Oakes Irrigation Research Site

Robert Titus Research Farm

Carrington Research Extension Center

North Dakota State University

Garrison Diversion Conservancy District

2015 ANNUAL REPORT

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NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

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Oakes Irrigation Research Site - Updates

Kelly Cooper

The Oakes Irrigation Research Site had a great year. Among the new projects and developments is a new water supply system. A horizontal well was installed December 7, 2015. The horizontal well is a relatively new way of extracting irrigation quantities of ground water in North Dakota. The well, as the name implies, runs horizontally to the surface for several hundred feet buried some 20 feet deep by a modified trenching machine. The well pipe is actually a poly sock wrapped plastic drain tile 8 inches in diameter. Several of these wells have been installed in the Oakes area during the last five years and most are performing adequately. Success is never a guarantee with any well, and horizontal wells are no exception. Careful planning is a must and drilling test wells along the intended length of the well is a requirement.

At the research site, we first looked up the logs of the test wells and existing wells near our intended installation area on the North Dakota Water Commission website. These all looked positive, with sand or gravel extending down to 30 feet below the surface. A requirement is to have no clay or silt layers between the installation surface and the depth of the well. Most commonly, the top two feet of soil is excavated before installation which typically removes finer material.

Our next step was to pick a location and dig test wells every 100 feet along the intended path. The test wells are done by using high pressure water forced through a 1½ inch plastic pipe which is forced into the ground by hand. The end of the pipe has a well screen and a special valve which allows water to exit out the end of the pipe, but closes when suction is applied. The procedure also shows how fast the aquifer will "take" water, which is a good indicator of hydraulic conductivity of the material and should indicate how fast water can come into the well. The new test wells revealed a layer of silty clay four to six feet below the ground surface extending for a couple hundred feet along the intended path of the well. Therefore, we decided to remove six feet of material. This not only removed the fine textured material so it would not get mixed in next to the well pipe, but would place the pipe farther into the aquifer. The water table at the time of installation was approximately 11 feet below ground level. The trench was six feet deep, 15 feet wide, and 800 feet long plus a ramp which allowed the trencher to enter and exit.

Installation started with the attachment of the standpipe to the trencher. The drain tile was then threaded through the trencher, much like threading a sewing machine. The drain tile or well pipe was then attached at the bottom of the stand pipe at a 90 degree angle. With the standpipe loosely connected to the trencher, the trencher digging chain is activated and the trencher digs its way into the ground as it is rotated into the vertical position. Once vertical, the trenching machine begins to move, leaving the standpipe behind, stringing out the drain tile 20 feet below. The entire process took nearly 3½ hours to install the 800 feet of tile. After conferring with several interested parties, we decided to tail up the end of the tile to ground surface at the end of the well to allow access. Garrison Diversion Conservancy District has been cleaning its drain tiles on a regular basis in the Oakes test area, and this will allow them to clean this well, if needed. Also, since this well is a relatively new technology, there may be utility in allowing access for various test equipment that could be placed in the well to monitor flow rates, iron bacteria build up, or silt infiltration.

Shortly after installation, the well was test pumped at 550 gallons per minute for 3½ hours. The draw down was 4½ feet and remained stable during the pumping period. We are working closely with the North Dakota Water Commission to develop a monitoring plan that will hopefully help us understand how to best utilize these types of wells in our area and elsewhere around the state. Many areas have adequate water, but drilling and connecting multiple wells is prohibitively expensive or not possible. The horizontal well system is another option to utilize water for beneficial purposes.

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Starting point of the horizontal well installation

Midpoint of the well installation and completed well installation

Another major improvement at the site was the installation of a new lateral irrigator. The new system is equipped to apply water with a variable-rate control system. This simply means if we have a plot that does not need water, for instance a dry edible bean plot that is mature, and is beside a potato plot that still needs water, the nozzles will stop delivering water at the bean plot, while nozzles remain operating on the potato plot. It also can put ¾ inch of water on one plot, and ½ inch on another. This system will improve our quality of research and allow different types of investigations on water use. The new irrigation system will sustain the basic needs on the project and offer many new opportunities well into the future.

We also acquired a new (used) Almaco plot combine which will serve us very nicely. The used machine has been outfitted with a brand new automated weighing and grain moisture testing system to collect sample data as we harvest the plots. The combine has a corn head and also a straight head that can be used for soybeans or small grain.

We would like to thank the North Dakota Corn Council, North Dakota Soybean Council, and the North Dakota State Water Commission for partial financial support of these improvements.

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RESEARCH PROGRAM

Data on irrigated crop production have been collected for the past 46 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: Kelly Cooper as research agronomist; Leonard Besemann as research specialist; and Heidi Eslinger as research technician. The Garrison Diversion Conservancy District provides most of the financial support. 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 2015

The winter of 2014 - 2015 began with an early snow and cold weather in November followed by warmer temperatures in December that continued into January. February saw the return of the colder temperatures experienced in November. Even with the early snowfall in November the winter concluded with below-average snowfall amounts. No record low temperatures were recorded. Most field work and planting dates were near average. The last frost in the spring was on May 19. The maximum temperature equaled or exceeded 90°F twelve times; once in June, four times in July, five times in August, and twice in September. The highest temperature was 98°F on September 3. Precipitation nearly doubled the long- term average in May. With the exception of May, precipitation was below the long-term average from April to October. The mean daily temperatures were within two degrees of the long-term averages for the season except for October which was four degrees above average. The first frost was September 29 with the first hard frost (≤ 28°F) October 9. All crops reached maturity before frost. Growing degree units in 2015 were above the long-term average.

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

	Precipitation			Average daily temperatures		
Month	2015	15-year average	25-year average	2015	15-year average	25-year average
	----------inches----------			----------°F----------		
April	0.17	1.54	1.54	46	44	44
May	6.00	3.40	3.24	54	56	57
June	3.19	4.71	4.34	68	67	66
July	0.77	2.65	3.14	71	71	71
August	1.30	2.36	2.12	68	69	69
September	0.80	2.62	2.71	63	61	60
October	1.86	2.04	2.16	50	46	46

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

Month	2015	10-year average	15-year average	25-year average
May	260	308	296	308
June	529	507	505	499
July	637	656	655	629
August	560	584	580	581
September	455	375	383	373
Total	2441	2430	2419	2388

[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.

	2015	10-year average	15-year average	25-year average
Last frost in Spring				
32 °F or less	19-May	6-May	6-May	5-May
28 °F or less	27-Apr	23-Apr	27-Apr	26-Apr
First frost in Fall				
32 °F or less	29-Sep	5-Oct	3-Oct	1-Oct
28 °F or less	9-Oct	12-Oct	9-Oct	7-Oct
Frost free period (days)	133	154	155	150

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Table 4. Irrigation water applied, 2015.

Study	Irrigation water applied
	inches
Dry edible bean variety trials	10.0
Field corn hybrid performance trial	13.9
Onion hybrid performance trial	12.5
Onion weed control study	12.5
Optimum corn stover removal for biofuel	
corn on corn	12.0
corn on soybean	12.0
soybean on corn	12.0
Potato trials	12.6
Soybean Sclerotinia study	15.7
Soybean studies	11.5
Soybean variety performance trials, Roundup Ready®	11.5
Soybean variety performance trials, Liberty Link	11.5
Soybean study - Mosaic	11.5
Strip-till	
corn on corn	12.0
corn on soybean	12.6
soybean on corn	11.5
Sunflower study*	4.4
Sugarbeet	12.8

*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. Twenty-three varieties were tested: nine miscellaneous beans (Table 1.), five navy beans (Table 2.), and nine pinto beans (Table 3).

MATERIALS AND METHODS

Soil:	Embden loam; pH = 7.1; 2.3% organic matter; soil N 9 lbs/acre; soil P, soil K was very high and soil S was high.
Previous crop:	2014 – sunflower and sugarbeet.
Seedbed preparation:	Spring conventional tillage.
Planting:	May 27 in 30-inch rows.
Plots:	Plots were 17 ft long by 5 ft (2 rows) wide. The study had four replications.
Fertilizer:	Broadcast 8 lbs N/acre, 42 lbs P_2O_5/acre, 48 lbs K_2O/acre and 10 lbs S/acre as 9-21-24-6 April 14.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Trust (1 pt/acre) May 26, Basagran (1.5 pt/acre) + COC (1.0% v/v) June 17, Raptor (4 oz/acre) + NIS (0.25% v/v) June 29 and Section 2EC (12 oz/acre) + COC (1.0% v/v) June 25 for weed control. Endura (8 oz/acre) July 8, Proline (5 oz/acre) July 23 for disease control.
Harvest:	Hand harvested bean varieties September 2 to September 9 as they matured. Harvest area for all bean varieties was five feet (two rows wide) by 17 feet. Beans were threshed with a stationary plot thresher September 2 to September 9.

RESULTS

The three classes of dry edible beans all had good yields for the 2015 season. The mean yield of the miscellaneous beans was 3605 lbs/acre. Pink Panther (kidney bean) had the highest yield of the miscellaneous beans yielding 3903 lbs/acre. The mean yield of the navy beans was 3423 lbs/acre. HMS Medalist had the highest yield of the navy bean yielding 3615 lbs/acre. The mean yield of the pinto beans was 3649 lbs/acre. ND-307 had the highest pinto bean yield at 4147 lbs/acre.

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Table 1. Misc Bean Variety Trial at the Oakes Irrigation Research Site in 2015.

Variety	Market Class	Days to PM	Seeds/ Pound	Seed Weight	Test Weight	Seed Yield 2015	2014	2013	2 or 3-yr. Avg.
				grams/100	lb/bu	---------- lb/ac ----------			
Eclipse	Black	82.5	2113	21.5	62.4	3529	2682	3130	3113
Merlot	Small Red	94.3	1113	40.8	59.9	3687	2727	2713	3042
Loreto	Black	88.5	2156	21.1	61.8	3844	2576	2880	3100
Zorro	Black	85.0	2037	22.3	63.3	3834	--	3278	--
Rio Rojo	Small Red	85.8	1288	35.2	63.5	3897	3186	3285	3456
Rosie	Light Red Kidney	97.5	887	51.2	57.2	3005	--	--	--
Talon	Dark Red Kidney	86.0	870	52.2	58.2	3355	--	--	--
Montcalm	Kidney Bean	94.0	802	56.6	57.6	3393	1891	--	2642
Pink Panther	Kidney Bean	84.0	714	63.5	55.1	3903	1132	--	2518
Mean		88.6	1331	40.5	59.9	3605	2455	3116	--
C.V. (%)		1.5	3.1	2.3	1.0	8.0	6.5	10.2	--
LSD 0.10		1.6	50	1.1	0.7	351	191	374	--
LSD 0.05		1.9	61	1.4	0.9	423	230	448	--

Planting date = May 27; Harvest date = September 2 to September 9

Previous Crop = Sugarbeet or spring wheat

Table 2. Navy Bean Variety Trial at the Oakes Irrigation Research Site in 2015.

Variety	Days to PM	Seeds/ Pound	Seed Weight	Test Weight	Seed Yield 2015	2014	2013	3-yr. Avg.
			grams/100		---------- lb/ac ----------			
HMS Medalist	88.5	2251	20.2	63.2	3615	2874	3320	3270
Avalanche	87.0	2012	22.6	64.3	3346	2463	2513	2774
Ensign	82.0	2002	22.7	64.4	3345	2936	3137	3139
Vista	87.3	2270	20.0	64.6	3365	2750	3363	3159
T9905	87.0	2095	21.8	64.1	3446	3321	3883	3550
Mean	86.4	2126	21.5	64.1	3423	2869	3116	--
C.V. (%)	1.2	3.1	3.0	0.8	5.4	6.0	10.2	--
LSD 0.10	1.3	83	0.8	0.7	235	208	374	--
LSD 0.05	1.6	102	1.0	0.8	287	253	448	--

Planting date = May 27; Harvest date = September 2 to September 8

Previous Crop = Sugarbeet or spring wheat

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Table 3. Pinto Bean Variety Trial at the Oakes Irrigation Research Site in 2015.

Variety	Days to PM	Seeds/ Pound	Seed Weight	Test Weight	Seed Yield 2015	2014	2013	2 or 3-yr. Avg.
			grams/100	lb/bu	---------- lb/ac ----------			
LaPaz	83.0	1227	37.1	61.8	3198	3116	3440	3251
Lariat	88.8	1068	42.6	59.1	3982	3209	3659	3617
Stampede	78.8	1081	42.0	58.5	3582	3046	3020	3216
Maverick	84.5	1094	41.6	59.0	3104	2955	3206	3088
ND-307	85.8	995	45.7	56.7	4147	3105	--	3626
Windbreaker	80.5	1020	44.5	58.4	3666	3168	3630	3488
Mean	85.4	1062	43.0	58.6	3649	3119	3116	--
C.V. (%)	1.5	4.1	4.2	1.4	9.4	6.3	10.2	--
LSD 0.10	1.6	52	2.2	1.0	415	236	374	--
LSD 0.05	1.9	63	2.6	1.2	501	284	448	--

Planting date = May 27; Harvest date = September 2 to September 8

Previous Crop = Sugarbeet or spring wheat

Dry edible bean (miscellaneous) trial

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Corn Hybrid Performance Trial - Irrigated

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 68 hybrids.

MATERIALS AND METHODS

Soil:	Embden loam, Gardena loam; pH = 7.2; 2.2% organic matter; soil N 17 lbs/acre; soil P, soil K and soil S was very high.
Previous crop:	2014 – wheat and edible bean.
Seedbed preparation:	Spring conventional tillage.
Planting:	Planted April 30 in 30-inch rows. Thinned to 36,900 plants/acre.
Fertilizer:	Broadcast 8 lbs N/acre, 42 lbs P_2O_5/acre, 48 lbs K_2O/acre and 10 lbs S/acre as 9-21-24-6 April 14. Stream bar 50 lbs N/acre May 5 as 28-0-0. Sidedress 145 lbs N/acre June 12 as 28-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest Control:	Harness (2 pt/acre) May 5, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05% v/v) + AMS (1½ lbs/acre) + Interlock (4 oz/acre) June 4.
Harvest:	October 20 with a plot combine. Harvest area was two rows 17 feet long.

Irrigated corn hybrid trial

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Table 1. Corn hybrid performance trial at the Oakes Irrigation Research Site in 2015.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Ht.	Plant Ht.	Grain Content				Test Wt.	Grain Yield		
							Protein	Starch	Oil	Moist.		2015	2 yr. Avg.	3 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	-------bu/ac-------		
Channel	194-14	94	VT2PRIB	79.0	46.0	98.3	8.9	73.8	2.7	14.9	58.2	257.3	--	--
Channel	195-56	95	VT2PRIB	79.0	47.7	99.2	8.7	73.4	2.9	14.1	57.1	256.9	--	--
Channel	197-50	97	STXRIB	79.3	49.1	99.4	9.1	73.7	2.5	15.9	57.4	264.9	--	--
Channel	197-68	97	STXRIB	82.8	47.4	100.9	9.1	72.8	3.2	16.4	60.3	261.2	--	--
Dairyland Seed	DS-9791RA	91	SSX	81.0	42.9	95.2	8.7	73.9	2.6	13.6	57.9	242.2	220.7	216.8
Dairyland Seed	DS-9693	93	SSX	83.0	53.3	104.2	9.9	71.9	3.4	17.4	58.0	234.0	216.4	--
Dairyland Seed	DS-9593	93	3000GT	80.3	51.7	100.8	9.1	74.5	1.9	13.3	57.9	228.2	--	--
Dairyland Seed	DS-9198	98	RA	80.8	48.0	97.6	8.8	74.2	2.3	13.5	56.7	233.1	--	--
Dairyland Seed	DS-9599	99	3000GT	81.5	50.6	99.5	7.2	73.8	2.5	15.8	58.3	256.4	--	--
Dairyland Seed	DS-9701	101	SSX	80.0	44.4	94.4	8.6	73.7	2.8	14.1	57.5	249.6	--	--
Innotech	IC4343-3110A	93	Agrisure Viptera 3110A	79.3	53.8	102.9	10.0	73.3	2.4	14.9	59.8	245.5	--	--
Innotech	IC4453-3110	94	Agrisure Viptera 3110	79.3	52.0	100.2	9.9	73.4	2.3	14.9	60.2	258.0	--	--
Innotech	IC4654-3111	96	Agrisure Viptera 3111	80.5	53.0	102.9	9.0	75.6	1.5	14.3	57.4	239.8	--	--
Innotech	IC4903-3111A	99	Agrisure Viptera 3111A	81.3	50.2	101.8	9.4	73.4	2.5	15.2	58.7	250.3	--	--
Integra	4652		GSS	80.5	50.9	98.3	8.8	74.2	2.3	14.7	58.5	257.2	--	--
Latham	LH 4455	94	VT3 PRO	80.8	45.4	95.0	9.1	73.1	2.8	14.7	58.9	254.2	--	--
Latham	LH 4645	96	VT2 PRO	79.5	50.3	96.6	10.0	73.3	2.4	14.0	58.5	239.8	--	--
Latham	EX 4729	97	SS	81.5	51.9	99.2	9.1	73.4	2.5	14.5	57.3	234.6	--	--
Latham	LH 5215		VT2 PRO	80.5	48.9	100.4	8.6	73.3	3.2	17.6	58.9	274.6	--	--
	MEAN			80.1	48.9	98.7	9.0	73.5	2.7	14.9	58.8	249.0	--	--
	C.V. (%)			0.9	3.6	1.7	6.1	0.7	11.2	3.1	2.3	5.1	--	--
	LSD 0.10			0.8	2.0	2.0	0.6	0.6	0.3	0.5	1.5	14.8	--	--
	LSD 0.05			1.0	2.4	2.4	NS	0.7	0.4	0.6	1.8	17.6	--	--

Planting Date = April 30; Harvest Date = October 20; Previous Crop = Dry edible bean

Table 1. Corn hybrid performance trial at the Oakes Irrigation Research Site in 2015.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Ht.	Plant Ht.	Grain Protein	Content Starch	Content Oil	Moist.	Test Wt.	Grain Yield 2015	Grain Yield 2 yr. Avg.	Grain Yield 3 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	-------bu/ac-------		
Legacy Seeds	L3011	90	VT3PRO	77.3	46.0	97.8	8.7	73.8	2.7	13.6	58.3	233.6	--	--
Legacy Seeds	L3115	91	VT2PRO	80.5	50.6	98.7	8.9	73.5	2.9	13.6	58.4	242.5	--	--
Legacy Seeds	L3114	92	VT2PRO	78.5	50.3	99.5	9.1	73.8	2.5	13.5	58.8	236.6	--	--
Legacy Seeds	L3022	92	GENSS	78.3	51.6	100.9	9.4	73.7	2.6	15.1	60.2	247.0	--	--
Legacy Seeds	L3043	93	VT2PRO	80.5	42.5	94.5	8.6	73.3	3.1	14.5	59.1	236.0	221.3	--
Legacy Seeds	L3712	96	VT3PRO	80.5	46.0	96.7	9.0	73.2	2.8	14.8	59.6	246.5	235.5	--
Legacy Seeds	L3845	97	GENSS	82.3	51.0	98.5	9.2	72.9	2.7	14.0	57.7	245.7	--	--
Legend	LR 9492	92	VT2RIB	79.5	46.0	96.5	8.4	73.6	2.9	14.2	59.6	249.8	--	--
Legend	LR 9394	94	GENSSRIB	80.3	47.6	96.5	9.0	73.1	3.1	17.3	61.5	244.7	--	--
Legend	LR 9495	95	VT2RIB	80.8	46.7	96.4	9.1	73.2	2.7	14.6	59.3	253.3	--	--
Legend	LR 9496	96	VT2RIB	82.0	52.9	102.3	9.4	73.3	2.7	15.7	59.0	256.9	--	--
Legend	LR 9497	97	VT2RIB	81.8	50.3	99.1	9.4	73.5	2.5	16.7	59.3	243.5	--	--
Northstar/Viking	VS 92-110	92	VT2P	80.3	45.0	95.3	8.5	73.4	3.0	14.9	60.2	249.1	--	--
Northstar/Viking	VS 94-571	94	VT2P	77.5	49.0	100.7	9.0	73.3	2.8	14.6	59.7	253.0	--	--
Nuseed	9504 VT3P Rib	95	VT Triple Pro	77.5	43.2	95.5	9.0	73.8	2.6	13.5	58.9	235.4	222.5	215.9
NuTech/G2 Genetics	5N-290	90	3000GT	79.3	54.4	102.9	9.3	74.2	2.6	13.2	56.2	246.3	--	--
NuTech/G2 Genetics	5G-9302	93	GT/CB/LL	80.0	54.6	102.5	9.8	73.3	2.4	15.1	60.0	249.1	--	--
NuTech/G2 Genetics	5X-894	94	HXT/RR2	78.5	47.1	94.6	8.9	73.5	2.6	14.0	58.2	246.0	225.3	221.2
NuTech/G2 Genetics	5N-195	95	3000GT	80.0	53.3	100.7	9.0	74.9	1.9	13.9	58.3	231.6	--	--
NuTech/G2 Genetics	5F-196	96	YGCB/Hx1/RR2/LL	78.5	52.3	101.9	8.7	74.3	2.2	14.1	56.2	238.4	--	--
NuTech/G2 Genetics	5F-198	98	YGCB/Hx1/RR2/LL	81.0	51.7	102.1	8.8	73.0	2.8	14.0	54.9	258.5	243.6	--
PFS	76S92	92	VT2PRO	80.5	44.4	96.0	8.6	73.6	3.0	14.4	59.8	228.4	220.0	225.9
PFS	81W95	95	SMARTSTAX	78.5	48.0	99.7	8.8	74.0	2.5	14.7	58.3	261.5	247.9	--
	MEAN			80.1	48.9	98.7	9.0	73.5	2.7	14.9	58.8	249.0	--	--
	C.V. (%)			0.9	3.6	1.7	6.1	0.7	11.2	3.1	2.3	5.1	--	--
	LSD 0.10			0.8	2.0	2.0	0.6	0.6	0.3	0.5	1.5	14.8	--	--
	LSD 0.05			1.0	2.4	2.4	NS	0.7	0.4	0.6	1.8	17.6	--	--

Planting Date = April 30; Harvest Date = October 20; Previous Crop = Dry edible bean

Table 1. Corn hybrid performance trial at the Oakes Irrigation Research Site in 2015.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Ht.	Plant Ht.	Grain Content Protein	Grain Content Starch	Grain Content Oil	Grain Content Moist.	Test Wt.	Grain Yield 2015	Grain Yield 2 yr. Avg.	Grain Yield 3 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	-------bu/ac-------		
PFS	55S96	96	VT3PRO	80.5	46.0	95.8	8.9	74.0	2.5	14.8	58.9	245.9	233.5	230.1
Proseed	1492 VT2P	92	VT2P	78.3	49.7	97.9	9.6	72.7	3.0	14.3	58.6	252.2	--	--
Proseed	1392 VT2P	92	VT2P	80.3	45.9	96.4	8.6	73.4	2.9	14.6	59.4	240.5	--	--
Proseed	1393 VT2P	93	VT2P	77.0	44.3	93.7	8.7	74.1	2.6	14.4	59.5	233.6	--	--
Proseed	1495 SS	95	SS	81.3	52.2	101.3	9.1	73.1	3.1	16.1	59.0	261.5	--	--
Proseed	1496 SS	96	SS	82.0	50.5	98.9	9.3	73.7	2.5	17.0	59.2	241.2	--	--
REA	3A922-RIB	92	RR2, Bt, CRW	79.0	45.4	94.2	8.8	73.9	2.6	14.9	59.5	244.0	--	--
REA	3A929-RIB	92	RR2, Bt, CRW	79.0	49.5	100.7	9.5	73.3	2.8	15.0	60.6	249.6	244.4	240.2
REA	4A930-RIB	93	RR2, Bt, CRW	77.5	43.8	97.0	8.8	73.1	3.0	14.3	58.0	248.5	--	--
REA	4A942-RIB	94	RR2, Bt, CRW	79.3	47.7	97.8	9.0	74.0	2.5	15.1	59.4	253.7	239.3	--
REA	4B953-RIB	95	RR2, Bt	80.5	50.1	101.1	8.7	74.1	2.4	13.8	59.3	253.7	--	--
REA	4A962-RIB	96	RR2, Bt, CRW	80.0	48.6	100.2	9.4	73.9	2.4	16.5	59.0	255.3	--	--
REA	4A972-RIB	97	RR2, Bt, CRW	79.5	51.0	100.7	9.0	73.6	2.6	14.9	58.5	259.3	246.3	--
REA	5A992-RIB	99	RR2, Bt, CRW	83.0	54.6	101.0	9.1	72.4	3.3	16.8	58.4	260.3	245.0	--
Renk	RK522SSTX	94	SSTX	79.5	49.0	100.5	8.9	73.7	2.7	14.9	58.2	249.3	234.1	236.4
Renk	RK544SSTX	95	SSTX	81.0	50.4	99.4	9.1	73.1	3.0	15.7	58.8	251.1	--	--
Renk	RK568VT3P	95	SSTX	79.3	45.0	94.9	9.1	73.1	2.8	14.3	59.4	251.8	240.3	238.4
Thunder	7993VT2P	93	VT2PRIB	80.3	44.3	95.9	8.6	73.5	2.8	14.5	59.3	247.0	--	--
Thunder	101-95SS	95	SS	82.5	50.5	96.6	9.3	74.0	2.4	17.0	62.4	246.5	--	--
Thunder	7396VT2P	96	VT2PRIB	79.3	49.6	96.9	9.8	73.2	2.8	14.4	58.4	255.4	242.9	243.0
Thunder	101-97SS	97	SS	81.5	52.2	101.4	9.3	73.4	2.8	15.5	59.5	258.9	--	--
	MEAN			80.1	48.9	98.7	9.0	73.5	2.7	14.9	58.8	249.0	--	--
	C.V. (%)			0.9	3.6	1.7	6.1	0.7	11.2	3.1	2.3	5.1	--	--
	LSD 0.10			0.8	2.0	2.0	0.6	0.6	0.3	0.5	1.5	14.8	--	--
	LSD 0.05			1.0	2.4	2.4	NS	0.7	0.4	0.6	1.8	17.6	--	--

Planting Date = April 30; Harvest Date = October 20; Previous Crop = Dry edible bean

Table 1. Corn hybrid performance trial at the Oakes Irrigation Research Site in 2015.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Ht.	Plant Ht.	Grain Protein	Content Starch	Content Oil	Moist.	Test Wt.	Grain Yield 2015	Grain Yield 2 yr. Avg.	Grain Yield 3 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	-------bu/ac-------		
Wensman Seed	W70975VT3PRIB		VT3PRIB	80.0	45.4	95.2	9.1	73.3	2.7	14.7	59.5	261.5	245.9	--
Wensman Seed	W90962STX		STX	78.5	47.7	100.9	8.9	73.4	2.8	14.8	57.8	275.6	--	--
Wensman Seed	W9288STXRIB		STXRIB	83.0	48.9	99.3	8.6	73.3	2.9	16.5	58.5	250.0	238.7	242.0
Wensman Seed	W90941STXRIB		STXRIB	79.0	50.2	98.5	8.8	73.8	2.6	13.9	57.4	247.8	241.7	--
Wensman Seed	W90979STXRIB		STXRIB	80.5	51.4	98.3	8.9	74.0	2.5	15.2	61.6	269.3	251.4	--
	MEAN			80.1	48.9	98.7	9.0	73.5	2.7	14.9	58.8	249.0	--	--
	C.V. (%)			0.9	3.6	1.7	6.1	0.7	11.2	3.1	2.3	5.1	--	--
	LSD 0.10			0.8	2.0	2.0	0.6	0.6	0.3	0.5	1.5	14.8	--	--
	LSD 0.05			1.0	2.4	2.4	NS	0.7	0.4	0.6	1.8	17.6	--	--

Planting Date = April 30; Harvest Date = October 20; Previous Crop = Dry edible bean

[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 75 hybrids.

MATERIALS AND METHODS

Soil:	Barnes-Svea; pH = 6.2; 3.2% organic matter; soil N 26 lbs/acre; soil P was low; soil K and soil S were very high.
Previous crop:	2014 – soybean.
Seedbed preparation:	Spring conventional tillage.
Planting:	Planted May 4 in 30-inch rows. Thinned to 33,200 plants/acre.
Fertilizer:	Broadcast 8 lbs N/acre, 42 lbs P_2O_5/acre and 48 lbs K_2O/acre and 10 lbs S/acre as 9-21-24-6 April 13. Stream bar 50 lbs N/acre as 28-0-0 May 5. Sidedress 145 lbs N/acre June 12 as 28-0-0.
Pest control:	Harness (2 pt/acre) May 8, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05% v/v) + AMS (1½ lbs/acre) June 18.
Harvest:	October 21 with a plot combine. Harvest area was two rows 22 feet long.

RESULTS

Overall yields were near the 2014 season high in the Oakes area. After generous rainfall amounts in May and June, conditions turned dry with less than three inches recorded for the remainder of the growing season. Even with the dry conditions, the mean yield was 182.7 bu/acre which was only slightly lower than the 2014 mean of 185.9 bu/acre.

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Table 2. Corn hybrid performance trial (dryland) Dickey County - Oakes Irrigation Research Site 2015.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Height	Plant Height	Grain Protein	Content Starch	Content Oil	Moisture	Test Wt.	Grain Yield 2015	Grain Yield 2 yr. Avg.	Grain Yield 3 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	-----bu/ac-----		
Allied Genetics	92G43	92	RR	83.3	57.8	98.7	9.5	73.3	2.4	15.5	56.9	168.6	--	--
Allied Genetics	96GB96	96	GT/CB/LL	83.3	52.7	99.6	9.5	73.3	2.4	15.5	58.1	159.6	--	--
Channel	189-03	89	VT2PRIB	79.0	48.4	95.5	9.4	73.8	2.1	13.2	57.9	190.1	--	--
Channel	190-13	90	VT2PRIB	80.7	44.3	91.6	9.8	73.7	2.2	13.4	57.3	163.9	169.8	--
Channel	191-85	91	VT2PRIB	78.7	44.9	93.1	9.9	73.4	2.3	13.6	57.2	178.9	--	--
Channel	194-14	94	VT2PRIB	82.3	49.1	97.8	9.4	74.2	1.9	15.6	57.7	199.1	--	--
Dairyland Seed	DS-9487RA	87	SSX	78.0	45.6	91.5	9.1	74.2	2.4	13.7	57.0	173.8	--	--
Dairyland Seed	DS-9791RA	91	SSX	82.7	42.6	91.8	10.3	72.7	2.6	14.9	56.9	178.4	181.5	147.3
Dairyland Seed	DS-9593	93	3000GT	82.7	53.6	98.4	9.6	73.8	2.2	14.2	58.3	169.3	--	--
Dairyland Seed	DS-9599	99	3000GT	83.7	52.2	99.2	9.5	73.1	2.7	17.6	58.1	165.4	--	--
Dairyland Seed	DS-9701	101	SSX	83.0	47.9	98.0	9.6	73.7	2.0	17.0	57.1	200.4	--	--
Funk's Frontiersman	091-E3VT2P	91	VT Double Pro RIB	80.0	49.0	94.2	9.5	72.8	2.9	13.6	58.2	197.8	197.2	163.0
Funk's Frontiersman	092-C6VT2P	92	VT Double Pro RIB	80.7	49.7	92.7	9.7	73.6	2.4	13.7	57.6	148.8	--	--
Funk's Frontiersman	092E5VT2PRIB	92	VT Double Pro RIB	82.7	45.5	92.6	9.6	73.0	2.8	15.3	57.0	191.7	--	--
Innotech	IC4286-3111	92	Agrisure Viptera 3111	83.0	54.6	100.8	9.6	73.4	2.5	13.5	57.4	197.9	--	--
Innotech	IC4343-3110A	93	Agrisure Viptera 3110A	82.7	55.4	102.0	9.8	73.1	2.4	15.5	57.4	199.2	--	--
Innotech	IC4310-3000GT	93	Agrisure 3000GT	83.0	55.9	100.3	10.1	72.5	2.7	13.9	57.6	185.7	--	--
Innotech	IC4453-3110	94	Agrisure Viptera 3110	82.3	51.9	98.5	10.3	73.3	2.2	14.8	58.9	167.8	--	--
Innotech	IC4772-3111	97	Agrisure Viptera 3111	82.7	47.4	95.4	9.4	72.9	2.8	14.4	58.2	148.1	--	--
Innotech	IC4903-3111A	99	Agrisure Viptera 3111A	83.0	49.8	92.3	10.3	72.7	2.5	15.8	58.1	165.1	--	--
Integra	9455		VT3P	80.7	48.5	93.1	9.6	72.2	2.8	14.0	56.7	200.8	--	--
	MEAN			82.0	48.8	94.7	9.8	73.2	2.4	14.7	57.4	182.7	--	--
	C.V. (%)			0.8	5.6	4.5	4.1	0.6	13.3	5.4	1.1	12.1	--	--
	LSD 0.10			0.9	3.2	5.69	0.5	0.5	0.4	0.9	0.7	25.8	--	--
	LSD 0.05			1.1	3.8	6.80	0.6	0.6	0.5	1.1	0.9	30.7	--	--

Planting Date = May 4; Harvest Date = October 21; Previous Crop = Soybean

Table 2. Corn hybrid performance trial (dryland) Dickey County - Oakes Irrigation Research Site 2015.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Height	Plant Height	Grain Protein	Content Starch	Content Oil	Moisture	Test Wt.	Grain Yield 2015	Grain Yield 2 yr. Avg.	Grain Yield 3 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	-----bu/ac-----		
Latham	LH 4242	92	VT2 PRO	82.7	47.2	92.0	9.8	73.7	1.9	14.8	56.3	191.9	--	--
Latham	LH 4455	94	VT3 PRO	83.0	44.5	91.5	10.0	73.3	2.4	16.1	58.5	180.7	--	--
Latham	LH 4645	96	VT2 PRO	82.0	47.5	89.4	9.9	74.0	2.0	13.7	55.5	186.2	--	--
Latham	EX 4729	97	SS	84.3	50.7	98.6	9.2	73.4	2.6	14.8	57.1	192.7	--	--
Legacy Seeds	L3011	90	VT3PRO	79.0	47.8	90.0	10.0	74.2	2.0	13.2	54.9	177.4	--	--
Legacy Seeds	L3115	91	VT2PRO	83.0	50.3	95.8	9.2	73.1	2.8	14.7	57.6	189.6	--	--
Legacy Seeds	L3114	92	VT2PRO	81.3	50.8	98.2	9.8	72.4	2.8	14.2	58.1	184.2	--	--
Legacy Seeds	L3022	92	GENSS	80.3	48.2	95.6	9.1	73.8	2.8	13.6	56.4	176.7	--	--
Legacy Seeds	L3043	93	VT2PRO	82.0	45.7	92.3	9.2	73.2	2.7	14.7	57.8	191.7	192.0	--
Legacy Seeds	L3712	96	VT3PRO	82.7	42.6	85.1	9.4	72.7	2.9	14.8	58.3	169.0	179.6	--
Legacy Seeds	L3845	97	GENSS	83.7	48.7	94.0	9.3	73.0	2.8	14.5	57.4	188.2	--	--
Legend	LR 9492	92	VT2RIB	83.0	48.2	96.2	10.0	72.9	2.7	14.8	57.8	186.3	--	--
Legend	LR 9394	94	GENSSRIB	82.0	47.2	93.6	9.1	73.5	3.2	16.1	57.5	165.0	--	--
Legend	LR 9495	95	VT2RIB	83.0	50.0	97.1	9.9	73.2	2.4	16.2	57.7	206.9	--	--
Legend	LR 9496	96	VT2RIB	84.0	53.9	100.5	9.8	73.8	1.9	15.3	57.4	181.3	--	--
Legend	LR 9497	97	VT2RIB	83.3	49.2	94.9	9.7	73.1	2.6	15.6	57.1	171.0	--	--
Mustang	3292 VT2P		VT2P	82.7	48.3	91.0	10.0	72.8	2.8	15.1	58.5	191.2	--	--
Mustang	4295 VT2P		VT2P	82.7	49.7	97.0	9.8	73.1	2.6	16.2	58.4	201.0	--	--
Northstar/Viking	VS 88-116	88	VT2P	82.0	50.5	98.4	10.3	72.6	2.7	14.3	59.4	192.4	--	--
Northstar/Viking	VS 91-591	91	VT2P	79.3	48.0	92.8	9.1	73.5	2.5	13.7	57.4	189.5	--	--
Northstar/Viking	VS 92-110	92	VT2P	82.7	46.9	93.8	9.3	73.0	2.8	15.0	57.7	187.5	--	--
	MEAN			82.0	48.8	94.7	9.8	73.2	2.4	14.7	57.4	182.7	--	--
	C.V. (%)			0.8	5.6	4.5	4.1	0.6	13.3	5.4	1.1	12.1	--	--
	LSD 0.10			0.9	3.2	5.69	0.5	0.5	0.4	0.9	0.7	25.8	--	--
	LSD 0.05			1.1	3.8	6.80	0.6	0.6	0.5	1.1	0.9	30.7	--	--

Planting Date = May 4; Harvest Date = October 21; Previous Crop = Soybean

Table 2. Corn hybrid performance trial (dryland) Dickey County - Oakes Irrigation Research Site 2015.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Height	Plant Height	Grain Protein	Content Starch	Content Oil	Moisture	Test Wt.	Grain Yield 2015	Grain Yield 2 yr. Avg.	Grain Yield 3 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	-----bu/ac-----		
Northstar/Viking	VS 94-571	94	VT2P	81.0	50.3	98.7	9.9	72.9	2.4	14.2	57.8	171.9	--	--
Nuseed	9202 VT2P Rib	92	VT Double Pro	81.0	48.0	97.2	9.9	72.3	2.9	13.8	55.4	191.7	--	--
Nuseed	9504 VT3P Prib	95	VT Triple Pro	80.0	43.4	91.9	9.6	73.4	2.6	14.9	56.4	182.0	180.1	152.1
NuTech/G2 Genetics	5N-290	90	3000GT	82.0	52.4	99.9	10.7	73.4	1.9	14.0	58.5	172.2	--	--
NuTech/G2 Genetics	5G-9302	93	GT/CB/LL	82.3	55.5	98.2	10.6	73.4	1.9	14.5	57.8	169.4	--	--
NuTech/G2 Genetics	5X-894	94	HXT/RR2	81.3	44.7	87.9	10.4	73.6	1.8	13.3	55.2	169.0	184.9	152.1
NuTech/G2 Genetics	5F-196	96	YGCB/Hx1/RR2/LL	80.7	54.7	93.2	9.5	72.6	3.0	14.6	57.7	199.3	--	--
NuTech/G2 Genetics	5F-198	98	YGCB/Hx1/RR2/LL	82.0	49.2	97.6	10.0	72.7	2.6	14.5	58.4	190.5	194.6	--
PFS	76S92	92	VT2PRO	82.7	47.0	93.8	10.4	73.4	2.1	15.7	57.1	183.5	193.0	--
PFS	81W95	95	SMARTSTAX	81.3	49.2	97.2	9.5	72.6	2.5	14.9	56.3	199.5	201.5	--
PFS	55S96	96	VT3PRO	83.3	46.3	92.0	9.5	73.2	2.9	16.1	57.6	183.6	185.9	--
Proseed	1492 VT2P	92	VT2P	81.0	46.6	88.3	9.9	72.3	2.9	13.5	57.7	171.8	--	--
Proseed	1392 VT2P	92	VT2P	82.3	47.2	93.0	9.6	73.1	2.6	14.5	56.5	184.4	--	--
Proseed	1393 VT2P	93	VT2P	80.3	43.9	88.5	9.7	73.0	2.4	14.3	56.6	162.7	167.9	--
Proseed	1495 SS	95	SS	82.7	48.9	98.4	9.5	73.8	2.3	14.7	58.2	194.2	--	--
Proseed	1496 SS	96	SS	83.3	50.1	95.6	10.3	73.7	1.8	15.4	55.6	193.8	--	--
REA	4B931-RIB	93	RR2, Bt, CRW	80.7	47.2	93.5	10.5	73.1	2.1	14.2	58.2	196.3	--	--
REA	4B953-RIB	95	RR2, Bt	83.0	50.2	95.6	10.5	73.7	1.9	14.8	55.0	195.5	197.5	--
REA	4A962-RIB	96	RR2, Bt, CRW	82.3	47.1	94.8	10.7	73.6	1.9	15.8	58.5	167.5	--	--
Renk	RK302	88	CONVENTIONAL	81.7	51.8	98.9	11.0	72.4	2.5	15.0	58.3	191.4	--	--
Renk	RK522SSTX	94	SSTX	82.3	47.0	92.4	10.4	73.4	2.1	15.1	56.9	186.0	192.2	158.8
	MEAN			82.0	48.8	94.7	9.8	73.2	2.4	14.7	57.4	182.7	--	--
	C.V. (%)			0.8	5.6	4.5	4.1	0.6	13.3	5.4	1.1	12.1	--	--
	LSD 0.10			0.9	3.2	5.69	0.5	0.5	0.4	0.9	0.7	25.8	--	--
	LSD 0.05			1.1	3.8	6.80	0.6	0.6	0.5	1.1	0.9	30.7	--	--

Planting Date = May 4; Harvest Date = October 21; Previous Crop = Soybean

Table 2. Corn hybrid performance trial (dryland) Dickey County - Oakes Irrigation Research Site 2015.

Brand	Hybrid	RM	Hybrid Traits[1]	Days to Silk	Ear Height	Plant Height	Grain Protein	Content Starch	Content Oil	Moisture	Test Wt.	Grain Yield 2015	Grain Yield 2 yr. Avg.	Grain Yield 3 yr. Avg.
					inch	inch	%	%	%	%	lb/bu	-----bu/ac-----		
Renk	RK544SSTX	95	SSTX	81.7	48.6	89.6	9.4	73.0	2.8	14.2	58.2	170.5	--	--
Renk	RK568VT3P	95	SSTX	82.0	46.6	90.4	10.2	73.6	2.1	15.5	57.7	175.3	183.3	151.5
Renk	RK568	95	CONVENTIONAL	82.7	44.8	91.1	9.4	74.0	2.0	15.2	57.1	179.3	--	--
Thunder	7993VT2P	93	VT2PRIB	82.7	47.6	95.0	10.0	73.3	2.3	14.6	57.8	178.6	181.9	148.0
Thunder	101-95SS	95	SS	83.0	49.6	95.1	9.2	74.1	2.1	15.5	56.3	177.6	--	--
Thunder	7396VT2P	96	VT2PRIB	81.0	49.6	96.5	9.0	73.7	2.5	14.0	57.3	179.1	187.4	157.2
Thunder	101-97SS	97	SS	84.0	53.7	97.6	10.3	72.7	2.6	14.4	57.5	178.4	--	--
Wensman Seed	W7268VT3PRIB		VT3PRIB	81.7	46.4	91.8	9.9	72.8	2.5	14.4	58.3	193.4	197.5	--
Wensman Seed	W70975VT3PRIB		VT3PRIB	82.7	44.8	89.2	9.1	73.2	3.0	14.4	57.6	184.0	187.4	--
Wensman Seed	W90962STX		STX	82.0	47.2	92.0	11.3	73.0	1.9	14.4	58.8	189.5	--	--
Wensman Seed	W90941STXRIB		STXRIB	81.3	50.1	96.8	10.4	73.6	1.9	15.2	57.2	190.1	189.5	--
Wensman Seed	W90979STXRIB		STXRIB	82.3	46.7	93.8	10.0	73.0	2.6	15.6	58.9	199.2	196.6	--
	MEAN			82.0	48.8	94.7	9.8	73.2	2.4	14.7	57.4	182.7	--	--
	C.V. (%)			0.8	5.6	4.5	4.1	0.6	13.3	5.4	1.1	12.1	--	--
	LSD 0.10			0.9	3.2	5.69	0.5	0.5	0.4	0.9	0.7	25.8	--	--
	LSD 0.05			1.1	3.8	6.80	0.6	0.6	0.5	1.1	0.9	30.7	--	--

Planting Date = May 4; Harvest Date = October 21; Previous Crop = Soybean

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

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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 21 varieties: sixteen sweet Spanish hybrids, two red hybrids and three white hybrids.

MATERIALS AND METHODS

Soil:	Embden sandy loam; pH = 7.2; 2.1% organic matter; soil N 34 lbs/acre; soil P, soil K and soil S were very high.
Previous crop:	2014 – soybean.
Seedbed preparation:	Spring conventional tillage.
Planting:	Direct seeded onions (250,000 seeds/acre) April 15 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 three ft (two rows) wide by 17 ft long. The study had four replications.
Fertilizer:	Broadcast 8 lbs N/acre, 42 lbs P_2O_5/acre, 48 lbs K_2O/acre and 10 lbs S/acre as 9-21-24-6 April 10. Stream bar 30 lbs N/acre June 3, June 29, July 2 and July 24 as 28-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Moxy 2E (4 oz/acre) May 26, Moxy 2E (16 oz/acre) June 4, Section 2EC (8 oz/acre) + COC (1.0% v/v) June 17, Moxy 2E (1.5 pt/acre) + Goal Tender (4 oz/acre) June 23, and hand weeding for weed control.
Harvest:	Pulled all onions September 28 and September 30 and left to field dry/cure. Onions were bagged October 1 and October 2 and were graded November 20 to December 8.

RESULTS

SV6672NW had the highest yield overall with a diameter in the 3- to 4-inch range. Antarctica and Spanish Medallion had the highest yield of onions greater than four inches. With the exception of BGS 322 and 503 (316 cwt/acre and 319 cwt/acre, respectively), total yields ranged from 439 cwt/acre to 989 cwt/acre with a mean of 695 cwt/acre (728 cwt/acre if the two low-yielding varieties were disregarded).

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Table 1. Onion hybrid performance trial at the Oakes Irrigation Research Site in 2015.

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
BGS 322	Bejo		24-Aug	6	61	165	80	316	4	45	145584
Calibra	Bejo	115	26-Aug	16	459	175	39	711	22	85	158557
Calibra	Bejo BV[2]	115	26-Aug	25	448	167	35	711	36	40	153753
Crockett	Bejo	118	12-Sep	8	493	244	31	797	22	65	177056
Delgado	Bejo	115	9-Sep	39	446	135	20	671	32	70	128528
Hamilton	Bejo	118	3-Sep	6	544	175	30	764	10	65	160720
Hamilton	Bejo BV	118	5-Sep	32	516	160	24	743	12	80	148708
Legend	Bejo	118	2-Sep	8	482	238	42	802	33	45	178497
Red Bull	Bejo BV	115	7-Sep	10	404	257	49	724	5	80	178497
Sedona	Bejo	120	5-Sep	23	584	157	15	794	15	85	146545
Sedona	Bejo BV	120	1-Sep	34	602	204	28	881	13	95	174173
SV4643NT	Bejo BV		31-Aug	37	448	145	26	667	12	70	143903
Talon	Bejo	110	28-Aug	3	360	206	50	626	8	75	168647
Tamara	Bejo	112	30-Aug	3	317	175	31	527	2	75	127807
503	BV		26-Aug	17	133	66	52	319	51	40	142221
2011	BV		1-Sep	34	557	215	31	844	7	90	169128
Antarctica	BV	115	5-Sep	51	660	140	14	878	14	50	154474
Blizzard	BV		2-Sep	25	555	203	21	827	23	80	163122
Commendable	Seminis BV	115	2-Sep	8	479	238	32	767	10	90	171050
Scimiter	BV		7-Sep	16	202	112	44	439	66	50	134293
Yellow Diamond	BV		30-Aug	32	518	220	35	825	22	75	178978
Spanish Medallion	Sakata BV		31-Aug	48	328	143	56	594	20	80	153993
SV4643NT	Seminis		27-Aug	44	462	180	34	732	13	95	166966
SV6672NW	Seminis	116	27-Aug	45	690	217	35	989	3	90	194833
Champ	Solar Seeds		24-Aug	0	154	223	58	440	6	85	140059
Mean			1-Sep	23	436	182	36	695	18	72	158403
C.V.(%)			0	88.2	11.1	19.6	23.1	7.4	74.7	31.6	8.2
LSD 0.10			5	23	57	42	10	61	16	NS	15335
LSD 0.05			6.0	NS	68	50	12	72	19	NS	18346

Planted April 15; Pulled/harvested September 29; Previous Crop = Soybean.

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

[1]Maturity given by seed supplier.

[2]BV supplied by Barry Vculek, all seed primed.

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Soybean Variety Trial

L. Besemann and H. Eslinger

Two soybean variety trials were conducted at the Oakes Irrigation Research Site; a Roundup Ready@ trial and a Liberty Link trial. Results for the Roundup Ready trial are listed in Table 1. Results for the Liberty Link trial are listed in Table 2. There were forty-six varieties in the Roundup Ready trial and ten varieties the Liberty Link trial.

MATERIALS AND METHODS

Soil:	Embden loam and Egeland loam; pH = 7.3; 1.8% organic matter; soil N 25 lbs/acre; soil P and soil K were very high; soil S was high.
Previous crop:	2014 – field corn.
Seedbed preparation:	Spring conventional tillage.
Planting:	Planted May 20 in 30-inch rows.
Plots:	Plots were 17 ft long by 5 ft (2 rows) wide. The study had four replications.
Fertilizer:	Broadcast 8 lbs N/acre, 42 lbs P_2O_5/acre, 48 lbs K_2O/acre and 10 lbs S/acre as 9-21-24-6 April 13.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	The Liberty Link and Roundup Ready soybean both received: Trust (1 pt/acre) May 19 weed control; Endura (8 oz/acre) July 8, Proline (5 oz/acre) July 23 controlled disease. Kendo (3 oz/acre) August 11 controlled insects. Additional weed control: Liberty Link soybeans received Liberty (34 oz/acre) + AMS (1.5 lb/10 gal) June 18, Liberty (28 oz/acre) + AMS (1.5 lb/10gal) June 30. The Roundup Ready soybeans received Roundup (30 oz/acre) + AMS (1 lb/10 gal) June 18, Roundup (20 oz/acre) + AMS (1 lb/10gal) June 30.
Harvest:	October 8 with a plot combine.

RESULTS

Yields in the Roundup Ready trial averaged 77.9 bu/acre. Yields in the Liberty Link trial averaged 74.4 bu/acre.

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Table 1. Soybean variety trial (Roundup Ready@) at the Oakes Irrigation Research Site 2015. (Page 1 of 2)

Brand	Variety	Mat Group[1]	Days to PM	Plant Ht.	Plant Lodge[2]	Seeds/ Pound	Seed Oil	Seed Protein	Test Wt	Seed Yield 2015	Seed Yield 2-yr. Ave.	Seed Yield 3-yr. Ave.
				inch	0 to 9		%	%	lb/bu	----bu/ac----		
Credenz	CZ 0767RY	0.7	116.5	39.3	0.0	2229	19.3	34.5	55.0	72.5	--	--
Credenz	CZ 1787 RY	1.7	123.8	41.8	1.3	2780	18.6	34.1	56.1	77.0	--	--
Dairyland Seed	DSR-0619/R2Y	0.6	116.5	30.0	1.0	2300	18.2	35.6	54.0	72.9	--	--
Dairyland Seed	DSR-0711/R2Y	0.7	118.3	39.0	0.0	2374	19.6	32.6	56.1	74.9	69.1	--
Dairyland Seed	DSR-0904/R2Y	0.9	116.8	40.0	0.0	2474	19.2	33.7	55.4	76.5	73.1	73.7
Dairyland Seed	DSR-1120/R2Y	1.1	122.5	37.0	1.3	2197	20.0	33.2	55.5	76.2	69.7	72.3
Dairyland Seed	DSR-1340/R2Y	1.3	122.0	40.0	1.5	2460	18.7	33.6	56.1	75.7	71.7	--
Dyna-Gro	S08RY76	0.8	119.3	35.0	1.0	2376	19.1	33.2	56.1	80.4	--	--
Dyna-Gro	S09RY64	0.9	121.8	35.3	0.8	2630	18.8	33.4	55.9	80.5	73.9	74.2
Dyna-Gro	S12RY44	1.2	119.0	37.3	0.0	2474	18.9	34.2	55.9	78.7	73.6	72.9
Integra	20815N	0.8	118.8	34.0	0.5	2453	19.0	33.5	55.9	78.9	--	--
Integra	20915N	0.9	121.5	36.5	0.5	2609	18.9	33.5	55.3	82.4	--	--
Legacy Seeds	LS-0833N RR	0.8	118.5	35.0	0.5	2466	19.0	33.5	55.2	77.6	--	--
Legacy Seeds	LS-0935N RR	0.9	121.3	32.8	2.0	2338	19.1	33.4	55.7	79.2	--	--
Legacy Seeds	LS-1134N RR	1.1	123.0	29.3	2.8	2460	19.5	33.8	55.4	75.0	--	--
Legacy Seeds	LS-1335N RR	1.3	122.0	38.0	0.5	2467	19.4	33.4	56.1	84.3	--	--
Mustang	9626		118.0	33.8	0.5	2449	19.3	33.2	55.8	81.2	--	--
Mustang	12224		122.0	37.3	1.0	2388	19.2	34.4	55.5	78.0	--	--
NorthStar Genetics	NS 0839NR2	0.8	119.0	37.3	1.0	2513	19.1	33.6	55.6	79.6	--	--
NorthStar Genetics	NS 0941NR2	0.9	118.0	35.5	1.0	2476	19.3	33.1	55.4	77.7	--	--
NorthStar Genetics	NS 0949R2	0.9	118.5	38.8	0.5	2382	19.0	34.3	55.5	72.0	--	--
NorthStar Genetics	NS 1040NR2	1.0	123.8	29.0	4.5	2474	19.5	33.8	55.4	77.1	--	--
NorthStar Genetics	NS1390NR2	1.3	122.5	37.3	0.8	2240	19.0	34.7	55.3	82.3	--	--
NuTech Seed	6097R2 G2 Genetics	0.9	119.8	33.5	1.5	2148	20.6	30.9	55.9	74.5	--	--
NuTech Seed	7104 G2 Genetics	1.0	118.3	37.3	0.5	2247	20.2	33.9	55.4	76.4	--	--
NuTech Seed	7138 G2 Genetics	1.3	122.8	40.0	0.5	2556	19.1	34.1	56.4	73.5	--	--
PFS	14R11N	1.1	119.0	38.0	0.3	2504	18.9	34.2	55.5	76.7	--	--
PFS	14R13	1.3	118.0	43.3	0.0	2185	18.9	34.4	55.6	74.0	--	--
Prairie Brand	PB-0777R2	0.7	118.3	35.0	1.0	2450	19.1	33.6	56.0	78.8	--	--
Prairie Brand	PB-0966R2	0.9	119.8	36.3	0.5	2363	19.1	33.5	55.7	82.2	--	--
Prairie Brand	PB-1234R2	1.2	123.5	37.8	1.0	2295	19.2	34.5	55.7	76.7	--	--
Proseed	30-80	0.8	118.0	34.3	0.5	2514	19.1	33.5	55.4	77.1	--	--
Proseed	PX 509N	0.9	118.8	33.0	0.5	2497	19.3	33.5	55.4	80.1	--	--
Proseed	31-10	1.1	118.5	40.8	0.0	2338	18.8	34.5	55.3	73.3	--	--
	Mean		120.0	36.2	0.9	2426	19.2	33.7	55.6	77.9	--	--
	C.V. (%)		0.9	6.6	92.1	2.3	0.7	0.71	1.2	4.7	--	--
	LSD 0.10		1.3	2.8	1.0	67	0.1	0.28	0.8	4.3	--	--
	LSD 0.05		1.5	3.3	1.1	79	0.2	0.34	0.9	5.1	--	--

Planting Date = May 20; Harvest Date = October 8; Previous Crop = Field corn

Table 1. Soybean variety trial (Roundup Ready@) at the Oakes Irrigation Research Site 2015.

Brand	Variety	Mat Group[1]	Days to PM	Plant Ht.	Plant Lodge[2]	Seeds/ Pound	Seed Oil	Seed Protein	Test Wt.	Seed Yield 2015	Seed Yield 2-yr. Ave.	Seed Yield 3-yr. Ave.
				inch	0 to 9		%	%	lb/bu	----bu/ac----		
Proseed	41-30N		123.5	37.3	1.3	2233	18.8	34.8	55.7	80.3	--	--
REA	R0815	0.8	117.5	36.0	0.0	2669	19.2	33.2	55.6	78.7	74.0	
REA	69G14	0.9	118.5	38.0	0.5	2472	19.3	33.2	56.2	81.0	74.9	76.5
REA	71G14	1.1	120.5	32.5	1.5	2394	19.2	33.7	56.1	77.8	71.9	75.1
Thunder	3408N	0.8	118.0	34.5	0.5	2477	19.1	33.7	55.3	78.2	74.8	--
Thunder	3511N	1.1	123.8	29.3	4.0	2446	19.4	33.9	55.8	73.1	--	--
Thunder	3614N	1.4	123.0	36.3	1.0	2449	19.1	33.7	56.2	82.5	--	--
Wensman	W3080NR2	0.8	118.5	34.5	0.8	2646	19.2	33.2	55.1	79.7	--	--
Wensman	W3090NR2	0.8	117.0	41.0	0.3	2450	19.2	33.8	55.0	76.5	72.4	72.8
Wensman	W3100NR2	1.0	120.8	34.3	0.8	2372	19.1	33.6	55.2	78.6	--	--
Wensman	W3121NR2	1.2	118.8	34.5	0.3	2486	18.9	34.1	55.6	80.2	74.6	75.2
Wensman	W3143NR2	1.4	121.5	37.8	0.8	2426	19.3	33.7	56.1	85.4	--	--
	Mean		120.0	36.2	0.9	2426	19.2	33.7	55.6	77.9	--	--
	C.V. (%)		0.9	6.6	92.1	2.3	0.7	0.71	1.2	4.7	--	--
	LSD 0.10		1.3	2.8	1.0	67	0.1	0.28	0.8	4.3	--	--
	LSD 0.05		1.5	3.3	1.1	79	0.2	0.34	0.9	5.1	--	--

Planting Date = May 20; Harvest Date = October 8; Previous Crop = Field corn

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

[2]Plant Lodge: 0 = no lodging; 9 = plants lying flat.

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Table 2. Soybean variety trial (Liberty Link) at the Oakes Irrigation Research Site 2015.

Brand	Variety	Mat Group[1]	Days to PM	Plant Ht	Plant Lodge[2]	Seeds/ Pound	Seed Oil	Seed Protein	Test Wt	Yield 2015
				inch	0 to 9		%	%	lb/bu	bu/ac
Credenz	CZ 0121LL	0.1	117.0	31.0	0.3	2395	19.4	33.4	55.8	67.1
Credenz	CZ 0525LL	0.5	117.0	36.0	0.8	2333	19.3	34.6	56.4	74.5
Credenz	CZ 0848LL	0.8	119.3	41.0	0.0	2456	18.9	34.6	56.6	71.9
Credenz	CZ 1332LL	1.3	122.0	40.8	0.5	2232	18.2	35.0	57.2	83.3
Credenz	CZ 1623LL		125.0	40.0	2.3	2803	18.1	35.5	57.5	69.9
Credenz	CZ 1845 LL		129.8	32.5	5.5	3170	18.4	34.6	56.3	71.6
NuTech Seed	2086L	0.8	118.5	41.3	0.0	2556	19.0	34.3	56.5	73.6
NuTech Seed	3103L	1.0	123.8	34.8	2.8	2459	19.1	34.5	56.3	74.5
NuTech Seed	3126L	1.2	123.3	42.5	0.8	2184	18.2	35.1	56.9	83.7
Thunder	5411LLN	1.1	123.0	30.8	2.8	2394	19.1	34.5	56.1	73.7
	Mean		121.9	37.1	1.6	2498	18.8	34.6	56.6	74.4
	C.V. (%)		0.9	7.0	76.5	4.0	1.0	1.0	0.8	4.3
	LSD 0.10		1.4	3.1	1.4	119	0.2	0.4	0.6	3.8
	LSD 0.05		1.7	3.8	1.7	144	0.3	0.5	0.7	4.6

Planting Date = May 20; Harvest Date = October 8; Previous Crop = Field corn

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

[2]Plant Lodge: 0 = no lodging; 9 = plants lying flat.

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Sugarbeet Variety Trial

L. Besemann and H. Eslinger

MATERIALS AND METHODS

Soil:	Embden loam and Egeland loam; pH = 7.1; 2.5% organic matter; soil N 14 lbs/acre; soil P and soil K were very high; soil S was high.
Previous crop:	2014 – wheat and sunflower.
Seedbed preparation:	Spring conventional tillage.
Planting:	Planted May 27 in 22-inch rows.
Plots:	Plots were 17 ft long by 7⅓ ft (4 rows) wide. The study had four replications.
Fertilizer:	Broadcast 8 lbs N/acre, 42 lbs P_2O_5/acre, 48 lbs K_2O/acre and 10 lbs S/acre as 9-21-24-6 April 14. Stream bar 60 lbs N/acre as 28-0-0 June 16 and July 2. Stream bar 80 lbs N/acre July 23 as 28-0-0.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Roundup (20 oz/acre) + AMS (1 lb/10 gal) June 5 and June 23 plus hand weeding controlled weeds.
Harvest:	October 26, harvest area was an eight foot section from the center two rows of each plot.

Table 1. Root yield of sugarbeet grown at the Oakes Irrigation Reseach Site in 2015.

Supplier	Variety	Field Yield	Yield[1]
			ton/ac
Beta Seed	X403	45.3	41.0
Beta Seed	X406	46.3	41.9
Beta Seed	X525	48.5	43.9
SES Vanderhave	SURR1141E	49.3	44.6
SES Vanderhave	SURR1142E	44.5	40.3
SES Vanderhave	SURR1143E	49.3	44.6
Syngenta	SY 1404	44.9	40.6
Syngenta	SY 1405	47.8	43.3
Syngenta	SY 1406	44.0	39.8
Mean		46.6	42.2
C.V. (%)		6.8	6.8
LSD 0.10		3.8	3.5
LSD 0.05		4.6	4.2

Planting date = May 27; Harvest date = October 19
Previous crop = sunflower or spring wheat
[1]Yield after an averaged tare weight was subtracted.

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Mosaic Soybean Study

K. Mann, L. Besemann and H. Eslinger

MATERIALS AND METHODS

Soil:	Maddock sandy loam; pH = 7.5; 1.4% organic matter; soil N 20 lbs/acre; soil P was very high; soil K and soil S was medium.
Previous crop:	2014 – potato.
Seedbed preparation:	Spring conventional tillage.
Hybrid:	Dairyland 0404 R2YVT
Planting:	May 22 in 30-inch rows.
Plots:	Plots were 40 ft long by 10 ft (4 rows) wide. The study had four replications.
Fertilizer:	Broadcast and incorporated treatments (see Table 1) May 21.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Trust (1 pt/acre) May 19, Roundup (30 oz/acre) + AMS (1 lb/10 gal) June 17, Roundup (20 oz/acre) + AMS (1 lb/10 gal) June 30, controlled weeds. Endura (8 oz/acre) July 8, Proline (5 oz/acre) July 23, controlled disease, Kendo (3 oz/acre) August 11, controlled insects.
Harvest:	October 8 with a plot combine. Harvest area was the center two rows, 37 feet long.

Mosaic soybean study

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Table 1. Specific details associated with treatments within the Mosaic soybean study.

Entry No.	Treatment	Formulation	Product	Formulation
				lb nutrient/acre
1	MAP	52% P2O5	11-52-0	40
2	MAP	52% P2O5	11-52-0	40
2	MOP	60% K2O	0-0-60	60
3	MAP	52% P2O5	11-52-0	40
3	Aspire	58% K2O	0-0-58-0.5B	60
4	MAP	52% P2O5	11-52-0	40
4	MOP	60% K2O	0-0-60	60
4	Granubor Preplant	14.3%	0-0-0-14.3B	0.5
5	MAP	52% P2O5	11-52-0	40
5	MOP	60% K2O	0-0-60	60
5	Granubor Preplant	14.3%	0-0-0-14.3B	1.0
6	MAP	52% P2O5	11-52-0	40
6	MOP	60% K2O	0-0-60	60
6	Granubor Preplant	14.3%	0-0-0-14.3B	2.0
7	MESZ	40% P2O5	12-40-0-10S-1Zn	40
7	MOP	60% K2O	0-0-60	60
8	MESZ	40% P2O5	12-40-0-10S-1Zn	40
8	Aspire	58% K2O	0-0-58-0.5B	60

Table 2. Agronomic data for the Mosaic soybean study at the Oakes Irrigation Research Site 2015.

Treatment	Population	Plant Lodge	Moisture	Test Wt	Yield 2015
	plants/ac	0 to 9	%	lb/bu	bu/ac
MAP	141570	0	11.5	55.9	72.9
MAP + MOP	140046	0	11.7	56.3	72.3
MAP + Aspire	139174	0	11.5	56.3	71.9
MAP + MOP + Granubor Preplant	138956	0	11.4	56.4	73.2
MAP + MOP + Granubor Preplant	137214	0	11.4	56.1	71.5
MAP + MOP + Granubor Preplant	137650	0	11.3	56.8	71.8
MESZ + MOP	145273	0	11.4	56.3	72.2
MESZ + Aspire	143312	0	11.6	56.5	72.6
Mean	140399		11.5	56.3	72.3
C.V. (%)	2.7		1.7	0.9	3.1
LSD 0.10	4587		NS	NS	NS
LSD 0.05	NS		NS	NS	NS

Planting Date = May 22; Harvest Date = October 8; Previous Crop = Potato

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Defining Glyphosate and Dicamba Drift Injury Thresholds in Potatoes

H. Hatterman-Valenti, A. Robinson, C. Auwarter, A. Crook, and E. Brandvik

A field study was conducted to correlate plant injury in potatoes to results a producer would receive from lab analysis of leaf tissue when off-target movement of glyphosate, dicamba, or the combination of both herbicides is suspected. Russet Burbank seed pieces were planted May 22. Simulated drift doses of glyphosate at 0.2, 0.04, 0.007 lb ai/acre, dicamba at 0.09, 0.02, 0.004 lb ai/acre; and glyphosate + dicamba at 0.2+0.09, 0.04+0.02, 0.007+0.004 lb ai/acre were applied to plants at the tuber initiation stage (July 7) using a CO_2 sprayer equipped with 8002 nozzles at 40 psi and an output of 20 GPA. Visual injury ratings and tissue sample collection occurred 10 and 20 days after application. Tissue samples were sent to South Dakota Agricultural Laboratories for residue analysis. Two of the four treated rows were harvested and graded to evaluate herbicide effect on potato yield and grade.

Summary: The highest dicamba dose (0.02 lb) alone or with glyphosate caused the most visible injury. The highest dicamba dose alone or with glyphosate reduced the total and marketable yield compared to the untreated. More undersized tubers (< 4 oz) were formed when plants received dicamba (0.09 or 0.02 lb) alone or with glyphosate.

Table 1. Defining glyphosate and dicamba drift injury thresholds in potatoes at the Oakes Irrigation Research Site in 2015.

		Rate	Injury	No. 2	No. 1						No. 2
No.	Treatment	(lb ai/ac)	(20 DAA)	< 4 oz	< 4 oz	4-6 oz	6-10 oz	10-14 oz	> 14 oz	Total	> 4 oz
			--- % ---	----------	----------	----------	----------	cwt/acre	----------	----------	----------
1	Untreated		0	5	48	79	152	50	14	403	294	57
2	Glyphosate	0.2	10	37	44	65	93	30	7	455	196	178
3	Glyphosate	0.04	0	5	56	108	139	43	7	421	297	63
4	Glyphosate	0.007	0	3	56	84	140	41	17	413	283	71
5	Dicamba	0.09	49	119	16	16	5	0	0	321	21	165
6	Dicamba	0.02	31	73	32	30	22	4	1	396	57	235
7	Dicamba	0.004	30	15	63	89	109	40	6	426	244	104
8	Glyphosate Dicamba	0.2 0.09	50	148	12	5	4	1	0	306	10	137
9	Glyphosate Dicamba	0.04 0.02	28	65	36	32	29	3	0	400	64	236
10	Glyphosate Dicamba	0.007 0.004	30	11	60	81	127	42	7	431	257	103
LSD (0.05)			4	24	20	28	49	20	7	63	87	66

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Evaluation of Plant Populations and Row Spacing for Management of Sclerotinia in Soybeans

M. Wunsch, M. Schaefer, B. Kraft and S. Kallis, L. Besemann, H. Eslinger

METHODS

General Agronomics: The study was on a Maddock sandy loam soil type. The previous crop was onion on replicate one and soybean on replicates two to six. The tillage operation consisted of disking once with a Wishek disk (April 14) followed by three passes with a multiweeder; once (April 29) to level the seedbed and twice to incorporate the herbicide (May 19). The maintenance herbicide applications were Trust (4 lbs/gal trifluralin; Winfield Solutions) applied at 1 pt/acre preplant incorporated (May 19) Roundup Power Max 30 oz/acre (June 17), and Roundup Power Max 20 oz/acre (June 30).

Experimental design: A completely randomized split-split block design with six replicates. Main factor = variety, sub-factor = seeding rate (132,000; 165,000; or 198,000 pure live seeds per acre), sub-sub-factor = row spacing (7, 14, 21, or 28 inches). The row spacing treatments – 28 inches (two rows per plot), 21 inches (three rows per plot), 14 inches (four rows per plot), and 7 inches (seven rows per plot. 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.

To maintain a constant distance between the outermost rows of adjacent plots, a filler plot with 14-inch row spacing was established on both sides of each of the 2-row plots seeded to 28-inch row spacing. For plots with 7-, 14-, and 21-inch row spacing, the distance between the outermost rows of adjacent plots was 18 inches. For plots with 28-inch row spacing, the distance between the outermost row of the adjacent (filler) plots and the soybeans was 25 inches.

Planting details: The study was planted on May 21, 2015. Seed treatments used were Apron Maxx RTA (5.0 fl oz/100 lbs seed) + Imidacloprid 4ST (3 fl oz/100 lbs seed). *Imidacloprid 4ST (Willowood) contains 4 lbs/gal thiamethoxam; Apron Maxx RTA (Syngenta) contains 0.096 lb/gal mefenoxam and 0.064 lb/gal fludioxonil.* Cell-Tech granular inoculum for soybean (minimum 100 million *Bradyrhizobium japonicum* viable cells/gr; Novozymes, Saskatoon, SK) was applied in-furrow 17.2 lb/acre.

Plant establishment: Soybean establishment was assessed June 11 when the soybeans were at the VC to V1 growth stage (predominant V1) by counting all plants along the full length of the plot in rows 2, 3, 5, and 6 of each 7-row plot (7-in. row spacing), rows 2 and 3 of each 4-row plot (14-in. row spacing), row 2 of each 3-row plot (21-in. row spacing), and the northern row of each 2-row plot (28-in. row spacing).

Bloom initiation: Bloom initiation, defined as 80 to 90% of plants at the R1 growth stage, was assessed every 2 to 3 days from the appearance of blossom until all varieties had reached 80-90% R1 by evaluating 10 immediately adjacent plants in each plot.

Canopy closure and height: The date that the ground could no longer be seen between rows within a plot was recorded for every plot by evaluating plots every 2 to 3 days as the canopy began to close in the bushiest variety until the canopy closed. Height of the canopy was assessed in one location per plot when the soybeans in that plot reached the R3 growth stage.

Number of nodes: The number of nodes per plant was assessed on one plant per plot when the soybeans in that plot reached the R3 growth stage.

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End-of-season plant population: Population was assessed concurrently with disease assessments on October 2-6 at the R8 growth stage by counting all plants along the full length of the plot in rows 2, 3, 5, and 6 of each 7-row plot (7-in. row spacing), rows 2 and 3 of each 4-row plot (14-in. row spacing), row 2 of each 3-row plot (21-in. row spacing), and the northern row of each 2-row plot (28-in. row spacing).

Disease assessments - in-season: Sclerotinia incidence and severity were assessed August 12 and August 20 on 50 plants per plot 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. The first 50 plants (from the east) along the southern row of each 2-row plot (28-inch row spacing), along the middle row of each 3-row plot (21-inch row spacing), along the second row from the south of each 4-row plot (14-inch row spacing), and along the second and third rows from the south of each 7-row plot (7-inch row spacing) were evaluated. If there were insufficient plants in the designated rows, the remainder of the 50 plants were evaluated in the next row to the north within the plot starting at the west end of the additional row.

Disease assessments - end of season: Sclerotinia incidence and severity were assessed October 2-6 at the R8 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. All plants were assessed along the full length of the plot in rows 2, 3, 5, and 6 of each 7-row plot (7-in. row spacing), rows 2 and 3 of each 4-row plot (14-in. row spacing), row 2 of each 3-row plot (21-in. row spacing) and the northern row of each 2-row plot (28-in. row spacing). An average of 117 plants and minimum of 46 plants were assessed in each plot.

Disease establishment and irrigation: The trial was established on a site with a previous history of Sclerotinia epidemics. To sustain the soil moisture necessary for apothecia development, the trial was irrigated aggressively to create conditions favorable for apothecia production and Sclerotinia infection.

Harvest, seed yield and quality assessment: The soybeans were harvested October 7. Yields were calculated on the basis of a 5-ft plot width and the measured plot length. The seed moisture was assessed after the grain was cleaned. The seed yield and quality results were adjusted from the actual grain moisture to a standard 13% moisture level. The percent of sclerotia by weight in the harvested grain was assessed by manually removing all sclerotia from a 200-gram subsample of grain from each plot.

Commentary: Sclerotinia disease development was low in this trial due to high temperatures and low relative humidity experienced in July and August.

Management of Sclerotinia in Soybeans

We appreciate partial financial support for this project form the North Dakota Soybean Council.

Evaluation of plant populations and row spacing for management of Sclerotinia in soybeans at Oakes, ND (2015)

Dairyland 'DSR-0404/R2Y' (0.4 maturity, moderately susceptible to Sclerotinia)

			Plant population		Days			Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested grain	13% moisture		
			VC-V1	R8	bloom to canopy closure	bloom to maturity	canopy clos. to maturity	(cm)	(number)	(%) ‡	(0-3)		Yield	Test weight	Seeds per lb
	plants/ac		June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1	**120,000**	**7-inch**	**137511**	**129608**	**-8** a*	**63**	**72**	**74**	**10**	**5** a*	**0.15** a*	**0.23** b*	**61** ab	**55.8** a*	**2797** a*
2	**120,000**	**14-inch**	**141798**	**129738**	**-7** a	**63**	**71**	**77**	**10**	**5** a	**0.14** a	**0.05** a	**67** a	**56.0** a	**2813** a
3	**120,000**	**21-inch**	**129992**	**120422**	**1** b	**63**	**62**	**76**	**9**	**4** a	**0.09** a	**0.07** ab	**66** a	**56.1** a	**2805** a
4	**120,000**	**28-inch**	**142569**	**127675**	**5** c	**63**	**59**	**81**	**10**	**4** a	**0.11** a	**0.05** ab	**59** b*	**55.6** a	**2757** a
		F:			142.40					0.66	0.52	3.62	6.13	0.87	1.47
		P>F:			< 0.0001					0.6047	0.6780	0.0381	0.0062	0.4802	0.2626
		CV:			-52.7					34.7	70.1	110.2	6.0	0.9	1.8
1	**150,000**	**7-inch**	**174968**	**160656**	**-8** a*	**64**	**72**	**82**	**10**	**3** a*	**0.07** a*	**0.14** b*	**64** b*	**55.8** a*	**2753** a*
2	**150,000**	**14-inch**	**170837**	**152554**	**-7** a	**64**	**71**	**81**	**9**	**4** a	**0.12** a	**0.09** ab	**63** b	**55.8** a	**2785** a
3	**150,000**	**21-inch**	**178370**	**164410**	**0** b	**64**	**64**	**79**	**9**	**3** a	**0.09** a	**0.04** a	**70** a	**55.8** a	**2748** a
4	**150,000**	**28-inch**	**162018**	**146338**	**5** c	**64**	**59**	**82**	**9**	**2** a	**0.05** a	**0.08** ab	**60** b	**55.6** a	**2748** a
		F:			206.92					2.86	1.60	4.18	10.07	1.12	0.41
		P>F:			< 0.0001					0.0718	0.2314	0.0245	0.0007	0.3719	0.7482
		CV:			-47.3					42.1	65.3	58.1	4.9	0.4	2.5
1	**180,000**	**7-inch**	**213235**	**189164**	**-8** a*	**64**	**72**	**81**	**10**	**2** b*	**0.06** ab*	**0.04** a*	**66** a*	**55.9** a*	**2757** a*
2	**180,000**	**14-inch**	**204132**	**183122**	**-7** a	**64**	**72**	**82**	**8**	**2** b	**0.06** ab	**0.07** a	**68** a	**55.7** a	**2715** a
3	**180,000**	**21-inch**	**198152**	**173569**	**-1** b	**64**	**66**	**83**	**10**	**4** b	**0.12** b	**0.10** a	**70** a	**55.8** a	**2716** a
4	**180,000**	**28-inch**	**204603**	**177543**	**4** c	**64**	**60**	**83**	**10**	**0** a	**0.01** a	**0.04** a	**60** b	**55.6** a	**2696** a
		F:			145.60					12.99	5.11	1.66	13.77	0.39	2.51
		P>F:			< 0.0001					0.0002	0.0124	0.2179	0.0001	0.7649	0.0986
		CV:			-37.1					40.0	79.0	85.7	4.2	0.6	1.5

Dairyland 'DSR-0747/R2Y' (0.7 maturity, tolerant to Sclerotinia)

			Plant population		Days bloom to canopy closure	Days bloom to maturity	Days canopy clos. to maturity	Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested grain	13% moisture		
			VC-V1	R8				(cm)	(number)	(%) ‡	(0-3)		Yield	Test weight	Seeds per lb
	plants/ac		June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1	**120,000**	**7-inch**	**132161**	**122653**	**-3** a*	**78**	**81**	**80**	**11**	**2** a*	**0.05** a*	**0.01** a*	**72** ab*	**57.0** a*	**2579** a*
2	**120,000**	**14-inch**	**136302**	**124952**	**-1** a	**78**	**79**	**80**	**11**	**2** a	**0.05** a	**0.01** a	**75** a	**57.2** a	**2579** a
3	**120,000**	**21-inch**	**130575**	**123023**	**6** b	**78**	**72**	**81**	**10**	**2** a	**0.04** a	**0.06** a	**77** a	**57.3** a	**2584** a
4	**120,000**	**28-inch**	**140250**	**124547**	**11** c	**76**	**65**	**88**	**10**	**2** a	**0.06** a	**0.02** a	**65** b	**57.0** a	**2553** a
		F:			277.51					0.67	0.23	1.05	7.69	1.01	0.56
		P>F:			< 0.0001					0.5835	0.8772	0.4012	0.0024	0.4145	0.6465
		CV:			29.5					64.0	60.0	212.8	6.5	0.6	1.7
1	**150,000**	**7-inch**	**145330**	**130689**	**-4** a*	**78**	**81**	**83**	**10**	**2** a*	**0.06** a*	**0.02** a*	**73** ab*	**57.0** a*	**2593** a*
2	**150,000**	**14-inch**	**162412**	**144442**	**-2** a	**78**	**80**	**83**	**10**	**4** a	**0.11** a	**0.08** a	**73** ab	**57.1** a	**2526** a
3	**150,000**	**21-inch**	**172454**	**155818**	**5** b	**78**	**73**	**84**	**10**	**3** a	**0.07** a	**0.03** a	**78** a	**57.0** a	**2533** a
4	**150,000**	**28-inch**	**164085**	**140021**	**10** c	**76**	**66**	**90**	**10**	**0** a	**0.01** a	**0.02** a	**69** b	**57.1** a	**2513** a
		F:			108.28					0.96	0.59	0.98	5.02	0.31	2.76
		P>F:			< 0.0001					0.4387	0.6332	0.4266	0.0132	0.8155	0.0787
		CV:			64.7					133.1	202.0	179.3	6.0	0.5	2.1
1	**180,000**	**7-inch**	**210545**	**185610**	**-4** a*	**78**	**82**	**83**	**9**	**3** a*	**0.09** a*	**0.02** a*	**74** b*	**57.1** a*	**2519** a*
2	**180,000**	**14-inch**	**204742**	**182177**	**-3** b	**78**	**81**	**84**	**9**	**3** a	**0.08** a	**0.04** a	**74** b	**57.0** a	**2507** a
3	**180,000**	**21-inch**	**197015**	**179455**	**6** c	**78**	**72**	**83**	**9**	**3** a	**0.09** a	**0.04** a	**80** a	**56.8** a	**2539** a
4	**180,000**	**28-inch**	**200583**	**176369**	**10** d	**76**	**66**	**86**	**10**	**2** a	**0.05** a	**0.02** a	**67** c	**57.1** a	**2517** a
		F:			359.85					0.32	0.21	0.22	21.48	1.68	0.45
		P>F:			< 0.0001					0.8140	0.8891	0.8831	< 0.0001	0.2142	0.7229
		CV:			37.3					66.1	110.9	176.6	4.0	0.5	2.0

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SUMMARY - Row Spacing Dairyland 'DSR-0404/R2Y' (0.4 maturity, moderately susceptible to Sclerotinia)

			Plant population		Days bloom to canopy closure	Days bloom to maturity	Days canopy clos. to maturity	Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested grain	13% moisture Yield	Test weight	Seeds per lb
			VC-V1	R8				(cm)	(number)	(%) ‡	(0-3)				
	plants/ac		June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1	**Average**	**7-inch**	**175238**	**159809**	**-8** a*	**64**	**72**	**79**	**10**	**4** ab*	**0.09** a*	**0.14** b*	**64** b*	**55.8** a*	**2769** a*
2	**Average**	**14-inch**	**172256**	**155138**	**-7** a	**64**	**71**	**80**	**9**	**4** b	**0.11** a	**0.07** a	**66** ab	**55.8** a	**2771** a
3	**Average**	**21-inch**	**168838**	**152800**	**0** b	**64**	**64**	**79**	**9**	**4** ab	**0.10** a	**0.07** ab	**69** a	**55.9** a	**2756** a
4	**Average**	**28-inch**	**169730**	**150518**	**5** c	**64**	**59**	**82**	**9**	**2** a	**0.06** a	**0.06** a	**60** c	**55.6** a	**2734** a
		F:			477.86					Signific. Trt x Pop	2.09	Signific. Trt x Pop	24.12	1.63	1.79
		P>F:			< 0.0001					Interaction	0.1143	Interaction	< 0.0001	0.1964	0.1621
		CV:			-45.1					41.7	72.8	93.3	5.1	0.7	2.0
SUMMARY - Seeding Rate Dairyland 'DSR-0404/R2Y' (0.4 maturity, moderately susceptible to Sclerotinia)															
1	**120,000/ac**	**Average**	**137968**	**126861**	**-3** a*	**63**	**66**	**77**	**10**	**5** a*	**0.12** a*	**0.10** a*	**63** a*	**55.9** a*	**2793** b*
2	**150,000/ac**	**Average**	**171549**	**155989**	**-2** a	**64**	**67**	**81**	**9**	**3** a	**0.09** a	**0.09** a	**64** a	**55.7** a	**2759** ab
3	**180,000/ac**	**Average**	**205031**	**180849**	**-3** a	**64**	**67**	**82**	**9**	**2** a	**0.06** a	**0.06** a	**66** a	**55.8** a	**2721** a
		F:			2.07					Signific. Trt x Pop	3.57	Signific. Trt x Pop	3.10	1.94	6.78
		P>F:			0.1771					Interaction	0.0678	Interaction	0.0894	0.1938	0.0138
		CV:			-45.1					41.7	72.8	93.3	5.1	0.7	2.0
SUMMARY - Row Spacing Dairyland 'DSR-0747/R2Y' (0.7 maturity, tolerant to Sclerotinia)															
1	**Average**	**7-inch**	**162678**	**146317**	**-4** a*	**78**	**81**	**82**	**10**	**2** a*	**0.07** a*	**0.02** a*	**73** b*	**57.0** a*	**2564** a*
2	**Average**	**14-inch**	**167819**	**150524**	**-2** b	**78**	**80**	**82**	**10**	**3** a	**0.08** a	**0.04** a	**74** b	**57.1** a	**2537** a
3	**Average**	**21-inch**	**166681**	**152766**	**6** c	**78**	**72**	**82**	**10**	**3** a	**0.07** a	**0.04** a	**79** a	**57.1** a	**2552** a
4	**Average**	**28-inch**	**168306**	**146979**	**10** d	**76**	**66**	**88**	**10**	**2** a	**0.04** a	**0.02** a	**67** c	**57.1** a	**2528** a
		F:			597.13					0.26	0.58	0.83	26.00	0.10	1.89
		P>F:			< 0.0001					0.8506	0.6340	0.4861	< 0.0001	0.9607	0.1456
		CV:			43.1					87.5	143.3	188.4	5.6	0.5	1.9
SUMMARY - Seeding Rate Dairyland 'DSR-0747/R2Y' (0.7 maturity, tolerant to Sclerotinia)															
1	**120,000/ac**	**Average**	**134822**	**123794**	**3** a*	**78**	**74**	**82**	**10**	**2** a*	**0.05** a*	**0.03** a*	**72** a*	**57.1** a*	**2574** a*
2	**150,000/ac**	**Average**	**161070**	**142743**	**2** a	**77**	**75**	**85**	**10**	**2** a	**0.06** a	**0.04** a	**73** a	**57.0** a	**2541** a
3	**180,000/ac**	**Average**	**203221**	**180903**	**2** a	**78**	**75**	**84**	**9**	**3** a	**0.08** a	**0.03** a	**74** a	**57.0** a	**2521** a
		F:			1.93					2.21	2.76	0.49	0.69	2.12	3.90
		P>F:			0.1951					0.1602	0.1114	0.6260	0.5235	0.1704	0.0561
		CV:			43.1					87.5	143.3	188.4	5.6	0.5	1.9

Pioneer 'P07T50R' (0.7 maturity; Sclerotinia rating of 2, where 10 is best)

			Plant population		Days bloom to canopy closure	Days bloom to maturity	Days canopy clos. to maturity	Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested grain	13% moisture		
			VC-V1	R8				(cm)	(number)	(%) ‡	(0-3)		Yield	Test weight	Seeds per lb
	plants/ac		June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1	**120,000**	**7-inch**	**125734**	**117340**	**-11** a*	**63**	**74**	**75**	**12**	**7** a*	**0.19** a*	**0.17** a*	**67** b*	**56.3** a*	**2508** a*
2	**120,000**	**14-inch**	**128086**	**120475**	**-9** b	**63**	**72**	**76**	**11**	**9** a	**0.26** a	**0.15** a	**70** ab	**56.5** a	**2488** a
3	**120,000**	**21-inch**	**126579**	**116314**	**-2** c	**63**	**65**	**78**	**11**	**9** a	**0.24** a	**0.17** a	**74** a	**56.1** a	**2503** a
4	**120,000**	**28-inch**	**139271**	**121684**	**4** d	**63**	**60**	**82**	**11**	**7** a	**0.20** a	**0.13** a	**64** bc	**56.4** a	**2497** a
		F:			243.81					0.21	0.37	0.34	9.11	1.57	0.10
		P>F:			< 0.0001					0.8907	0.7782	0.7961	0.0011	0.2374	0.9581
		CV:			-23.0					36.2	57.1	52.2	5.0	0.6	2.7
1	**150,000**	**7-inch**	**161083**	**160573**	**-11** a*	**63**	**74**	**80**	**10**	**6** a*	**0.18** a*	**0.18** a*	**67** a*	**56.6** a*	**2535** b*
2	**150,000**	**14-inch**	**173437**	**154135**	**-10** a	**63**	**73**	**76**	**11**	**9** a	**0.28** a	**0.28** a	**70** a	**56.6** a	**2476** ab
3	**150,000**	**21-inch**	**157422**	**146604**	**-3** b	**63**	**66**	**81**	**9**	**7** a	**0.20** a	**0.11** a	**71** a	**56.2** a	**2472** a
4	**150,000**	**28-inch**	**155727**	**135315**	**3** c	**63**	**60**	**84**	**11**	**7** a	**0.19** a	**0.15** a	**60** b	**56.7** a	**2518** ab
		F:			109.51					0.49	0.42	0.57	14.38	1.30	4.28
		P>F:			< 0.0001					0.6922	0.7381	0.6412	0.0001	0.3095	0.0227
		CV:			-29.8					50.7	83.1	126.7	4.9	0.8	1.5
1	**180,000**	**7-inch**	**187966**	**172611**	**-11** a*	**64**	**75**	**81**	**10**	**6** a*	**0.17** a*	**0.07** a*	**69** b*	**56.2** a*	**2521** a*
2	**180,000**	**14-inch**	**206771**	**189538**	**-10** a	**63**	**73**	**79**	**9**	**4** a	**0.12** a	**0.08** a	**73** a	**56.4** a	**2505** a
3	**180,000**	**21-inch**	**190883**	**175203**	**-4** b	**63**	**67**	**83**	**10**	**6** a	**0.17** a	**0.16** a	**74** a	**56.4** a	**2495** a
4	**180,000**	**28-inch**	**206103**	**184443**	**2** c	**63**	**61**	**82**	**10**	**7** a	**0.19** a	**0.18** a	**64** c	**56.4** a	**2483** a
		F:			170.83					0.25	0.66	1.89	23.05	0.21	0.84
		P>F:			< 0.0001					0.8601	0.5875	0.1752	< 0.0001	0.8863	0.4911
		CV:			-20.4					35.9	51.5	82.4	3.6	0.8	1.7

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Pioneer '90Y90' (0.9 maturity; Sclerotinia rating of 5, where 10 is best)

			Plant population		Days bloom to canopy closure	Days bloom to maturity	Days canopy clos. to maturity	Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested grain	13% moisture		
			VC-V1	R8				(cm)	(number)	(%) ‡	(0-3)		Yield	Test weight	Seeds per lb
	plants/ac		June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1	**120,000**	**7-inch**	**130417**	**121222**	**-8** a*	**66**	**74**	**85**	**11**	**1** a*	**0.03** a*	**0.07** a*	**69** a*	**56.7** a*	**2239** a*
2	**120,000**	**14-inch**	**135139**	**125324**	**-6** a	**66**	**73**	**86**	**10**	**3** a	**0.09** a	**0.08** a	**73** a	**56.8** a	**2247** a
3	**120,000**	**21-inch**	**138089**	**127975**	**2** b	**66**	**64**	**81**	**11**	**2** a	**0.06** a	**0.10** a	**73** a	**56.6** a	**2256** a
4	**120,000**	**28-inch**	**133664**	**119712**	**7** c	**66**	**60**	**84**	**10**	**2** a	**0.05** a	**0.02** a	**63** b*	**56.6** a	**2255** a
		F:			194.30					1.02	1.19	0.91	11.79	0.55	0.11
		P>F:			< 0.0001					0.4135	0.3485	0.4605	0.0003	0.6537	0.9540
		CV:			-89.8					76.4	96.0	134.7	4.6	0.6	2.5
1	**150,000**	**7-inch**	**152656**	**142383**	**-8** a*	**66**	**75**	**84**	**9**	**1** a*	**0.04** a*	**0.07** a*	**71** b*	**56.6** a*	**2275** b*
2	**150,000**	**14-inch**	**168223**	**153817**	**-7** a	**66**	**73**	**81**	**10**	**3** a	**0.07** a	**0.04** a	**73** ab	**56.7** a	**2232** ab
3	**150,000**	**21-inch**	**168238**	**157844**	**1** b	**66**	**65**	**84**	**9**	**2** a	**0.06** a	**0.03** a	**76** a	**56.5** a	**2227** ab
4	**150,000**	**28-inch**	**168637**	**149400**	**6** c	**66**	**60**	**85**	**9**	**0** a	**0.01** a	**0.04** a	**66** c	**56.8** a	**2223** a
		F:			284.67					0.96	0.52	0.55	16.97	1.22	3.41
		P>F:			< 0.0001					0.4358	0.6723	0.6566	< 0.0001	0.3353	0.0450
		CV:			-54.8					138.2	210.7	106.2	3.5	0.4	1.4
1	**180,000**	**7-inch**	**197522**	**181178**	**-8** a*	**67**	**75**	**85**	**9**	**2** ab*	**0.05** ab*	**0.03** ab*	**73** a*	**56.8** a*	**2229** a*
2	**180,000**	**14-inch**	**197999**	**182134**	**-6** a	**67**	**73**	**84**	**9**	**2** ab	**0.05** ab	**0.04** ab	**77** a	**57.0** a	**2201** a
3	**180,000**	**21-inch**	**196270**	**178455**	**1** b	**67**	**65**	**83**	**9**	**3** b	**0.07** b	**0.10** b	**77** a	**56.8** a	**2231** a
4	**180,000**	**28-inch**	**202868**	**180861**	**6** c	**67**	**61**	**86**	**9**	**0** a	**0.00** a	**0.00** a	**67** b*	**56.6** a	**2210** a
		F:			209.81					5.14	3.46	3.58	14.58	0.87	1.07
		P>F:			< 0.0001					0.0121	0.0435	0.0393	0.0001	0.4775	0.3897
		CV:			-61.1					66.6	87.9	120.9	4.2	0.7	1.6

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SUMMARY - Row Spacing		Pioneer 'P07T50R' (0.7 maturity; Sclerotinia rating of 2, where 10 is best)												
				Days									13% moisture	
		Plant population		bloom to	bloom to	canopy clos.	Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested			
		VC-V1	R8	canopy closure	maturity	to maturity	(cm)	(number)	(%) ‡	(0-3)	grain	Yield	Test weight	Seeds per lb
plants/ac		June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1 **Average**	**7-inch**	**158261**	**150175**	**-11** a*	**63**	**74**	**79**	**11**	**6** a*	**0.18** a*	**0.14** a*	**68** b*	**56.4** a*	**2521** a*
2 **Average**	**14-inch**	**169431**	**154716**	**-9** b	**63**	**73**	**77**	**10**	**8** a	**0.22** a	**0.17** a	**71** ab	**56.5** a	**2490** a
3 **Average**	**21-inch**	**158295**	**146040**	**-3** c	**63**	**66**	**81**	**10**	**7** a	**0.20** a	**0.15** a	**73** a	**56.2** a	**2490** a
4 **Average**	**28-inch**	**167034**	**147147**	**3** d	**63**	**60**	**83**	**11**	**7** a	**0.19** a	**0.15** a	**62** c	**56.5** a	**2499** a
	F:			466.30					0.07	0.31	0.15	40.66	1.69	1.54
	P>F:			< 0.0001					0.9757	0.8213	0.9293	< 0.0001	0.1824	0.2170
	CV:			-24.8					41.6	67.5	89.9	4.5	0.7	2.0
SUMMARY - Seeding Rate		Pioneer 'P07T50R' (0.7 maturity; Sclerotinia rating of 2, where 10 is best)												
1 **120,000/ac**	**Average**	**129918**	**118953**	**-4** a*	**63**	**68**	**78**	**11**	**8** a*	**0.22** a*	**0.16** a*	**68** a*	**56.3** a*	**2499** a*
2 **150,000/ac**	**Average**	**161917**	**149157**	**-5** ab	**63**	**68**	**80**	**10**	**7** a	**0.21** a	**0.18** a	**67** a	**56.5** a	**2500** a
3 **180,000/ac**	**Average**	**197931**	**180449**	**-6** b	**63**	**69**	**81**	**10**	**6** a	**0.16** a	**0.12** a	**70** a	**56.3** a	**2501** a
	F:			8.36					0.21	0.54	0.84	1.58	2.72	0.01
	P>F:			0.0073					0.8134	0.5990	0.4581	0.2529	0.1140	0.9871
	CV:			-24.8					41.6	67.5	98.9	4.5	0.7	2.0
SUMMARY - Row Spacing		Pioneer '90Y90' (0.9 maturity; Sclerotinia rating of 5, where 10 is best)												
1 **Average**	**7-inch**	**160198**	**148261**	**-8** a*	**67**	**74**	**85**	**10**	**1** ab*	**0.04** a*	**0.06** a*	**71** b*	**56.7** a*	**2248** a*
2 **Average**	**14-inch**	**167121**	**153758**	**-7** a	**66**	**73**	**84**	**10**	**3** b	**0.07** a	**0.05** a	**74** a	**56.8** a	**2227** a
3 **Average**	**21-inch**	**167532**	**154758**	**2** b	**66**	**65**	**83**	**10**	**2** ab	**0.06** a	**0.08** a	**75** a	**56.6** a	**2238** a
4 **Average**	**28-inch**	**168389**	**149991**	**6** c	**66**	**60**	**85**	**10**	**1** a	**0.02** a	**0.02** a	**65** c	**56.7** a	**2229** a
	F:			672.76					3.30	2.16	2.20	41.13	1.22	0.92
	P>F:			< 0.0001					0.0287	0.1060	0.1014	< 0.0001	0.3141	0.4390
	CV:			-66.7					91.6	137.4	128.1	4.1	0.6	1.9
SUMMARY - Seeding Rate		Pioneer '90Y90' (0.9 maturity; Sclerotinia rating of 5, where 10 is best)												
1 **120,000/ac**	**Average**	**134327**	**123558**	**-1**	**66**	**68**	**84**	**10**	**2** a*	**0.06** a*	**0.07** a*	**69** b*	**56.7** a*	**2249** a*
2 **150,000/ac**	**Average**	**164438**	**150861**	**-2**	**66**	**68**	**84**	**9**	**2** a	**0.04** a	**0.04** a	**71** ab	**56.6** a	**2239** a
3 **180,000/ac**	**Average**	**198665**	**180657**	**-2**	**67**	**69**	**85**	**9**	**2** a	**0.04** a	**0.04** a	**74** a	**56.8** a	**2218** a
	F:			1.90					0.81	0.59	1.02	7.44	1.38	1.83
	P>F:			0.1995					0.4737	0.5706	0.3952	0.0105	0.2967	0.2100
	CV:			-66.7					91.6	137.4	128.1	4.1	0.6	1.9

Dairyland 'DSR-0711/R2Y' (0.7 maturity, susceptible Sclerotinia)

			Plant population		Days			Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested grain	13% moisture		
			VC-V1	R8	bloom to canopy closure	bloom to maturity	canopy clos. to maturity	(cm)	(number)	(%) ‡	(0-3)		Yield	Test weight	Seeds per lb
	plants/ac		June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1	**120,000**	**7-inch**	**108519**	**100013**	**-5** a*	**72**	**76**	**74**	**10**	**0.6** a*	**0.02** a*	**0.00** a*	**72** b*	**57.1** a*	**2444** ab*
2	**120,000**	**14-inch**	**114951**	**107478**	**-4** a	**72**	**75**	**76**	**10**	**0.3** a	**0.01** a	**0.01** a	**76** a	**57.0** a	**2473** b
3	**120,000**	**21-inch**	**113847**	**101854**	**6** b	**72**	**66**	**74**	**10**	**1.3** a	**0.03** a	**0.01** a	**75** ab	**57.1** a	**2440** ab
4	**120,000**	**28-inch**	**114048**	**107519**	**11** c	**72**	**60**	**77**	**11**	**0.4** a	**0.01** a	**0.00** a	**68** c	**56.7** a	**2370** a
		F:			740.44					0.27	0.47	0.79	17.96	1.99	3.45
		P>F:			< 0.0001					0.8428	0.7060	0.5162	< 0.0001	0.1593	0.0436
		CV:			31.8					201.9	227.2	260.6	2.9	0.6	2.4
1	**150,000**	**7-inch**	**135859**	**127264**	**-5** a*	**72**	**77**	**77**	**11**	**0.3** a*	**0.01** a*	**0.00** a*	**75** ab*	**57.0** a*	**2435** a*
2	**150,000**	**14-inch**	**146771**	**137598**	**-4** a	**72**	**76**	**75**	**11**	**0.4** a	**0.01** a	**0.02** a	**76** ab	**56.9** a	**2418** a
3	**150,000**	**21-inch**	**122714**	**120600**	**6** b	**72**	**66**	**79**	**10**	**0.6** a	**0.02** a	**0.00** a	**78** a	**56.9** a	**2427** a
4	**150,000**	**28-inch**	**156680**	**147052**	**11** c	**72**	**61**	**83**	**11**	**0.0** a	**0.00** a	**0.00** a	**71** b	**56.9** a	**2438** a
		F:			321.78					0.87	0.81	0.84	3.84	0.14	0.47
		P>F:			< 0.0001					0.4794	0.5089	0.4918	0.0318	0.9349	0.7059
		CV:			44.7					197.5	208.3	408.0	5.6	0.6	1.4
1	**180,000**	**7-inch**	**163935**	**150646**	**-5** a*	**72**	**77**	**77**	**10**	**0.2** a*	**0.01** a*	**0.02** a*	**75** a*	**57.1** a*	**2439** a*
2	**180,000**	**14-inch**	**172491**	**157668**	**-3** b	**72**	**75**	**77**	**10**	**0.3** a	**0.01** a	**0.01** a	**76** a	**57.1** a	**2421** a
3	**180,000**	**21-inch**	**167905**	**151592**	**5** c	**72**	**67**	**76**	**10**	**0.5** a	**0.01** a	**0.05** a	**77** a	**57.0** a	**2430** a
4	**180,000**	**28-inch**	**168736**	**151958**	**11** d	**72**	**61**	**85**	**10**	**0.7** a	**0.02** a	**0.01** a	**69** b	**56.8** a	**2400** a
		F:			177.96					0.66	0.63	0.72	11.85	1.13	0.44
		P>F:			< 0.0001					0.5882	0.6098	0.5580	0.0003	0.3672	0.7253
		CV:			74.9					128.7	143.0	266.5	3.5	0.6	2.5

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Dairyland 'DSR-0711/R2Y' (0.7 maturity, susceptible Sclerotinia) - plots used for in-season notes

			Plant population		Days bloom to canopy closure	Days bloom to maturity	Days canopy clos. to maturity	Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested grain	13% moisture		
			VC-V1	R8				(cm)	(number)	(%) ‡	(0-3)		Yield	Test weight	Seeds per lb
	plants/ac		June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1	**120,000**	**7-inch**	**107852**	**102001**	**-4** a*	**72**	**76**	**75**	**11**	**1.1** a*	**0.03** a*	**0.01** a*	**68** b*	**57.2** a*	**2448** a*
2	**120,000**	**14-inch**	**121556**	**116816**	**-3** a	**72**	**75**	**77**	**10**	**2.4** a	**0.06** a	**0.04** a	**75** a	**57.2** a	**2450** a
3	**120,000**	**21-inch**	**116168**	**102507**	**6** b	**72**	**66**	**74**	**10**	**0.3** a	**0.01** a	**0.03** a	**75** a	**56.9** b	**2433** a
4	**120,000**	**28-inch**	**117241**	**115532**	**12** c	**72**	**60**	**80**	**11**	**0.3** a	**0.01** a	**0.01** a	**64** b	**57.1** ab	**2406** a
		F:			145.22					1.92	1.95	0.44	13.79	5.40	0.50
		P>F:			< 0.0001					0.1699	0.1653	0.7289	0.0001	0.0101	0.6866
		CV:			53.5					133.5	173.1	210.7	4.8	0.3	2.9
1	**150,000**	**7-inch**	**134195**	**125891**	**-5** a*	**72**	**76**	**75**	**11**	**0.6** a*	**0.01** a*	**0.00** a*	**72** ab*	**57.1** a*	**2467** a*
2	**150,000**	**14-inch**	**140151**	**127351**	**-3** a	**72**	**75**	**75**	**10**	**1.1** a	**0.03** a	**0.03** a	**74** a	**57.1** a	**2449** a
3	**150,000**	**21-inch**	**140101**	**136615**	**6** b	**72**	**66**	**79**	**10**	**1.5** a	**0.04** a	**0.01** a	**77** a	**57.0** a	**2417** a
4	**150,000**	**28-inch**	**155753**	**141283**	**12** c	**72**	**60**	**79**	**10**	**0.0** a	**0.00** a	**0.02** a	**67** b	**56.8** a	**2421** a
		F:			180.14					1.68	1.48	1.23	6.58	1.14	0.79
		P>F:			< 0.0001					0.2140	0.2600	0.3349	0.0047	0.3648	0.5164
		CV:			61.4					148.9	172.7	191.9	5.5	0.5	2.6
1	**180,000**	**7-inch**	**161265**	**150768**	**-5** a*	**73**	**77**	**76**	**10**	**0.3** a*	**0.01** a*	**0.01** a*	**72** b*	**57.1** a*	**2416** a*
2	**180,000**	**14-inch**	**169391**	**157145**	**-3** a	**73**	**76**	**77**	**10**	**1.3** a	**0.04** a	**0.02** a	**77** ab	**56.9** a	**2432** a
3	**180,000**	**21-inch**	**171728**	**162967**	**5** b	**73**	**67**	**81**	**10**	**1.2** a	**0.03** a	**0.02** a	**79** a	**56.9** a	**2400** a
4	**180,000**	**28-inch**	**189216**	**164751**	**12** c	**73**	**60**	**79**	**11**	**0.6** a	**0.02** a	**0.03** a	**69** bc	**57.0** a	**2403** a
		F:			108.25					0.37	0.73	0.22	13.41	0.69	0.71
		P>F:			< 0.0001					0.7754	0.5493	0.8777	0.0002	0.5705	0.5604
		CV:			75.4					161.3	176.9	152.6	4.0	0.6	1.8

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SUMMARY - Row Spacing Dairyland 'DSR-0711/R2Y' (0.7 maturity, susceptible Sclerotinia)

			Plant population		Days			Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested grain	13% moisture		
			VC-V1	R8	bloom to canopy closure	bloom to maturity	canopy clos. to maturity	(cm)	(number)	(%) ‡	(0-3)		Yield	Test weight	Seeds per lb
plants/ac			June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1	**Average**	**7-inch**	**136104**	**125974**	**-5** a*	**72**	**77**	**76**	**10**	**0.4** a*	**0.01** a*	**0.01** a*	**74** a*	**57.1** a*	**2439** a*
2	**Average**	**14-inch**	**144738**	**134248**	**-3** b	**72**	**75**	**76**	**10**	**0.3** a	**0.01** a	**0.01** a	**76** a	**57.0** a	**2437** a
3	**Average**	**21-inch**	**134822**	**124682**	**6** c	**72**	**66**	**76**	**10**	**0.8** a	**0.02** a	**0.02** a	**77** a	**57.0** a	**2433** a
4	**Average**	**28-inch**	**146488**	**135509**	**11** d	**72**	**61**	**82**	**11**	**0.4** a	**0.01** a	**0.00** a	**69** b	**56.8** a	**2403** a
		F:			908.99					0.56	0.84	0.89	18.16	1.78	1.89
		P>F:			< 0.0001					0.6467	0.4795	0.4523	< 0.0001	0.1637	0.1448
		CV:			50.5					182.0	213.3	352.5	4.2	0.6	2.1

SUMMARY - Seeding Rate Dairyland 'DSR-0711/R2Y' (0.7 maturity, susceptible Sclerotinia)

1	**120,000/ac**	**Average**	**112841**	**104216**	**2** a*	**72**	**70**	**75**	**10**	**0.7** a*	**0.02** a*	**0.00** a*	**73** a*	**57.0** a*	**2432** a*
2	**150,000/ac**	**Average**	**140506**	**133128**	**2** a	**72**	**70**	**79**	**11**	**0.3** a	**0.01** a	**0.00** a	**75** a	**56.9** a	**2430** a
3	**180,000/ac**	**Average**	**168267**	**152966**	**2** a	**72**	**70**	**79**	**10**	**0.4** a	**0.01** a	**0.02** a	**74** a	**57.0** a	**2423** a
		F:			0.31					0.21	0.37	2.33	1.98	0.31	0.23
		P>F:			0.7404					0.8119	0.6989	0.1474	0.1887	0.7428	0.8004
		CV:			50.5					182.0	213.3	352.5	4.2	0.6	2.1

SUMMARY - Row Spacing Dairyland 'DSR-0711/R2Y' (0.7 maturity, susceptible Sclerotinia) - plots used for in-season notes

1	**Average**	**7-inch**	**134438**	**126220**	**-4** a*	**72**	**76**	**76**	**11**	**0.6** a*	**0.01** a*	**0.01** a*	**71** b*	**57.1** a*	**2444** a*
2	**Average**	**14-inch**	**143699**	**133771**	**-3** a	**72**	**75**	**77**	**10**	**1.6** a	**0.04** a	**0.03** a	**75** a	**57.0** a	**2444** a
3	**Average**	**21-inch**	**142665**	**134030**	**6** b	**72**	**66**	**78**	**10**	**1.0** a	**0.02** a	**0.02** a	**77** a	**56.9** a	**2417** a
4	**Average**	**28-inch**	**154070**	**140522**	**12** c	**72**	**60**	**80**	**11**	**0.3** a	**0.01** a	**0.02** a	**67** c	**57.0** a	**2410** a
		F:			412.63					1.92	2.69	1.00	30.74	2.52	1.55
		P>F:			< 0.0001					0.1397	0.0576	0.4000	< 0.0001	0.0702	0.2155
		CV:			63.4					146.7	175.6	189.7	4.8	0.5	2.5

SUMMARY - Seeding Rate Dairyland 'DSR-0711/R2Y' (0.7 maturity, susceptible Sclerotinia) - plots used for in-season notes

1	**120,000/ac**	**Average**	**115704**	**109214**	**3** a*	**72**	**69**	**77**	**11**	**1.0** a*	**0.03** a*	**0.02** a*	**70** b*	**57.1** a*	**2434** a*
2	**150,000/ac**	**Average**	**142550**	**132785**	**2** a	**72**	**69**	**77**	**10**	**0.8** a	**0.02** a	**0.01** a	**72** ab	**57.0** a	**2438** a
3	**180,000/ac**	**Average**	**172900**	**158908**	**2** a	**73**	**70**	**78**	**10**	**0.8** a	**0.02** a	**0.02** a	**74** a	**57.0** a	**2413** a
		F:			0.60					0.40	0.17	0.25	4.72	0.92	0.69
		P>F:			0.5676					0.6825	0.8423	0.7870	0.0360	0.4282	0.5236
		CV:			63.4					146.7	175.6	189.7	4.8	0.5	2.5

Dairyland 'DSR-0711/R2Y' - combined analysis across plots used for in-season notes and plots only assessed at end of season

SUMMARY - Row Spacing Dairyland 'DSR-0711/R2Y' (0.7 maturity, susceptible Sclerotinia)

			Plant population		Days bloom to canopy closure	Days bloom to maturity	Days canopy clos. to maturity	Plant height	Nodes /plant	Sclerotinia incidence	Sclerotinia sev. Index	Sclerotia in harvested	13% moisture		
			VC-V1	R8				(cm)	(number)	(%) ‡	(0-3)	grain	Yield	Test weight	Seeds per lb
plants/ac			June 11	Oct. 2-6	Days	Days	Days	Aug. 6-11 | R3 stage		Oct. 2-6 | R8 growth stage		% by weight	bu/ac	lbs/bu	seeds/lb
1	**Average**	**7-inch**	**135271**	**126097**	**-5** a*	**72**	**77**	**76**	**10**	**1 a***	**0.01 a***	**0.01 a***	**72** b*	**57.1 a***	**2441** b*
2	**Average**	**14-inch**	**144219**	**134010**	**-3** b	**72**	**75**	**76**	**10**	**1 a**	**0.03 a**	**0.02 a**	**76** a	**57.0 ab**	**2441** b
3	**Average**	**21-inch**	**138744**	**129356**	**6** c	**72**	**66**	**77**	**10**	**1 a**	**0.02 a**	**0.02 a**	**77** a	**56.9 ab**	**2425** ab
4	**Average**	**28-inch**	**150279**	**138016**	**11** d	**72**	**61**	**81**	**11**	**0 a**	**0.01 a**	**0.01 a**	**68** c	**56.9 b**	**2407** a
		F:			1126.24					1.43	2.26	1.00	52.14	3.19	3.03
		P>F:			< 0.0001					0.2382	0.0871	0.3953	< 0.0001	0.0274	0.0333
		CV:			58.7					161.7	193.0	247.8	4.5	0.5	2.3
SUMMARY - Seeding Rate															
1	**120,000/ac**	**Average**	**114273**	**106715**	**3** a*	**72**	**69**	**76**	**10**	**0.8** a*	**0.02** a*	**0.01** a*	**72** b*	**57.0** a*	**2433** a*
2	**150,000/ac**	**Average**	**141528**	**132957**	**2** a	**72**	**70**	**78**	**10**	**0.6** a	**0.01** a	**0.01** a	**74** a	**57.0** a	**2434** a
3	**180,000/ac**	**Average**	**170583**	**155937**	**2** a	**72**	**70**	**79**	**10**	**0.6** a	**0.02** a	**0.02** a	**74** a	**57.0** a	**2418** a
		F:			0.37					0.50	0.49	1.33	4.94	0.60	0.89
		P>F:			0.6933					0.6134	0.6213	0.2868	0.0180	0.5588	0.4267
		CV:			58.7					161.7	193.0	247.8	4.5	0.5	2.3
COMBINED RESULTS - Combined analysis of all five varieties. Dairyland DSR0711, plots evaluated for disease during the season were excluded from analysi															
1	**Average**	**7-inch**	**158496**	**146107**	**-7** a*	**69**	**76**	**80**	**10**	**3** ab*	**0.08** ab*	**0.07**	**70** c*	**56.6** a*	**2508** b*
2	**Average**	**14-inch**	**164273**	**149677**	**-6** b	**69**	**74**	**80**	**10**	**4** b	**0.10** b	**0.07**	**72** b	**56.6** a	**2492** ab
3	**Average**	**21-inch**	**159234**	**146209**	**2** c	**69**	**67**	**80**	**10**	**3** b	**0.09** ab	**0.07**	**74** a	**56.6** a	**2494** ab
4	**Average**	**28-inch**	**163990**	**146029**	**7** d	**68**	**61**	**84**	**10**	**2** a	**0.06** a	**0.05**	**65** d	**56.5** a	**2479** a
		F:			significant var*trt					3.33	2.83	1.11	144.38	1.81	12.90
	pure live	*P>F:*			interaction					0.0203	0.0395	0.3447	< 0.0001	0.1468	< 0.0001
	seeds/ac	*CV:*			-124.1					66.1	102.4	132.6	4.7	0.6	2.0
1	**132,000**	**7-inch**	**129975**	**119476**	**-0.6** a*	**68**	**69**	**79**	**10**	**4** a*	**0.09** a*	**0.07**	**69** b*	**56.6** a*	**2509** b*
2	**165,000**	**14-inch**	**159896**	**146376**	**-0.9** ab	**69**	**70**	**82**	**10**	**3** a	**0.08** a	**0.07**	**70** ab	**56.6** a	**2494** ab
3	**198,000**	**21-inch**	**194623**	**175165**	**-1.3** b	**69**	**70**	**82**	**10**	**3** a	**0.07** a	**0.06**	**71** a	**56.6** a	**2477** a
		F:			5.17					2.09	1.30	1.14	6.88	0.65	9.33
		P>F:			0.0091					0.1339	0.2829	0.3285	0.0023	0.5272	0.0004
		CV:			-124.1					66.1	102.4	132.6	4.7	0.6	2.0

[z] **Plant population**: Soybean establishment was assessed June 11 when soybeans were at the VC to V1 growth stage and end-of-season soybean populations were assessed Oct. 2-6 at the R8 growth stage by counting all plants along the full length of the plot in rows 2, 3, 5, and 6 of each 7 row plot (7-in. row spacing), rows 2 and 3 of each 4-row plot (14-in. row spacing), row 2 of each 3-row plot (21-in. row spacing) and the northern row of each 2-row plot (28-in. row spacing).
[y] **Days from bloom to canopy closure**: Number of days between bloom initiation (80-90% of the plants with an open blossom) and canopy closure (canopy fully covered ground between the rows).
[x] **Days from bloom to maturity**: Number of days between bloom initiation (80-90% of the plants with an open blossom) and maturity (R8 growth stage; at least 95% of the pods reached their full color).
[w] **Days from canopy closure to maturity**: Number of days between canopy closure (canopy fully covered ground between rows) and maturity (R8 growth stage; at least 95% of the pods reached their full color).
[v] **Canopy height**: Height of the canopy at the R3 growth stage; assessed at two locations per plot.
[u] **Number of nodes**: Number of nodes per plant at the R3 growth stage; within each plot, 10 plants were assessed (five plants at each of two locations per plot).
[s] **Sclerotinia stem rot incidence**: Assessed Oct. 2-6 at the R8 growth stage by evaluating all plants in the middle 3 rows of plots seeded to 7-inch rows, middle 2 rows of plots seeded to 14-inch rows, middle row of plots seeded to 21-inch rows, and first row of plots seeded to 28-inch rows.
[r] **Sclerotinia severity**: Average disease severity among plants expressing Sclerotinia stem rot on Oct. 2-6 at the R8 growth stage. 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. Assessed by evaluating all plants in the middle 3 rows of plots seeded to 7-inch rows, middle 2 rows of plots seeded to 14-inch rows, middle row of plots seeded to 21-inch rows, and first row of plots seeded to 28-inch rows.
[q] **Sclerotinia disease severity index**: Average disease severity across all plants, including those without any disease, on Oct. 2-6 at the R8 growth stage. 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. Assessed by evaluating all plants in the middle 3 rows of plots seeded to 7-inch rows, middle 2 rows of plots seeded to 14-inch rows, middle row of plots seeded to 21-inch rows, and first row of plots seeded to 28-inch rows.
[p] **Sclerotia in harvested grain**: Assessed by manually removing all sclerotia from a 200-gram subsample of grain from each plot.
‡ To meet model assumptions of normality and homoskedasticity, analysis of variance was conducted on data subjected to a systematic natural-log transformation [LN(x+1) for data sets that included values < 1.0, LN(x) for data sets with all values ≥ 1.0].
*** Within-column means followed by different letters are significantly different** ($P < 0.05$; Tukey multiple comparison procedure).

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DISEASE PROGRESSION. Dairyland 'DSR0711'

			Sclerotinia incidence (%) [s]			Sclerotinia severity index (0 to 3) [r]		
	Seeding rate	Row Spacing	Aug. 12	Aug. 20	Oct. 2-6	Aug. 12	Aug. 20	Oct. 2-6
1	132,000 pls/ac	7-inch	0.0	0.3	1.1	0.00	0.00	0.03
2	132,000 pls/ac	14-inch	0.7	0.3	2.4	0.01	0.01	0.06
3	132,000 pls/ac	21-inch	0.0	0.0	0.3	0.00	0.00	0.01
4	132,000 pls/ac	28-inch	0.0	0.0	0.3	0.00	0.00	0.01
1	165,000 pls/ac	7-inch	0.0	0.0	0.6	0.00	0.00	0.01
2	165,000 pls/ac	14-inch	0.3	0.3	1.1	0.00	0.01	0.03
3	165,000 pls/ac	21-inch	0.3	0.7	1.5	0.01	0.02	0.04
4	165,000 pls/ac	28-inch	0.0	0.3	0.0	0.00	0.01	0.00
1	198,000 pls/ac	7-inch	0.0	0.0	0.3	0.00	0.00	0.01
2	198,000 pls/ac	14-inch	0.0	0.0	1.3	0.00	0.00	0.04
3	198,000 pls/ac	21-inch	1.0	1.0	1.2	0.02	0.02	0.03
4	198,000 pls/ac	28-inch	0.0	0.0	0.6	0.00	0.00	0.02
	Seeding rate	Row Spacing						
1	COMBINED	7-inch	0.0	0.1	0.6	0.00	0.00	0.01
2	COMBINED	14-inch	0.3	0.2	1.6	0.00	0.00	0.04
3	COMBINED	21-inch	0.4	0.6	1.0	0.01	0.01	0.02
4	COMBINED	28-inch	0.0	0.1	0.3	0.00	0.00	0.01
	Seeding rate	Row Spacing						
1	132,000 pls/ac	COMBINED	0.2	0.2	1.0	0.00	0.00	0.03
2	165,000 pls/ac	COMBINED	0.2	0.3	0.8	0.00	0.01	0.02
3	198,000 pls/ac	COMBINED	0.3	0.3	0.8	0.00	0.01	0.02

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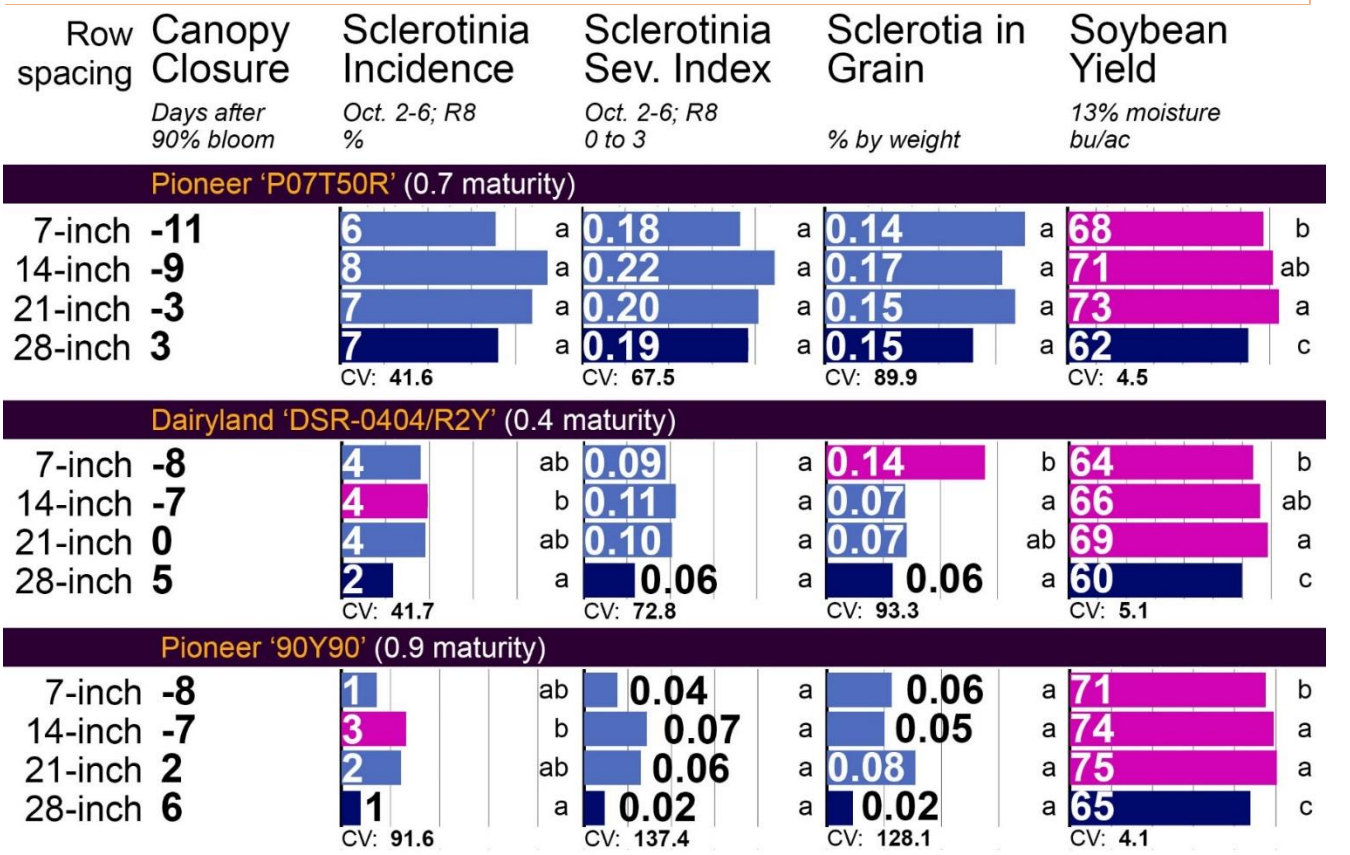
Impact of row spacing on Sclerotinia disease levels and soybean yield

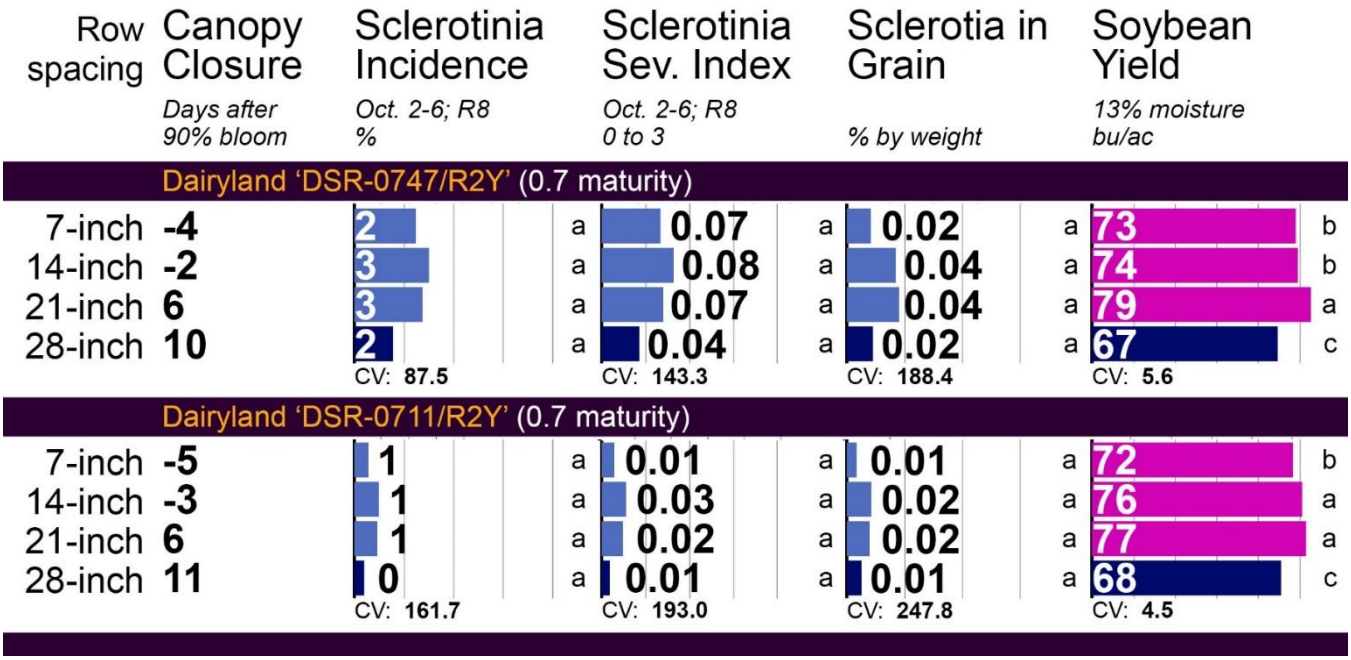
1. soybean varieties with early canopy closure (relative to bloom initiation)

Presented are the combined results across three seeding rates (132,000, 165,000, and 198,000 pure live seeds/ac).



2. soybean varieties with later canopy closure (relative to bloom initiation)

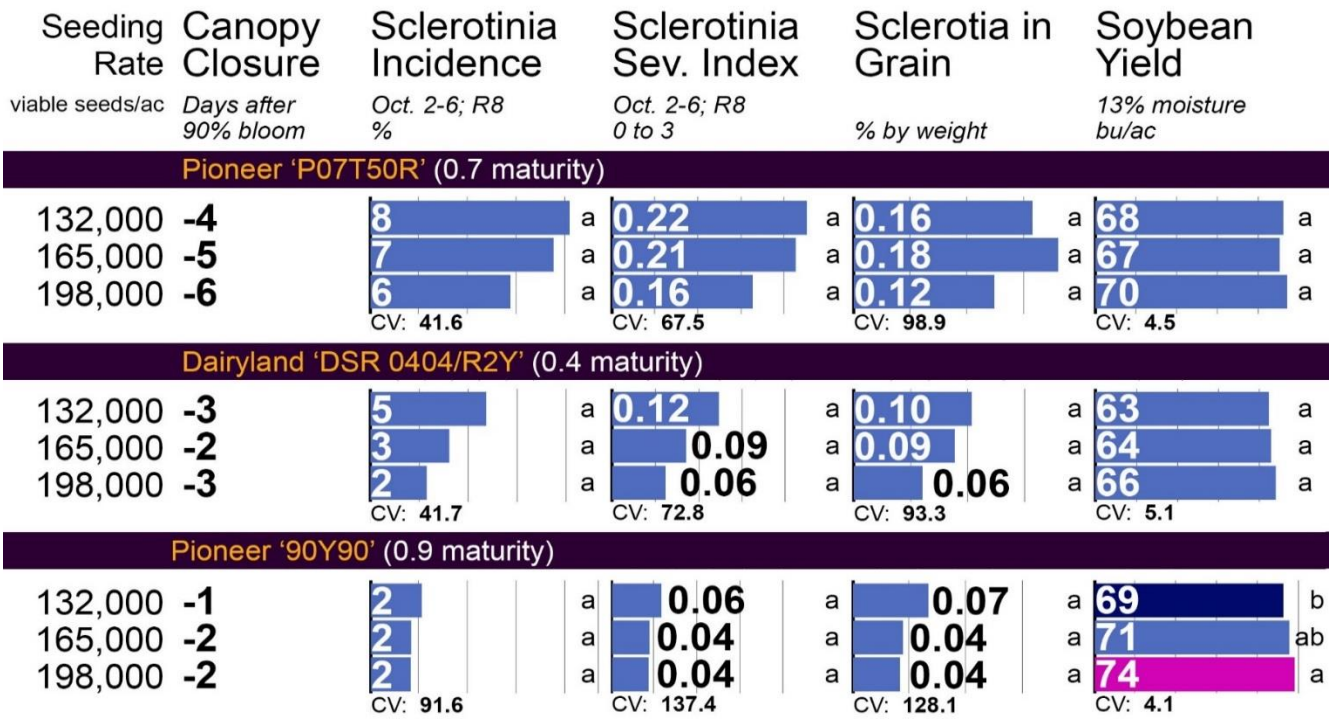
Presented are the combined results across three seeding rates (132,000, 165,000, and 198,000 pure live seeds/ac).



Impact of seeding rate on Sclerotinia disease levels and soybean yield

1. soybean varieties with early canopy closure (relative to bloom initiation)

Presented are the combined results across four row spacings (7, 14, 21, and 28 inches).

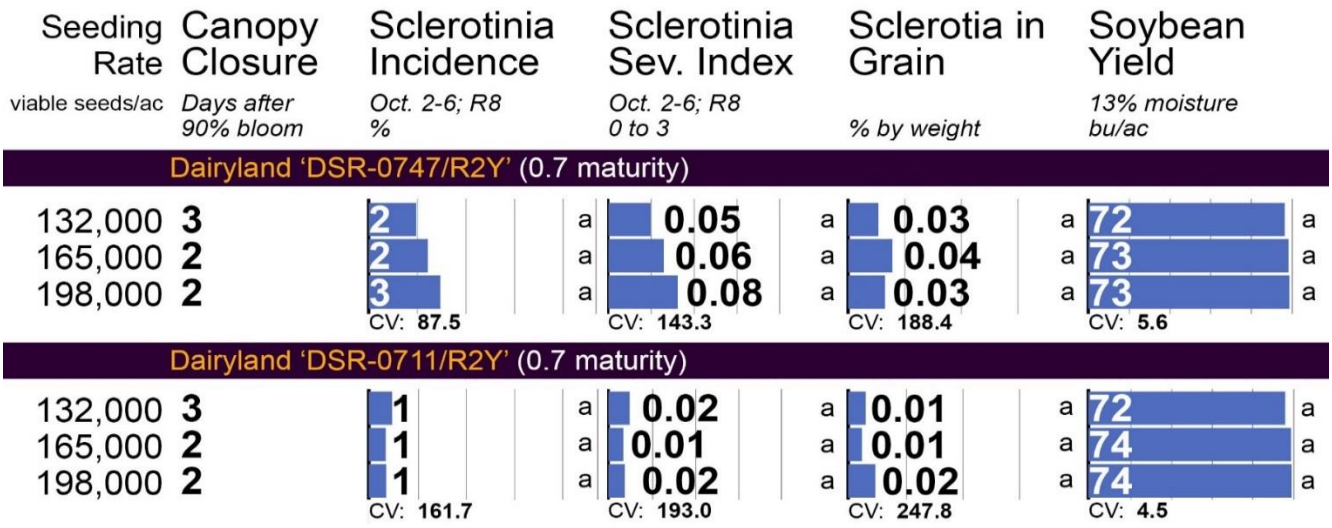


ESTABLISHED PLANT POPULATIONS:

	LOW SEEDING RATE		INTERMEDIATE SEEDING RATE		HIGH SEEDING RATE	
Variety	V1-V2	R8 growth stage	V1-V2	R8 growth stage	V1-V2	R8 growth stage
Pioneer 'P07T50R'	130,000	119,000 plants/ac	162,000	149,000 plants/ac	198,000	180,000 plants/ac
Dairyland 'DSR-0404'	138,000	127,000 plants/ac	172,000	156,000 plants/ac	205,000	181,000 plants/ac
Pioneer '90Y90'	134,000	124,000 plants/ac	164,000	151,000 plants/ac	199,000	181,000 plants/ac

2. soybean varieties with later canopy closure (relative to bloom initiation)

Presented are the combined results across four row spacings (7, 14, 21, and 28 inches).



ESTABLISHED PLANT POPULATIONS:

	LOW SEEDING RATE		INTERMEDIATE SEEDING RATE		HIGH SEEDING RATE	
Variety	V1-V2	R8	V1-V2	R8	V1-V2	R8
Dairyland 'DSR-0747'	135,000	124,000 plants/ac	161,000	143,000 plants/ac	203,000	181,000 plants/ac
Dairyland 'DSR-0711'	114,000	107,000 plants/ac	142,000	133,000 plants/ac	171,000	156,000 plants/ac

Optimizing Fungicide Application Timing for Sclerotinia Control in Soybeans

M. Wunsch, M. Schaefer, B. Kraft and S. Kallis, L. Besemann, H. Eslinger

METHODS

General Agronomics: The study was on a Maddock sandy loam soil type. The previous crop was field corn and the tillage operation consisted of disking once with a Wishek disk (April 14) followed by three passes with a multiweeder; once (April 29) to level the seedbed and twice to incorporate the herbicide. The maintenance herbicide applications were Trust (4 lbs/gal trifluralin; Winfield Solutions) applied at 1 pt/acre preplant incorporated (May 19) Roundup Power Max 30 oz/acre (June 17) and Roundup Power Max 20 oz/acre (June 30).

Experimental design: A completely randomized block design with six replicates, with fungicide timing evaluated within each row spacing as a separate experiment. 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. Every treatment plot was separated by a non-harvested buffer plot.

Planting details: Dairyland 'DSR 0711 R2' was seeded in the 14-inch row experiment. Dairyland 'DSR 0305 R2' was seeded in the 28-inch row experiment. The study was planted on May 21, 2015. Seed treatments used were Apron Maxx RTA (5.0 fl oz/100 lbs seed) + Imidacloprid 4ST (3 fl oz/100 lbs seed). *Imidacloprid 4ST (Willowood) contains 4 lbs/gal thiamethoxam; Apron Maxx RTA (Syngenta) contains 0.096 lb/gal mefenoxam and 0.064 lb/gal fludioxonil.* Cell-Tech granular inoculum for soybean (minimum 100 million *Bradyrhizobium japonicum* viable cells/gr; Novozymes, Saskatoon, SK) was applied in-furrow 17.2 lb/acre.

Fungicide applications:

Application details: Fungicide were applied with a 60-inch hand boom equipped with four equally-spaced TeeJet 8001VS flat-fan nozzles at a spray volume of 19 gal water/acre operated at 45 psi.
Application A: 50% of the plants were at the R1 growth stage; wind SW at 7 MPH, temperature 74°F, relative humidity at 56% with 40% cloud cover.
Application B: 80-100% of the plants were at the R2 growth stage and the narrow rows were at 100% canopy closure and the wide rows at 60% canopy closure; wind NNW at 3 mph, temperature 80°F, relative humidity 69% with 40% cloud cover.
Application C: 100% of the plants were at the R2 growth stage; canopy closure was 100% in the narrow rows and 90% in the wide rows, wind S at 8 mph, temperature 76°F, relative humidity 75% with 80% cloud cover.

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 September 15 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. All plants were assessed in each plot.

Harvest, seed yield and quality assessment: The trial was harvested on October 8. 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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Commentary: Sclerotinia disease development was low in this trial due to high temperatures and low relative humidity experienced in July and August.

We appreciate partial financial support for this project form the North Dakota Soybean Council.

Narrow (14-inch) rows Dairyland 'DSR0711/R2Y'

Treatment	Date	Canopy closure	Growth stage
1 Non-treated			
2 Aproach 250SC 9 fl oz/ac + NIS 0.25%	(A): July 8	<100% canopy closure	50% at R1 growth stage
3 Aproach 250SC 9 fl oz/ac + NIS 0.25%	(B): July 14	100% canopy closure	80-100% at R2 growth stage
4 Aproach 250SC 9 fl oz/ac + NIS 0.25%	(A,C): July 8, July 16		50% at R1, 100% at R2
5 Endura 70WG 5.5 oz/ac	(A): July 8	<100% canopy closure	50% at R1 growth stage
6 Endura 70WG 5.5 oz/ac	(B): July 14	100% canopy closure	80-100% at R2 growth stage
7 Endura 70WG 5.5 oz/ac	(A,C): July 8, July 16		50% at R1, 100% at R2
8 Endura 70WG 5.5 oz/ac	(C): July 16	100% canopy closure	100% at R2

	Sclerotinia incidence	Sclerotinia severity	Sclerotinia sev. index	Yield	Test weight
	Sept. 15 | R7 growth stage			13% moisture	
Treatment	percent	1 to 3	0 to 3	bu/ac	lbs/bu
1 Non-treated	**1.8** a*	**2.67**	**0.05** a*	**75** a*	**56.9** a*
2 Aproach 250SC 9 fl oz/ac + NIS 0.2	**1.8** a	**2.72**	**0.05** a	**75** a	**57.1** a
3 Aproach 250SC 9 fl oz/ac + NIS 0.2	**1.7** a	**2.75**	**0.05** a	**78** a	**57.0** a
4 Aproach 250SC 9 fl oz/ac + NIS 0.2	**0.7** a	**2.92**	**0.02** a	**75** a	**57.1** a
5 Endura 70WG 5.5 oz/ac	**1.2** a	**2.65**	**0.03** a	**77** a	**56.9** a
6 Endura 70WG 5.5 oz/ac	**1.3** a	**2.55**	**0.03** a	**77** a	**56.9** a
7 Endura 70WG 5.5 oz/ac	**1.3** a	**2.80**	**0.04** a	**77** a	**57.1** a
8 Endura 70WG 5.5 oz/ac	**0.6** a	**2.90**	**0.02** a	**73** a	**57.1** a
F:	0.58		0.51	1.01	0.96
P>F:	0.7710		0.8194	0.4411	0.4728
CV:	121.6		121.7	5.1	0.5

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Wide (28-inch) rows Dairyland 'DSR0305/R2Y'

Treatment	Date	Canopy closure	Growth stage
1 Non-treated			
2 Aproach 250SC 9 fl oz/ac + NIS 0.25%	(A): July 8	< 50% canopy closure	50% at R1 growth stage
3 Aproach 250SC 9 fl oz/ac + NIS 0.25%	(B): July 14	60% canopy closure	80-100% at R2 growth stage
4 Aproach 250SC 9 fl oz/ac + NIS 0.25%	(A,C): July 8, July 16	<50%, 90% canopy closure	50% at R1, 100% at R2
5 Endura 70WG 5.5 oz/ac	(A): July 8	< 50% canopy closure	50% at R1 growth stage
6 Endura 70WG 5.5 oz/ac	(B): July 14	60% canopy closure	80-100% at R2 growth stage
7 Endura 70WG 5.5 oz/ac	(A,C): July 8, July 16	<50%, 90% canopy closure	50% at R1, 100% at R2
8 Endura 70WG 5.5 oz/ac	(C): July 16	90% canopy closure	100% at R2 growth stage

	Sclerotinia incidence	Sclerotinia severity	Sclerotinia sev. index	Yield	Test weight
	Sept. 15 | R8 growth stage			13% moisture	
Treatment	percent	1 to 3	0 to 3	bu/ac	lbs/bu
1 Non-treated	**2.0** a*	**2.79**	**0.06** a*	**72** a*	**55.0** a*
2 Aproach 250SC 9 fl oz/ac + NIS 0.2	**3.7** a	**2.29**	**0.09** a	**75** a	**55.7** a
3 Aproach 250SC 9 fl oz/ac + NIS 0.2	**2.8** a	**2.87**	**0.08** a	**73** a	**55.6** a
4 Aproach 250SC 9 fl oz/ac + NIS 0.2	**1.3** a	**2.93**	**0.04** a	**73** a	**55.5** a
5 Endura 70WG 5.5 oz/ac	**2.3** a	**2.72**	**0.06** a	**72** a	**55.5** a
6 Endura 70WG 5.5 oz/ac	**1.6** a	**2.81**	**0.05** a	**72** a	**55.6** a
7 Endura 70WG 5.5 oz/ac	**0.9** a	**2.72**	**0.02** a	**74** a	**55.5** a
8 Endura 70WG 5.5 oz/ac	**0.3** a	**2.67**	**0.01** a	**76** a	**55.5** a
F:	1.96		1.61	1.61	1.46
P>F:	0.0965		0.1723	0.1732	0.2214
CV:	69.8		95.7	3.5	0.7

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Strip-Till, Corn on Corn, Nitrogen Rate Study

L. Besemann and H. Eslinger

Conventional grown continuous corn requires extensive tillage with high fuel use. Continuous corn requires about 40 lb more N/acre than corn grown on soybean ground.

The objectives of this study are to grow continuous corn in a strip-till system that eliminates full width tillage and to find efficient nitrogen rates.

MATERIALS AND METHODS

Soil:	Embden sandy loam and Hecla sandy loam; pH = 7.3; 2.2% organic matter; soil N average 19 lbs/acre; soil P and soil K were very high; soil S was medium.
Previous crop:	2014 - field corn.
Seedbed preparation:	Strip-till April 24 with an Orthman strip-till machine.
Hybrid:	Dairyland DS9791RAa.
Planting:	Planted April 28 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 April 24. Stream-bar all plots 13 lbs N/acre and 17.6 lbs S/acre as 15-0-0-20 May 7. Stream-bar 79 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 5. Sidedress N treatments as 28-0-0 (three inches deep) June 11; the 150 lb treatment received 48 lbs N/acre, the 150d treatment received 81 lbs N/acre and the 200 lb treatment received 131 lbs N/acre.
Irrigation:	Hand move sprinkler irrigation as needed.
Pest control:	Harness (2 pt/acre) May 8, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05%v/v) + AMS (1½ lbs/acre) + Interlock (4 oz/acre) June 4.
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 14 with a JD 4400 combine. Harvest area was the middle four rows of each plot, 137 feet long.

RESULTS

Determining nitrogen sufficiency in time is important to achieve N efficiency. Remote sensing utilized 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 2015.

Fertilizer N Rate	Grain Yield[1]	Grain Yield 2009-15	Harvest Moisture	Test Weight	Chlorophyll Meter Reading[2]	NDRE[3]	Nitrate-N Stalk	Nitrate-N Fall Soil	Seed Protein	Seed Starch	Seed Oil	Emerge Date	Silk Date
lb/acre	bu/ac		%	lb/bu	4-Aug	5-Aug	ppm	lbs/ac	----------%	----------			
22	86.6	83.8	13.0	54.4	11.1	0.1558	38	12	6.9	74.5	2.9	18-May	24-Jul
100	156.6	168.5	14.2	55.6	38.4	0.2678	43	22	7.8	74.3	2.7	18-May	23-Jul
150	183.0	189.0	14.4	56.8	53.6	0.2974	402	24	8.7	73.8	2.7	19-May	23-Jul
150d	175.2	198.5	14.6	55.9	48.7	0.2810	41	20	8.5	73.9	2.7	20-May	24-Jul
200	190.3	209.4	14.1	56.1	54.0	0.3021	985	61	9.1	73.5	2.7	20-May	23-Jul
Mean	158.3	--	14.1	55.7	41.2	0.2608	302	28	8.2	74.0	2.7	19-May	24-Jul
C.V. (%)	6.4	--	1.3	0.7	6.3	5.8	77.8	28.3	2.3	0.5	7.0	0	0
LSD 0.10	12.7	--	0.2	0.5	3.3	0.0190	296	10	0.2	0.5	NS	0.7	NS
LSD 0.05	15.5	--	0.3	0.6	4.0	0.0232	362	12	0.3	0.6	NS	0.9	NS

Planting Date = April 28; Harvest Date = October 14; 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 objectives of this study were 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 loam and Gardena loam; pH = 7.1; 1.9% organic matter; Soil N average 27 lbs/acre; soil P and soil K were very high; soil S was high.
Previous crop:	2014 – soybean.
Seedbed preparation:	Strip-till April 27 with an Orthman strip-till machine.
Hybrid:	Dairyland DS9791Aa
Planting:	Planted April 28 @ 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 April 27. Stream-bar all plots with 13 lbs N/acre and 17.6 lbs S/acre as 15-0-0-20 May 7. Stream-bar 79 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 5. Sidedress N treatments as 28-0-0 (three inches deep) June 11; 200 lb treatment received 131 lbs N/acre, the 150 lb treatment received 81 lbs N/acre and the 100d treatment received 31.5 lbs N/acre.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Harness (2 pt/acre) May 8, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05%v/v) + AMS (1½ lbs/acre) + Interlock (4 oz/acre) 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:	Hand harvest October 14 and October 15. 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 utilized 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 2015.

Fertilizer N Rate	Grain Yield[1]	Grain Yield 2009-15	Harvest Moisture	Test Weight	Chlorophyll Meter Reading[2]	NDRE[3]	Nitrate-N Stalk	Nitrate-N Fall Soil	Population	Seed Protein	Seed Oil	Seed Starch	Emerge Date	Silk Date
lb/acre	bu/ac	bu/ac	%	lb/bu	4-Aug	6-Aug	ppm	lbs/ac	plants/ac	----------%----------				
22	150.1	129.4	15.7	52.0	29.7	0.2692	121	14	30963	7.2	1.9	75.4	19-May	23-Jul
100	192.0	179.9	15.6	52.9	46.4	0.3263	39	15	31846	7.6	2.0	75.0	19-May	22-Jul
100d	201.7	193.7	15.7	52.9	53.9	0.3415	108	22	30257	8.0	2.1	74.8	19-May	22-Jul
150	217.2	222.8	15.7	53.7	58.3	0.3515	270	37	32258	8.5	2.1	74.5	19-May	22-Jul
200	220.7	232.5	15.3	53.9	62.4	0.3485	985	70	30786	8.6	2.0	74.4	19-May	21-Jul
Mean	196.3	--	15.6	53.1	50.1	0.3274	304	32	31222	8.0	2.0	74.8	19-May	22-Jul
C.V. %	4.6	--	3.2	2.0	9.1	3.8	46.2	38	4.0	3.1	8.3	0.6	--	0
LSD 0.10	11.4	--	NS	NS	5.7	0.0156	177	15	NS	0.3	NS	0.5	--	0.8
LSD 0.05	13.9	--	NS	NS	7.0	0.0191	217	19	NS	0.4	NS	0.6	--	NS

Planting Date = April 28; Harvest Date = October 14; 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 = 7.3; 2.1% organic matter; soil N 14 lb/acre; soil P was high; soil K was very high; soil S was medium.
Previous crop:	2014 – field corn.
Seedbed preparation:	Strip-till April 27 with an Orthman strip-till machine.
Hybrid:	Dairyland DSR 0404 R2Y.
Planting:	May 22 @ 174,200 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 April 27.
Irrigation:	Overhead sprinkler irrigation as needed.
Pest control:	Roundup (30 oz/acre) + AMS (1 lb/10 gal) June 4 and Roundup (30 oz/acre) + AMS (1 lb/10 gal) + Mon 63410 (1.5 qt/acre) June 23 for weed control.
Harvest:	September 30 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.

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Impact of Inoculation Timing on Seed Yield and Quality in Confection Sunflowers

M. Wunsch, B. Kraft, M. Schaefer and S. Kallis, L. Besemann and H. Eslinger

Methods

General Agronomics: The study was on a Maddock sandy loam soil type. The soil fertility results from the fall soil test: pH = 7.5; 1.6% organic matter; soil N 22 lbs/acre; soil P = 25 ppm, soil K = 181 ppm, soil S 24 lb/acre and soil Zn = 1.09 ppm. The previous crop was spring wheat and the tillage operation consisted of disking once followed by two passes with a multiweeder to smooth the seedbed and incorporate the herbicide Trust (4 lbs/gal trifluralin; Winfield Solutions) applied at 1 pt/acre preplant incorporated June 1.

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

Planting details: Nuseed 'Jaguar' sunflowers were planted on June 1 using a Monosem vacuum precision planter. The seeding rate was 3.83 seeds/linear foot of row = 60,000 seeds/acre. The final plant population was 1 plant every 12 inches of row = 17,400 plants/acre. The final population was established by manual thinning the sunflowers at the V2 growth stage June 17 and June 18.

Disease establishment: 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 approximately 30,000 spores were delivered through 3 squirts of the spray bottle.

Inoculation methods – R5.1 to R5.3 inoculation timing: Inoculations were conducted over multiple days such that every head was inoculated at R5.1 to R5.3 (10 to 30% of the disk flowers blooming or already bloomed). In each inoculation, approximately 30,000 spores were delivered through three squirts of the spray bottle.

Inoculation methods – R5.4 to R5.6 inoculation timing: Inoculations were conducted over multiple days such that every head was inoculated at R5.4 to R5.6 (40 to 60% of the disk flowers blooming or already bloomed). In each inoculation, approximately 30,000 spores were delivered through three squirts of the spray bottle.

Inoculation methods – R5.7 to R5.9 inoculation timing: Inoculations were conducted over multiple days such that every head was inoculated at R5.7 to R5.9 (70 to 90% of the disk flowers blooming or already bloomed). In each inoculation, approximately 30,000 spores were delivered through three squirts of the spray bottle.
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.

Disease assessments: Disease assessments were conducted on August 25 and August 26 at the R7 growth stage and on September 10 and September 11 at the R8 growth stage. Each plant was evaluated for the percent of the head exhibiting Sclerotina head rot.

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Harvest and seed yield and quality assessment: Plants were manually clipped and bagged on September 16 and September 17 as the sunflowers approached maturity (sunflowers reached R9 on September 11) and subsequently run through a combine. To adjust yield data to standard moisture levels, seed moisture levels were assessed from all plots at harvest. The entire plot was harvested, and plot-level yields were adjusted to a standard 10% moisture level. The percent sclerotia (by weight) in the harvested grain was assessed by manually removing all sclerotia from a 120-gram subsample of grain from each plot.

Statistical analysis: Data were evaluated with analysis of variance except those data sets for which multiple plots included missing data (Sclerotinia heat rot severity, shattering incidence and severity; for these data sets, any plots in which no disease was observed were recorded as missing data). 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.
The R9 Sclerotinia head rot incidence and severity index data and % seed over 25/64 sieve for hybrid '12GCF05' exhibited a moderate deviation from normality due to outliers; a systematic transformation could not be found that addressed the problem, and the untransformed data were analyzed. 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)] was applied. *Assessment of whether results differed by inoculation timing and/or hybrid and whether there was an interaction between inoculation timing and hybrid*: 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 (hybrid) utilizing replicate-by-hybrid interaction for the error term. *Assessment of inoculation timing*: The impact of inoculation timing treatments was evaluated separately for each hybrid; where no significant ($P < 0.05$) hybrid x inoculation treatment interaction occurred, it was also evaluated in the combined data across hybrids, with data from each hybrid considered a separate replicate (for a total of 16 replicates). 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. Analyses were implemented in PROC UNIVARIATE and PROC GLM of SAS (version 9.3; SAS Institute, Cary, NC).

Conclusions:
* Disease was most severe when sunflower heads were inoculated when 10-30% and 70-90% of disk flowers were blooming or had already completed bloom. The reduced disease development observed when inoculations were conducted when 40-60% of disk flowers were blooming or already completed bloom may have been caused by environmental conditions less favorable for disease when sunflowers were predominantly at this growth stage.
* Yields were reduced 0.44 to 0.53% for every 1% increase in the average percent of heads exhibiting head rot. The impact of disease yield was similar irrespective of whether inoculations were conducted at R5.1-5.3, R5.4-5.6, or R5.7-5.9.
* The results suggest that, to be effective, fungicides will probably need to be applied at bloom initiation when conditions favorable to disease occur.

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Table 1. Disease, Seed Yield and Seed Quality Response to Inoculation Timing.

	Sclerotinia head rot								
	Aug. 25-26 | R7 growth stage			Sept. 10-11 | R8 growth stage					
	Incidence	Severity	Sev Index	Incidence	Severity	Sev Index	Yield	Test weight	Sclerotia in harvested grain
	----------%----------						lbs/ac	lbs/bu	% by weight
Non-inoculated	14 a*	38 ab*	6 a*	74 a*	68 a*	51 a*	2715 a*	41.3 a*	3 a*
Inoculated once at R5.1 to R5.3 (first third of bloom)	38 b	38 ab	15 b	90 b	85 bc	78 bc	2264 b	41.0 ab	7 b
Inoculated once at R5.4 to R5.6 (second third of bloom)	26 a	33 a	9 a	89 b	82 b	74 b	2534 a	41.9 ab	6 b
Inoculated once at R5.7 to R5.9 (last third of bloom)	43 b	41 b	18 b	94 b	88 c	83 c	2162 b	40.3 b	9 c
F:	14.83	4.11	14.17	13.65	13.00	16.88	10.79	3.37	12.32
P>F:	< 0.0001	0.0127	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0282	< 0.0001
CV:	27.5	20.6	34.4	6.2	6.8	10.9	10.1	4.5	34.3

SCLEROTINIA HEAD ROT YIELD LOSS RELATIONSHIP RELATIVE TO INOCULATION TIMING

Oakes:

For every 1% increase in Sclerotinia severity index, yields were reduced 0.44% when sunflowers were inoculated at R5.1-5.3, 0.46% when sunflowers were inoculated at R5.4-5.6, and 0.53% when sunflowers were inoculated at R5.7-5.9.

Carrington:

For every 1% increase in Sclerotinia severity index, yields were reduced 0.64% when sunflowers were inoculated at R5.1-5.3, 0.58% when sunflowers were inoculated at R5.4-5.6, and 0.53% when sunflowers were inoculated at R5.7-5.9.

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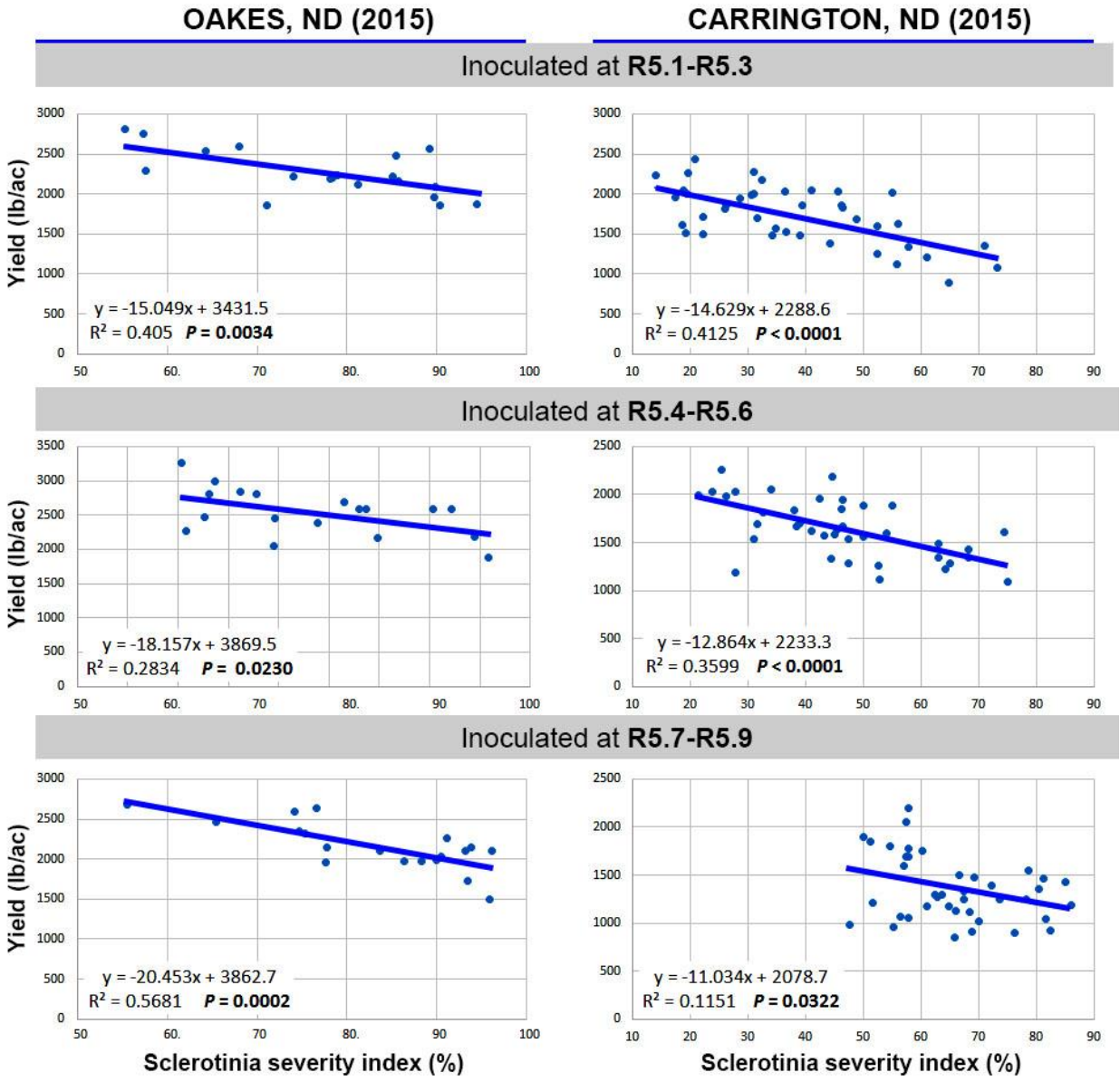

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Optimum Corn Stover Removal for Biofuels and the Environment

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: 2015 – field corn, 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: 2015 – field corn, 2014 - soybean, 2013 - field corn, 2012 - soybean, 2011 - field corn, 2010 - soybean, 2009 - field corn, 2008 - soybean, 2007 - field corn.
	Block III: 2015 – soybean, 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 = 6.3; 2.4% organic matter; soil N 34 lbs/acre; soil P and soil K were very high; soil S was medium.
	Block II: pH = 6.5; 2.3% organic matter; soil N 23 lbs/acre; soil P and soil K were very high; soil S was high.
	Block III: pH = 6.5; 1.7% organic matter; soil N 28 lbs/acre; soil P was very high; soil K was high; soil S was low.
Seedbed preparation:	Strip-tilled April 24 with an Orthman strip-till machine.
Hybrid:	Corn: Wensman W90941STX RIB.
Variety:	Soybean: Dairyland DSR 0404 R2Y.
Planting:	Block I: Corn, May 1 in 30-inch rows @ 33,000 seeds/acre.
	Block II: Corn, May 1 in 30-inch rows @ 33,000 seeds/acre.
	Block III: Soybean, May 22 in 30-inch rows @ 174,200 seeds/acre.

Fertilizer:	Block I: Stream-bar 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 May 5, 50 lbs N/acre as 28-0-0 May 5, 13 lbs N/acre and 18 lbs S/acre as 15-0-0-20 May 7. Sidedress 145 lbs N/acre as 28-0-0 June 12.
	Block II: Stream-bar 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 May 5, 50 lbs N/acre as 28-0-0 May 5, 13 lbs N/acre and 18 lbs S/acre as 15-0-0-20 May 7. Sidedress 145 lbs N/acre as 28-0-0 June 12.
	Block III: Stream-bar 12 lbs N/acre and 40 lbs P_2O_5/acre as 10-34-0 May 5.
Irrigation:	Hand move sprinkler irrigation as needed.
Pest control:	Block I: Harness (2 pt/acre) May 8, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05% v/v) + AMS (1½ lbs/acre) + Interlock (4 oz/acre) June 4.
	Block II: Harness (2 pt/acre) May 8, Laudis (3 oz/acre) + AAtrex 9-O (0.5 lb ai/acre) + Destiny (0.05% v/v) + AMS (1 ½ lbs/acre) + Interlock (4 oz/acre) June 4.
	Block III: Roundup (30 oz/acre) + AMS (1 lb/10 gal) June 4 and Roundup (30 oz/acre) + AMS (1 lb/10 gal) + MON 63410 (1.5 qt/acre) June 23.
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) from rows 6 and 7 from each plot on October 12 and October 13.
	Block II: Hand harvested the entire length (27 feet) from rows 6 and 7 from each plot on October 13.
	Block III: Harvested with a JD 4400 combine (48 rows 108 feet long, recorded with a weigh wagon) on September 30.

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RESULTS BLOCK I (Corn/Corn) - 2015

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 percent confidence level. Longer term data from 2009 to 2015 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 (Corn/Soybean) - 2015

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

RESULTS BLOCK III (Soybean/Corn) - 2015

All soybean plots were combine harvested and bulked. The soybeans yielded 56.7 bu/acre @ 13 % (harvest moisture = 9.2%) and had a test weight of 57.2 lbs/bu.

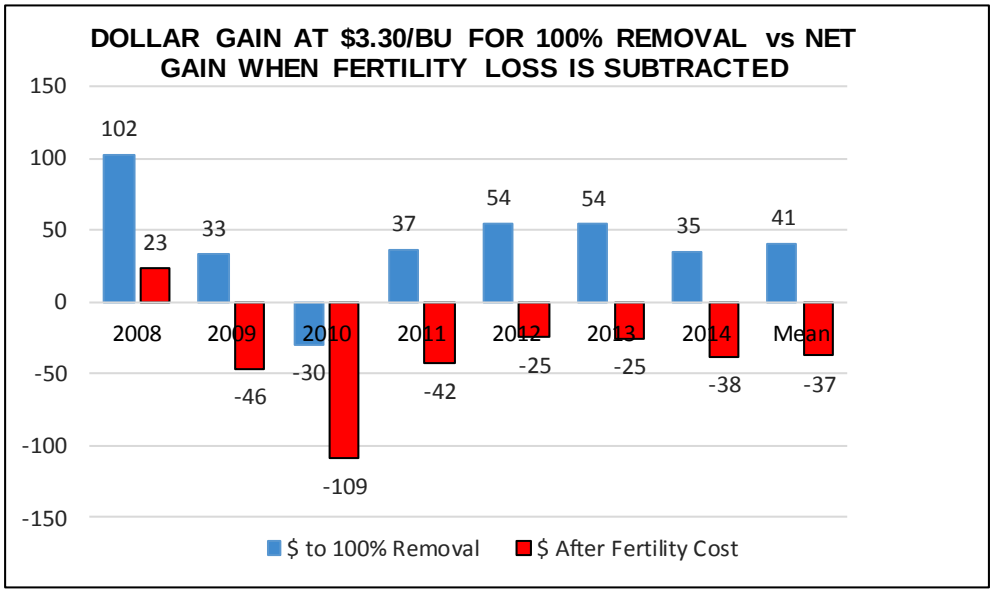

Figure 1. The net return when the fertility cost leaving the field is subtracted from the yield advantage in 100 percent removal plots compared to 0 percent removal plots for corn on corn 2008 to 2014 (Mean) at the Oakes Irrigation Research Site.

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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 2015.

Stover Removal	Grain Yield[1]	Grain Yield 2009-14	Harvest Moisture	Test Weight	Stalk DM Removal[2]	Stalk DM Removal 2008-14	Chlorophyll Meter Reading[3]	NDRE[4]	Population	Stalk Nitrate-N	Fall soil Nitrate-N
%	bu/ac	bu/ac	%	lb/bu	------ ton/ac ------		4-Aug	5-Aug	plants/ac	ppm	lbs
0	195.1	213.1	15.2	54.8	0.0	0.0	57.2	0.3244	32670	1929	74
33	201.4	218.8	15.4	55.2	1.8	2.2	58.7	0.3278	32025	1737	66
67	202.6	220.3	15.3	54.1	2.1	3.3	62.6	0.3240	31864	1660	83
100	205.7	221.2	15.3	54.5	3.5	5.0	58.7	0.3179	32347	1549	94
Mean	201.2	--	15.3	54.6	1.8	--	59.3	0.3235	32226	1719	79
C.V. (%)	6.3	--	2.0	1.1	9.9	--	3.8	0.9	3.8	16.4	52.0
LSD 0.10	NS	--	NS	NS	0.24	--	2.9	0.0039	NS	NS	NS
LSD 0.05	NS	--	NS	NS	0.29	--	3.6	0.0048	NS	NS	NS

Table 1. The affect of corn stover removal from 0 to 100% on grain yield and other agronomic parameters for corn on corn plots 2015 (continued).

Stover Removal	Seed			Emerge Date	Silk Date	Nutrients in stover[2]			Nutrient Value	
	Oil	Protein	Starch			N	P	K	2015[2]	2008-2015
%	----------%----------					------ lb/acre ------			------ $/ac ------	
0	2.2	9.2	73.5	22-May	22-Jul	0	0.0	0	0	0
33	2.2	8.9	73.7	20-May	20-Jul	26	1.3	24	18	35
67	2.2	9.0	73.7	20-May	20-Jul	31	2.1	24	20	50
100	2.2	8.8	73.9	20-May	20-Jul	52	2.8	53	37	73
Mean	2.2	8.9	73.7	21-May	20-Jul	27	1.5	25	19	--
C.V. (%)	13.2	2.7	0.6	0	0	27.3	45.9	44.4	30.8	--
LSD 0.10	NS	NS	NS	0.8	1.3	9.6	0.9	15	7.5	--
LSD 0.05	NS	NS	NS	0.9	1.7	12	1.1	18	9.3	--

Planting Date = May 1; Harvest Date = October 13 ; Previous Crop = Corn

Fertilizer Rate lbs/acre = 220 N, 40 P_2O_5, 18 S; Irrigation = 12.0 inches.

[1] Yield adjusted to 15.5% moisture.

[2] Corn stover removed spring of 2015 from 2014 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 2009-2015.

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	213.1	20.8	54.1	54.4	0.3545	2362	8.6	24-Jul	29-Sep
33	218.8	20.1	54.7	55.6	0.3566	2760	8.6	22-Jul	28-Sep
67	220.3	20.1	54.6	57.1	0.3570	2740	8.6	22-Jul	27-Sep
100	221.2	19.6	54.8	56.5	0.3525	2915	8.7	21-Jul	27-Sep
Mean	218.4	20.2	54.5	55.9	0.3551	2694	8.6	22-Jul	28-Sep

Table 3. The affect of corn stover removal from 0 to 100% on grain yield and other agronomic parameters for corn on soybean plots 2015.

Previous Year Stover Removal	Grain Yield[1]	Grain Yield 2009-15	Harvest Moisture	Test Weight	Chlorophyll[2]	NDRE[3]	Fall Soil Nitrate-N	Population	Seed			Emerge Date	Silk Date
									Oil	Protein	Starch		
%	bu/ac		%	lb/bu	4-Aug	5-Aug	lbs	plants/ac	----------%----------				
0	217.9	225.8	14.9	55.3	61.7	0.3272	114	33074	2.4	9.1	73.3	20-May	19-Jul
33	211.5	220.8	14.3	55.4	61.4	0.3268	124	33396	2.4	8.9	73.4	20-May	20-Jul
67	219.4	221.8	14.3	55.6	61.0	0.3371	151	33396	2.4	8.9	73.6	20-May	19-Jul
100	216.2	224.3	14.6	55.6	62.1	0.3286	120	33235	2.5	9.0	73.4	20-May	19-Jul
Mean	216.3	--	14.5	55.5	61.5	0.3299	127	33275	2.4	9.0	73.4	20-May	19-Jul
C.V. (%)	4.1	--	2.4	0.9	6.8	2.2	36.0	3.2	10.7	2.2	0.6	0	0
LSD 0.10	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

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

Fertilizer Rate lbs/acre = 220 N, 40 P_2O_5, 18 S; Irrigation = 12.0 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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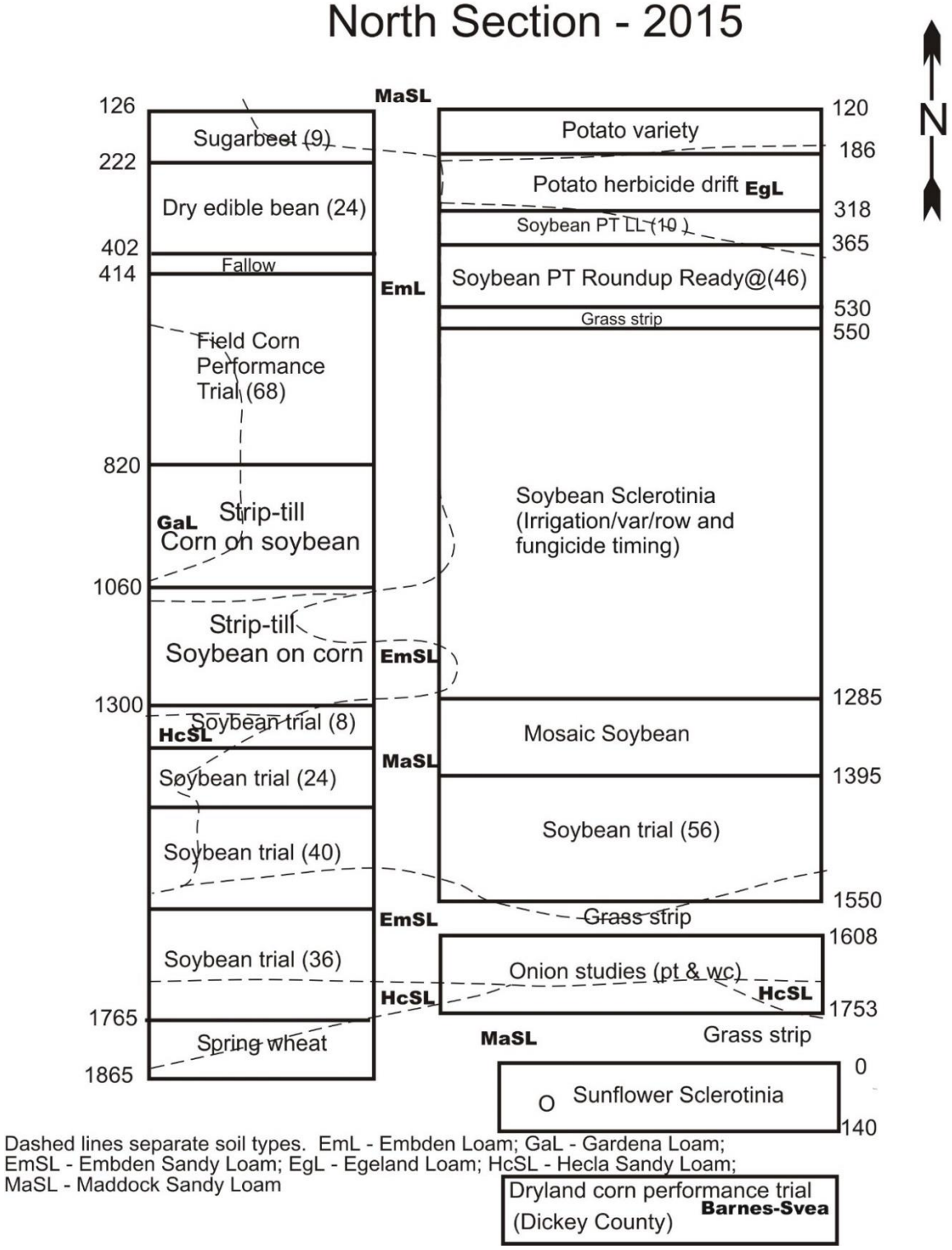
OAKES IRRIGATION RESEARCH SITE

North Section - 2015



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

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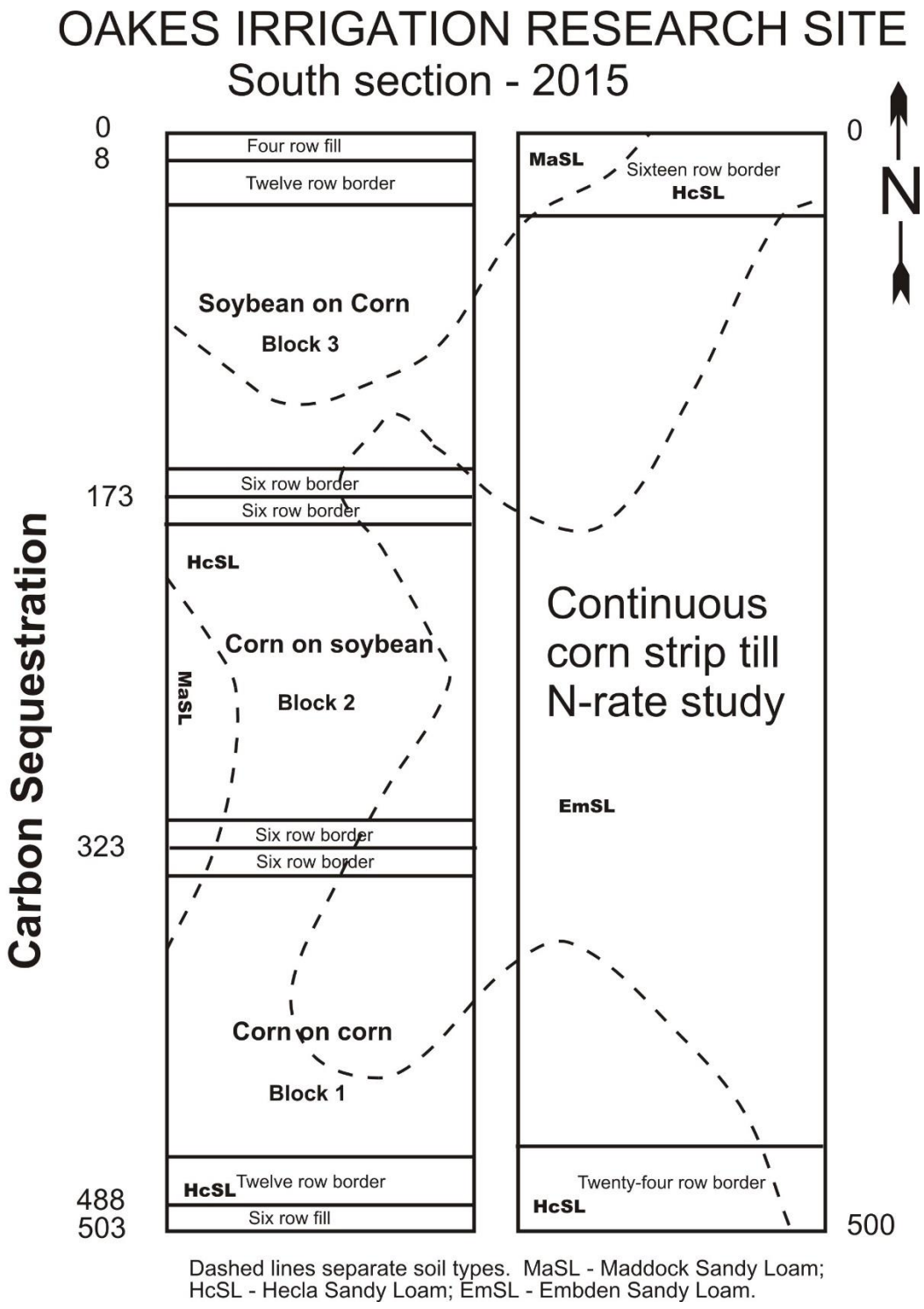

Dashed lines separate soil types. MaSL - Maddock Sandy Loam; HcSL - Hecla Sandy Loam; EmSL - Embden Sandy Loam.

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