch rows @ 33,000 seeds/acre.
	Block II: Soybean May 27 in 30-inch rows @ 205,000 seeds/acre.
	Block III: Corn May 10 in 30-inch rows @ 33,000 seeds/acre.

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Fertilizer:	Block I: Twelve lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 via strip-till May 9. Stream-bar 10 lbs N/acre and 23 lbs S/acre as 12-0-0-26 and 60 lbs N/acre as 28-0-0 May 22. Sidedress 135 lbs N/acre as 28-0-0 June 17.
	Block II: Twelve lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 via strip-till May 9.
	Block III: Twelve lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 via strip-till May 9. Stream-bar 10 lbs/N acre and 23 lbs S/acre as 12-0-0-26 and 60 lbs N/acre as 28-0-0 May 22. Sidedress 135 lbs N/acre as 28-0-0 June 17.
Irrigation:	Hand move sprinkler irrigation as needed.
Pest control:	Block I: Harness (2 pt/acre) May 22, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05% v/v) + AMS (1½ lbs/acre) June 3.
	Block II: Roundup Power Max (30 oz/acre) + AMS (10 lbs/100 gal) June 7. Roundup Power Max (20 oz/acre) + AMS (1 lbs/10 gal) June 25.
	Block III: Harness (2 pt/acre) May 22; Laudis (3 oz/acre) + AAtrex 9-0 (0.5 lb ai/acre) + Destiny (0.05% v/v) + AMS (1½ lbs/acre) June 3.
Remote sensing:	Remote sensing was achieved with an Opti-Sciences CCM 200 Plus 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 6 and 7 from each plot on October 17.
	Block II: Harvested with a JD 4400 combine (48 rows 108 feet long, recorded with a weigh wagon) on October 8.
	Block III: Hand harvested the entire length (27 feet) of rows 6 and 7 from each plot on October 17.

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RESULTS BLOCK I (Corn/Corn) - 2014

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 at the 95 percent confidence level. Stover removal had no effect on chlorophyll readings (Opti-Science CCM 200), Normalized Difference Red Edge (NDRE) indice (Holland Crop Circle ACS 430) and stalk nitrate-N (Table 1) at the 95 per cent confidence level. Longer term data from 2009 to 2014 is presented in Table 2. The effect on 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 Figure 1.

RESULTS BLOCK II (Soybean/Corn) - 2014

All soybean plots were combine harvested and bulked. The soybeans yielded 51.0 bu/acre at 11.1% moisture (51.2 bu/acre @ 13 %) and had a test weight of 58.5 lbs/bu.

RESULTS BLOCK III (Corn/Soybean) - 2014

Stover removal rates of 33, 67, and 100 had no effect on grain yield, moisture or test weight (Table 3).

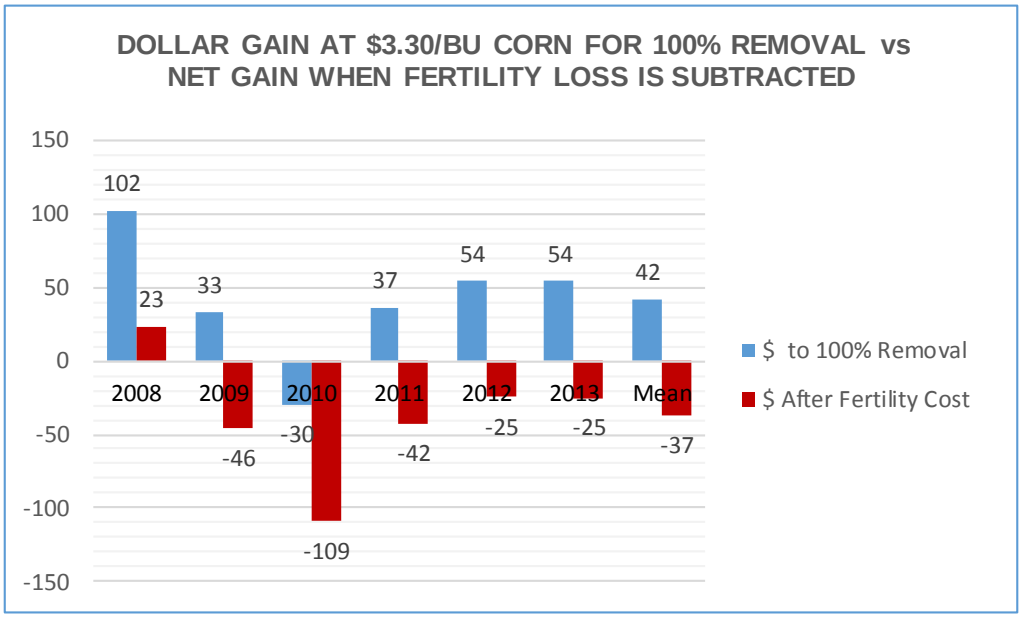

Figure 1. The net return when the fertility cost leaving the field is subtracted from the yield advantage in 100 percent removal plots compared to 0 percent removal plots for corn on corn from 2008 to 2013 (Mean) at the Oakes Irrigation Research Site.

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Table 1. The affect of corn stover removal from 0 to 100% on grain yield and other agronomic parameters for corn on corn plots in 2014.

Stover Removal	Grain Yield[1]	Grain Yield 2009-14	Harvest Moisture	Test Weight	Stalk DM Removal[2]	Stalk DM Removal 2008-13	Chlorophyll Meter Reading[3]	NDRE[4]	Population	Stalk Nitrate-N	Fall soil Nitrate-N
%	bu/ac	bu/ac	%	lb/bu	------ ton/ac ------		4-Aug	4-Aug	plants/ac	ppm	lbs/ac
0	191.9	216.1	16.5	51.9	0.0	0.0	51.5	0.3346	32831	1606	18
33	208.0	221.7	15.7	52.0	2.1	2.3	51.8	0.3462	34364	1896	36
67	204.3	223.3	16.2	52.2	2.8	3.5	53.2	0.3476	34284	1850	26
100	208.3	223.8	15.9	52.4	4.4	5.3	53.1	0.3461	33558	1603	57
Mean	203.1		16.1	52.1	2.3		52.4	0.3436	33759	1738	34
C.V. (%)	4.2		5.0	2.7	6.1		2.7	1.8	3.6	15.4	48.6
LSD 0.10	11.1		NS	NS	0.18		NS	0.0078	NS	NS	22
LSD 0.05	NS		NS	NS	0.23		NS	NS	NS	NS	27

Table 1. The affect of corn stover removal from 0 to 100% on grain yield and other agronomic parameters for corn on corn plots in 2014. (continued)

Stover Removal	Seed			Emerge Date	Silk Date	Mature Date	Nutrients in stover[2]			Nutrient Value	
	Oil	Protein	Starch				N	P	K	2014[2]	2008-2014
%	----------%----------						------ lb/acre ------			---------- $/ac ----------	
0	1.8	9.4	74.2	26-May	26-Jul	25-Sep	0	0	0	0	0
33	1.7	9.1	74.5	25-May	24-Jul	24-Sep	26	2	29	24	38
67	1.8	9.1	74.4	25-May	24-Jul	24-Sep	42	2	43	37	55
100	1.7	9.2	74.6	25-May	23-Jul	24-Sep	60	3	86	62	79
Mean	1.8	9.2	74.4	25-May	24-Jul	24-Sep	32	2	40	31	
C.V. (%)	19.7	2.9	0.7	0	0	0	13.8	26.9	28.0	19.0	
LSD 0.10	NS	NS	NS	0.65	1.5	NS	6	0.6	14	7.6	
LSD 0.05	NS	NS	NS	0.80	1.9	NS	7	0.8	18	9.4	

Planting Date = May 10; Harvest Date = October 17; Previous Crop = Corn.

Fertilizer Rate lbs/acre = 242 N, 40 P_2O_5, 23 S; Irrigation = 8.0 inches.

[1] Yield adjusted to 15.5% moisture.

[2] Corn stover removed spring of 2014 from 2013 corn crop.

[3] Opti-Science CCM 200.

[4] Holland Crop Circle ACS active canopy sensor (normalized difference red edge) - NDRE.

Table 2. Corn on Corn Stover Removal - NDSU Oakes Irrigation Research site 2009-2014.

Stover Removal	Grain Yield	Harvest Moisture	Test Weight	Chloroph Reading	Reading NDRE	Stalk Nitrate-N	Grain Protein	Silk Date	Mature Date
%	bu/ac	%	lb/bu			ppm	%		
0	216.1	21.7	54.0	54.0	0.3605	2434	8.6	7/24	9/29
33	221.7	20.9	54.6	55.1	0.3624	2931	8.5	7/23	9/28
67	223.3	20.9	54.6	56.1	0.3636	2920	8.5	7/22	9/27
100	223.8	20.3	54.9	56.1	0.3594	3143	8.6	7/21	9/27
Mean	221.2								

Table 3. The affect of corn stover removal from 0 to 100% on grain yield and other agronomic parameters for corn on soybean plots in 2014.

Previous Year Stover Removal	Grain Yield[1]	Grain Yield 2009-14	Harvest Moisture	Test Wt.	Chlorophyll[2]	NDRE[3]	Nitrate-N Stalk test	Nitrate-N Fall Soil	Population	Seed Oil	Seed Protein	Seed Starch	Emerge Date	Silk Date	Mature Date
%	bu/ac		%	lb/bu	4-Aug	4-Aug	ppm	lbs/ac	plants/ac	--------%		----------			
0	220.5	227.2	15.7	53.2	52.7	0.3535	1800	42	32670	2.2	9.3	73.7	25-May	23-Jul	24-Sep
33	221.3	222.4	15.6	53.4	52.1	0.3532	1428	73	33315	2.0	9.2	74.1	25-May	22-Jul	24-Sep
67	205.4	222.2	15.1	53.1	48.8	0.3481	1156	29	33073	2.1	9.2	73.9	25-May	22-Jul	24-Sep
100	222.4	225.7	15.4	53.5	54.3	0.3536	1628	89	33719	1.9	9.3	74.2	25-May	22-Jul	24-Sep
Mean	217.4		15.5	53.3	51.9	0.4	1503	58	33194	2.1	9.2	74.0	25-May	22-Jul	24-Sep
C.V. (%)	5.2		5.3	1.2	5.9	1.8	45.5	56.6	2.5	11.0	2.7	0.6	0	0	0
LSD 0.10	NS		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LSD 0.05	NS		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Planting Date = May 10; Harvest Date = October 17 ; Previous Crop = Soybean.

Fertilizer Rate lbs/acre = 242 N, 40 P_2O_5, 23 S; Irrigation = 8.0 inches.

[1]Yield adjusted to 15.5% moisture.

[2]Opti-Science CCM 200.

[3]Holland Crop Circle ACS active canopy sensor (normalized difference red edge) - NDRE.

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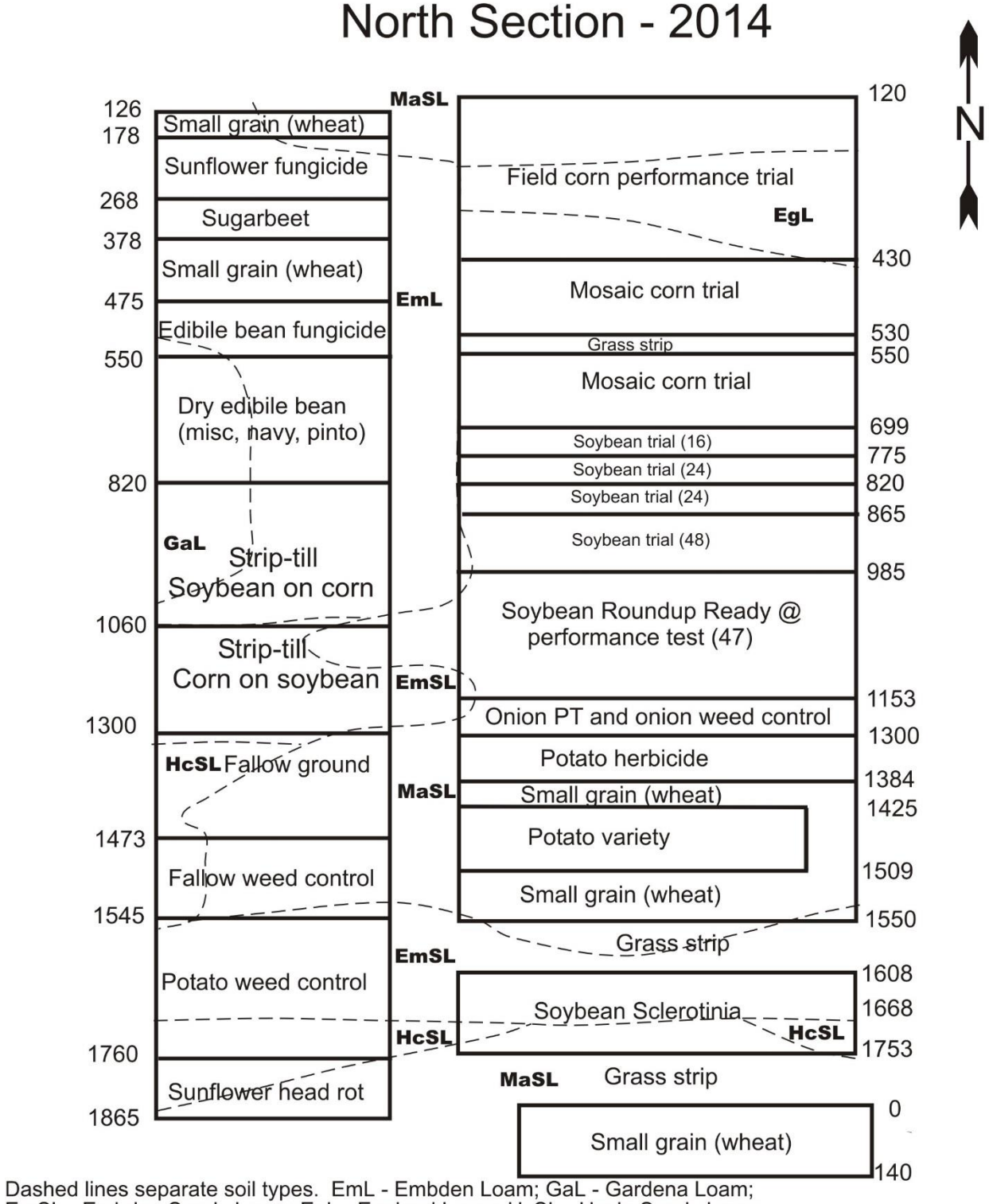
OAKES IRRIGATION RESEARCH SITE

North Section - 2014



Dashed lines separate soil types. EmL - Embden Loam; GaL - Gardena Loam; EmSL - Embden Sandy Loam; EgL - Egeland Loam; HcSL - Hecla Sandy Loam; MaSL - Maddock Sandy Loam

Dryland corn performance trial
Barnes-Svea
(Fullerton Site - Dickey County)

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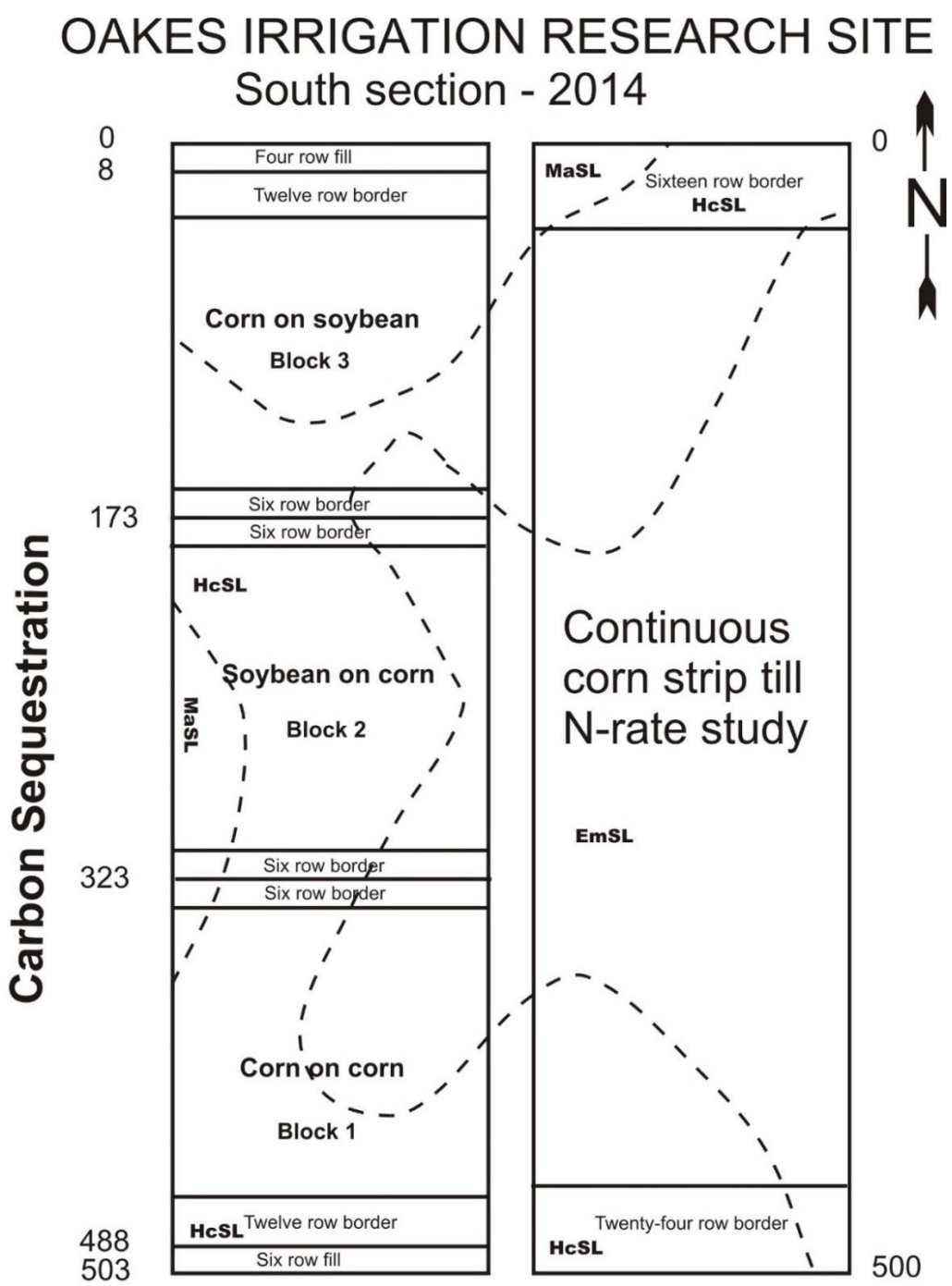

Dashed lines separate soil types. MaSL - Maddock Sandy Loam; HcSL - Hecla Sandy Loam; EmSL - Embden Sandy Loam.

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