ANNUAL PROGRESS REPORT 2015

SOUTHEAST SOUTH DAKOTA EXPERIMENT FARM

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE UNIVERSITY

This is an annual report of the research program at the Southeast South Dakota Research Farm in cooperation with South Dakota Agricultural Experiment Station, SDSU Plant Science, and SDSU Animal Science and has special significance for those engaged in agriculture and the agriculturally related businesses in the ten county area of Southeast South Dakota. The results shown are not necessarily complete or conclusive. Interpretations given are tentative because additional data resulting from continuation of these experiments may result in conclusions different from those based on any one year.

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The Southeast Farm is located at 29974 University Road, Beresford, SD 57004. Telephone 605-563-2989; Fax 605-563-2941; Farm Supervisor, Peter Sexton email (peter.sexton@sdstate.edu).

Internet web page: http://www.sdstate.edu/ps/research/farms/southeast/index.cfm

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Peter Sexton, Farm Supervisor
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Sheila Price, Research Assistant
Ruth Stevens, Senior Secretary
Doug Johnson, Senior Ag Technician
Garold Williamson, Ag Foreman
Kevin Henseler, Ag Technician (Summer)
Jared Thompson, Ag Technician (Livestock)
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ACKNOWLEDGEMENTS

The applied research effort at the SDSU Southeast Farm depends on the goodwill and hard work of many people. Our board members represent the rural communities of southeast South Dakota and donate their time and share their expertise and thought to the operations of the farm. They need to be acknowledged for their critical contribution to the research farm and its continued success. The staff members at the farm - Garold Williamson, Ruth Stevens, Brad Rops, Doug Johnson, and Sheila Price – are the folks who make the farm operational from day to day and also hold the farm together across the years, contributing to its constancy of purpose. Sara Berg, Anthony Bly, David Karki, Paul Johnson, Dave Vos, Jill Alms, Scott Cortus, and many others from SDSU research and extension have also contributed to the farm's efforts of the past year and we look forward to continuing to work with them in research and extension roles in the coming year. Kevin Henseler and Jared Thompson were able to work for the farm on part-time basis this past year – which is vital at key points in order to keep things moving forward in a timely manner - their contribution also, needs to be acknowledged.

Support of the Ag Experiment Station at SDSU lead by Dr. Daniel Scholl, and David Wright, Dept. Head Plant Science, and Joe Cassidy, Dept. Head Animal Science, have also been important for the farm's operation. We look forward to continuing and expanding our interaction with SDSU faculty and college administrators in the coming year.

As always, we are thankful to God for yet another year that we can move forward with work, and we continue to hope the year ahead will be a good and productive one.

This publication was edited and compiled by Ruth Stevens and Peter Sexton.

Planting multi-hybrid plots; Southeast Research Farm

INTRODUCTION ……………..……………………………………………………..Pete Sexton
Farm Supervisor

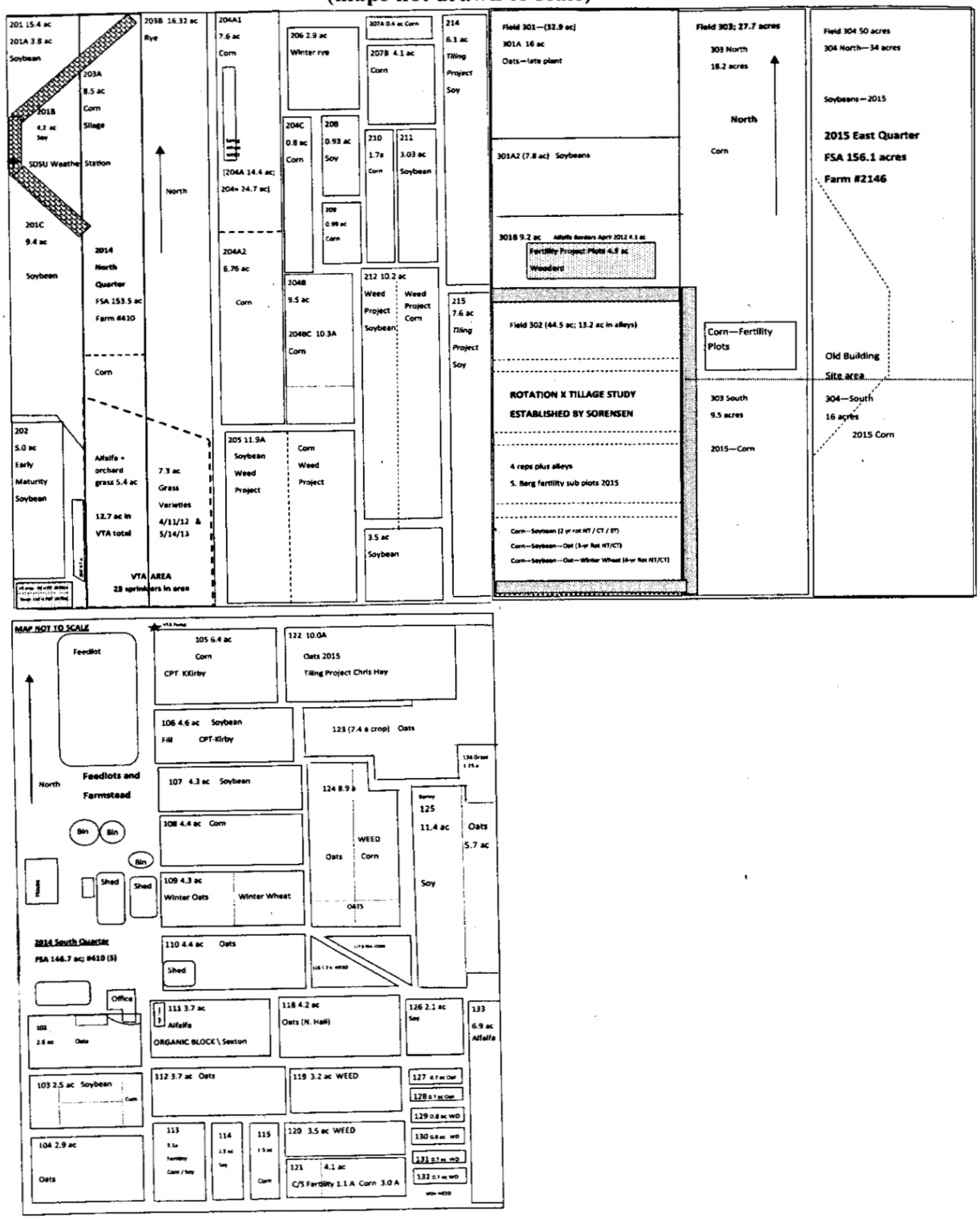
Weather-wise the 2015 season was about as good as it gets for our immediate area. Other than a short period of mild stress in mid-July, we didn't have any drought stress to speak of, and we didn't have any extended periods of above-average temperatures which would create heat stress and shorten grain-filling periods. On the other hand, prices are low with an abundance of grain on the market, so efficiency will be critical in the year ahead.

There are a number of projects that the new year will bring to the research farm. Dr. Sandeep Kumar has received a very large grant from the USDA to look at how grazing cover crops impacts soil quality and productivity. Much of this work will be based out of the Southeast Farm. Ultimately, the goal here is to stack enterprises and include grazing of cover crops and crop residues as a way to increase returns off the whole system and also at the same time hopefully improve soil quality. If the grazing is well-managed this should be a win-win situation. Another area the farm is expanding in is the production of fruit trees and perhaps some vegetables in our new high tunnel. We plan to bring a student-intern on board to help with this over the summer so that it doesn't take away from our other work. This is a small beginning, but we hope it will develop well as it represents an opportunity for younger folks with only a few acres to get started in agriculture, and it also represents an opportunity for diversification. Eating locally produced food is the trend right now – we might as well take advantage of that and add value to our system where we can. Of course we plan to carry on with our collaborators at SDSU to facilitate their work with crop performance testing of corn and soybean lines, herbicide and fungicide evaluations, tile drainage, fertilizer and seed treatments, swine nutrition and feedlot rations. These things may not seem glamorous, but they represent the management details that often make the difference between profit and loss or success and failure in crop and livestock production.

The farm's strategic goals are to: 1) Improve character of the soil (soil quality); 2) Achieve grain yield goals and optimize cost of production and profitability; 3) Optimize livestock production including use of novel approaches in integrating livestock and crop production; 4) Increase association membership and improve public relations and outreach; 5) Broaden scope of research to include small-scale and beginning farmers and horticulture work as opportunity permits. Our overall objective is to contribute to the public welfare for folks in southeast South Dakota by conducting unbiased agricultural research. This annual report is part of our effort to deliver on this objective. I hope this report is of value for your operation. It represents the work of many faculty and staff from SDSU as well as the crew at the research farm. We are always looking to improve on our efforts and like to listen to new ideas- please feel free to stop in and visit or call to share suggestions and comments about our research. We plan to have our summer field day on July 12, and a fall one on September 8, God willing. We hope that you can make it to Beresford for both events. We hope you have a good year ahead.

2015 Southeast Farm Land Use Map

(maps not drawn to scale)



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WEATHER AND CLIMATE SUMMARY

Ruth Stevens*, Peter Sexton, Brad Rops, Doug Johnson, Garold Williamson, and Sheila Price

The 2015 weather was ideal for row crops. A combination of plentiful rainfall and cooler than normal maximum temperatures during the summer months allowed crops to grow without significant drought or heat stress producing above average yields. September and October had above normal temperatures, and October had below normal precipitation helping row crops to mature and fields to dry. There were scattered area fields, however, with late harvested corn and soybeans due to the above normal precipitation the area received in July, August, and September. Late fall brought above normal temperatures and heavy wet snows to immediate area that further saturated the ground, and created very muddy conditions in fields and feed yards.

The 2015 Southeast Farm weather and climate information that is compiled from daily observations is summarized in tables and graphs on pages 2 thru 6.

Average annual maximum and minimum temperatures were above normal in 2015. However, the growing season had four months (May, June, July, and August) with cooler than normal temperatures. There were seven months (January, March, April, September, October, November, and December) with above average max temperatures (Table 1; Fig. 1); and there were seven months (January, April, June, September, October, November, and December) with above normal min temperatures. The average annual max temperature was 60°F and average annual min temperature was 37°F; which were both above average (+1.4 and +1.3 degrees, respectively) (Table 3).

The coldest and hottest temperatures of the year were recorded on February 27 (-16°F) and June 9 (96°F) respectively, a 112-degree temperature range (Table 3). Frost-free season at the Southeast Farm in 2015 was 168 days on a 32°F basis and 177 days on a 28°F-basis, The last spring frost was on April 29 (29˚F) and last freeze was on April 22 (19˚ F). The first fall frost was on October 14 (32˚F) and a freeze occurred on October 16 (24˚F).

Annual precipitation and growing season precipitation were both above average in 2015 (Table 2, Fig. 2 and 3). Southeast Farm received 30.3 inches of annual precipitation, which is 119% of normal (Table 3). Growing season precipitation measured from April thru September was 24.9 inches (131% of the normal). Southeast Farm received 44.2 inches of snowfall in 2015; 10 inches during the first half of the year and 34 inches during November and December.

The 2015 growing season (April – October) accumulation of growing degree units (GDU's) was 3175 units (104% of average), (Fig. 4 and 5) with the months of April, September, and October having above normal GDU's. Evaporation recorded at the Southeast Research Farm during May through September was 28.8 inches (Fig. 6 and 7). Southeast Research Farm received 23.7 inches of rainfall during the same period of time.

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Table 1. Temperatures[a] at the Southeast Research Farm - 2015

	2015 Average Air Temps. (°F)		63-year Average Air Temps. (˚F)		Departure from 63-year Average	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
January	31.1	11	26.6	5.4	4.5	5.4
February	28.5	4.7	32.1	11.0	-3.6	-6.3
March	54.5	21.9	44.1	22.8	10.4	-0.9
April	64.6	35.9	60.2	35.1	4.4	0.8
May	69.5	47	72.0	47.3	-2.5	-0.3
June	80.6	58.4	81.4	57.7	-0.8	0.7
July	82.7	61	86.0	62.0	-3.3	-1.0
August	79.6	57.2	84.0	59.4	-4.4	-2.2
September	78.5	56.1	75.6	49.1	2.9	7.0
October	66.1	39	63.5	37.6	2.6	1.4
November	48.6	26.8	45.2	23.7	3.4	3.1
December	33.9	19.7	30.7	11.5	3.2	8.2

[a] Computed from daily observations

Table 2. Precipitation at the Southeast Research Farm - 2015

Month	Precipitation 2015 (inches)	63-year Average (inches)	Departure from Avg. (inches)
January	0.24	0.46	-0.22
February	0.31	0.81	-0.50
March	0.32	1.42	-1.10
April	1.16	2.53	-1.37
May	3.53	3.44	0.09
June	3.56	4.23	-0.67
July	5.91	3.12	2.79
August	7.05	2.98	4.07
September	3.64	2.7	0.94
October	1.04	1.85	-0.81
November	2.21	1.15	1.06
December	1.29	0.65	0.64
Totals	30.26	25.34	4.92

<u>ACKNOWLEDGEMENT</u>:

Weather data is compiled from daily observations collected by Southeast Farm Personnel in cooperation with, Dennis Todey, South Dakota State Climatologist, South Dakota Office of Climatology and SDSU Extension, and the National Weather Service, Sioux Falls, SD. More climate information is available at South Dakota State University – South Dakota Climate and Weather site: http://climate.sdstate.edu/climate_site/climate.htm.

Table 3. 2015 Climate Summary; Southeast Research Farm, Beresford, SD

Annual Precipitation (inch)	30.26	119%*
Growing Season Precip (Apr-Sep, inch)	24.85	131%
Jan-Mar	0.87	32%
Apr-Jun	8.25	81%
Jul-Sep	16.60	189%
Oct-Dec	4.54	124%
Annual Snow (inch); (Jan-Jun/Jul-Dec)	9.9/34.3	44.2 total
Growing Degree Units (GDU); Apr - Oct	3175	104%
Minimum / Maximum Air Temp, ºF	-16° F Feb 27	96° F Jun 9
Last Spring Frost; 32º / 28º basis	Apr 29 - 29° F	Apr 22 - 19°F
First Fall Frost; 32º / 28º basis	Oct 14 - 32°F	Oct 16 - 24°F
Frost Free Period (days); 32º / 28º basis	168	180
Average Annual High / Low	60 / 37	+1.4 / +1.3
Evaporation / rainfall May–Sept (inch)	28.8	23.7

% of Normal

Figure 1. 2015 Average Max / Min Temperatures

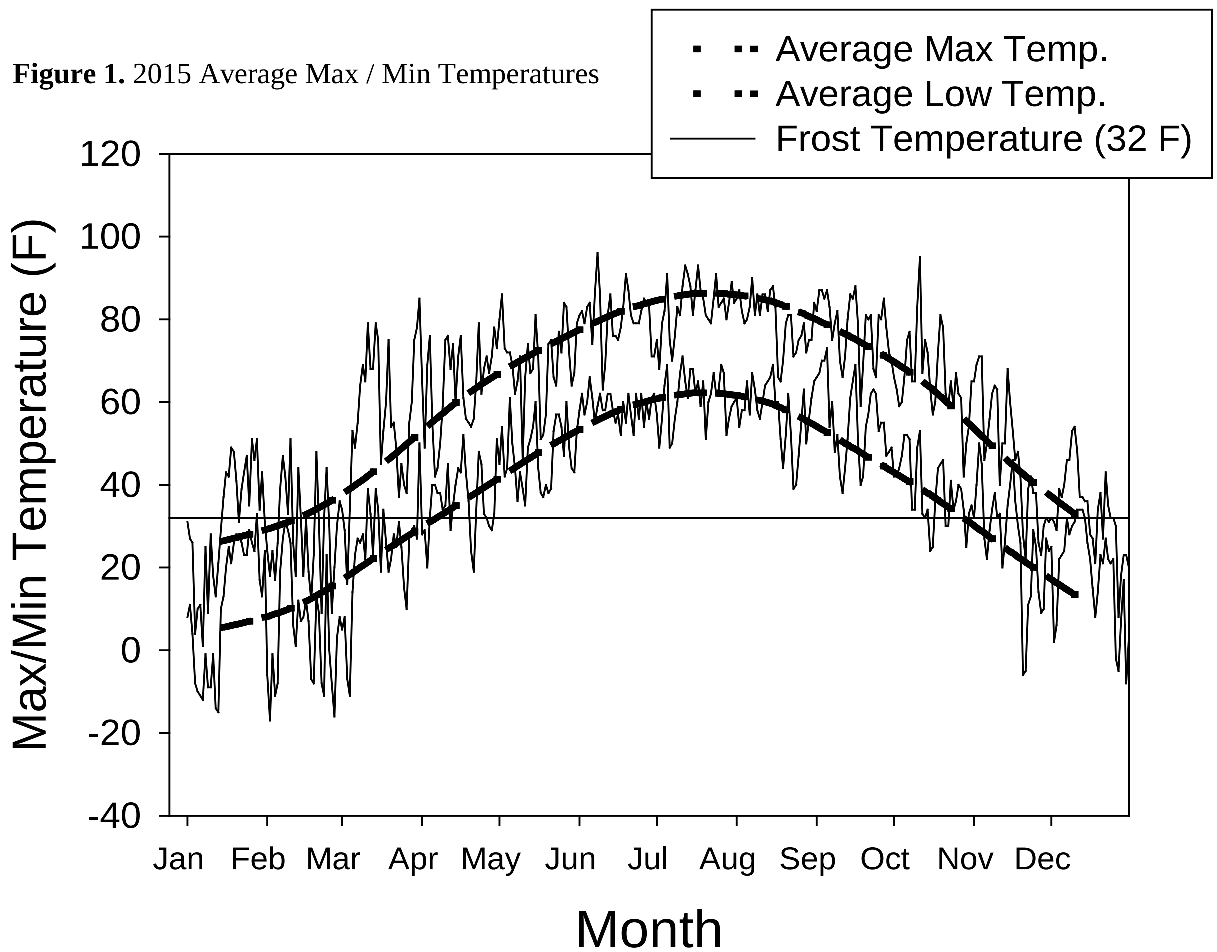


Figure 2. 2015 Monthly Precipitation;
Southeast Farm, Beresford, SD

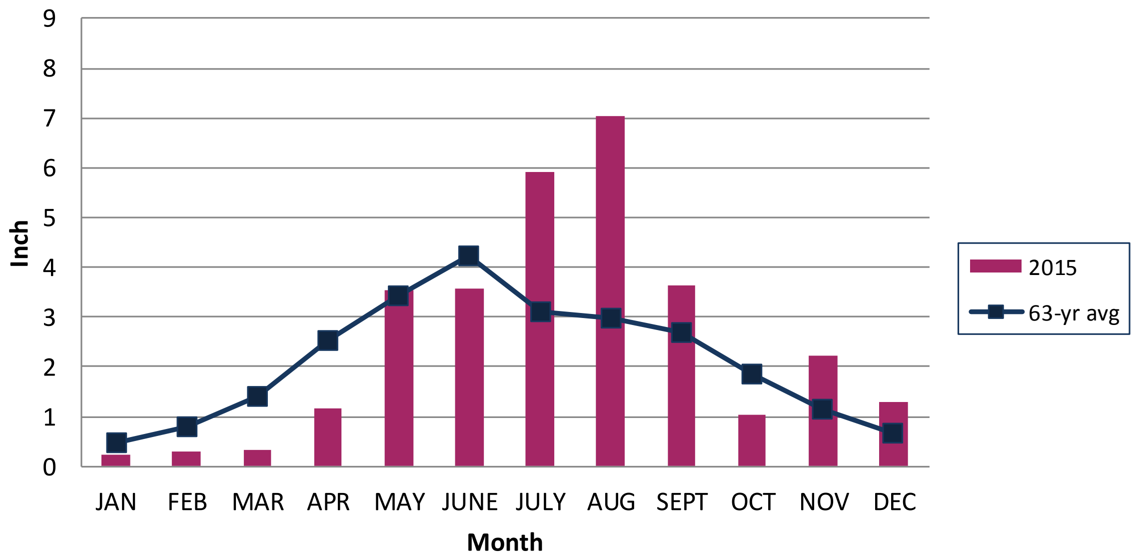


Figure 3. 2015 Cumulative Precipitation;
Southeast Farm, Beresford. SD

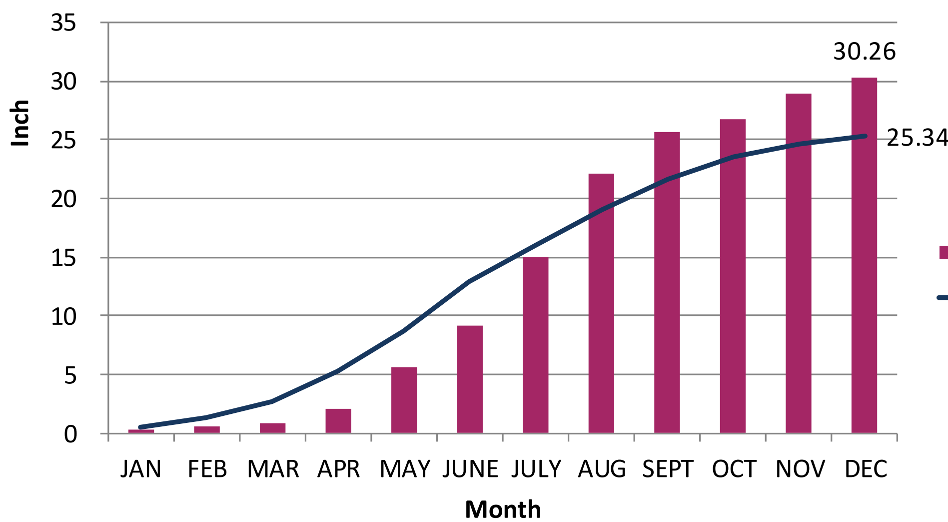


Figure 4. 2015 Growing Degree Units (GDU's); Southeast Farm, Beresford SD

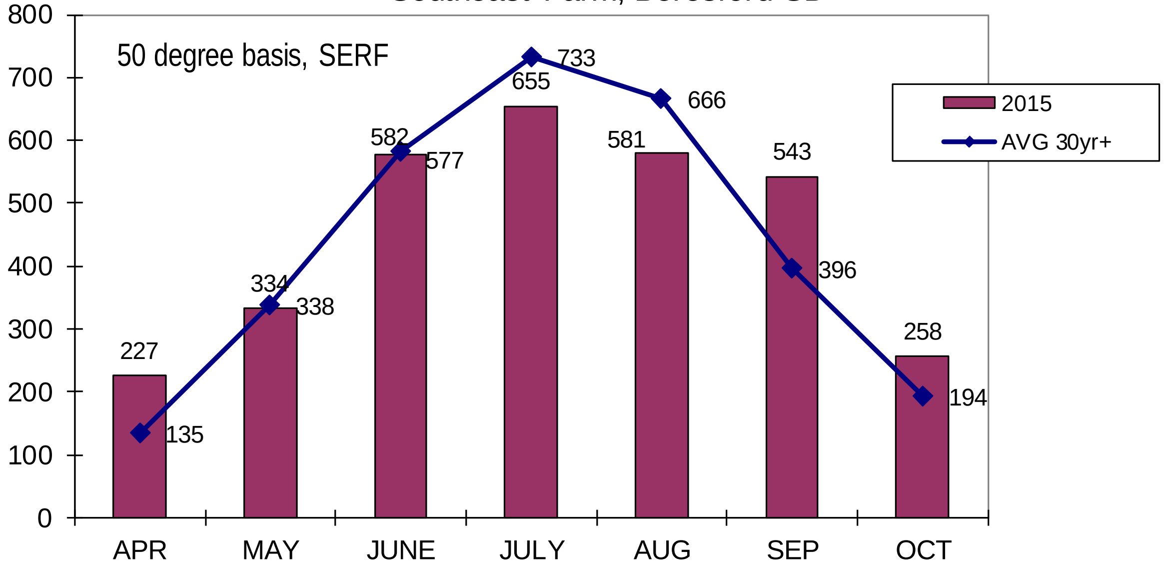


Figure 5. 2015 Cummulative GDU's; Southeast Farm, Beresford, SD

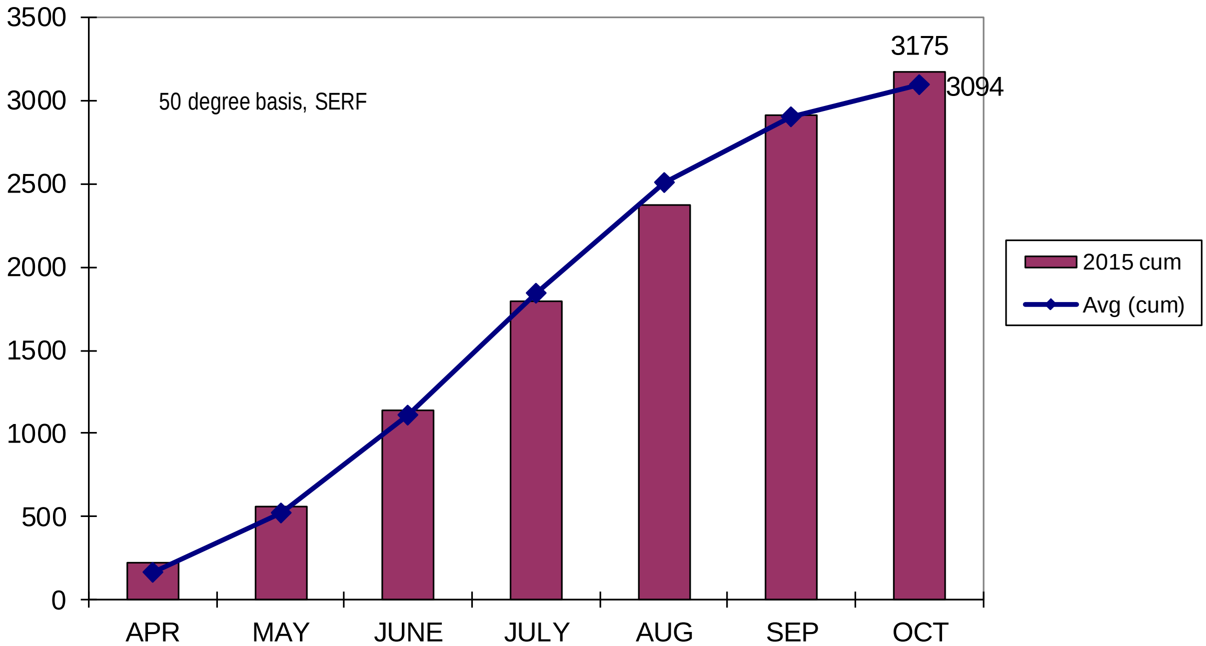


Figure 6. 2015 Growing Season
Rainfall vs. Evaporation
Southeast Farm

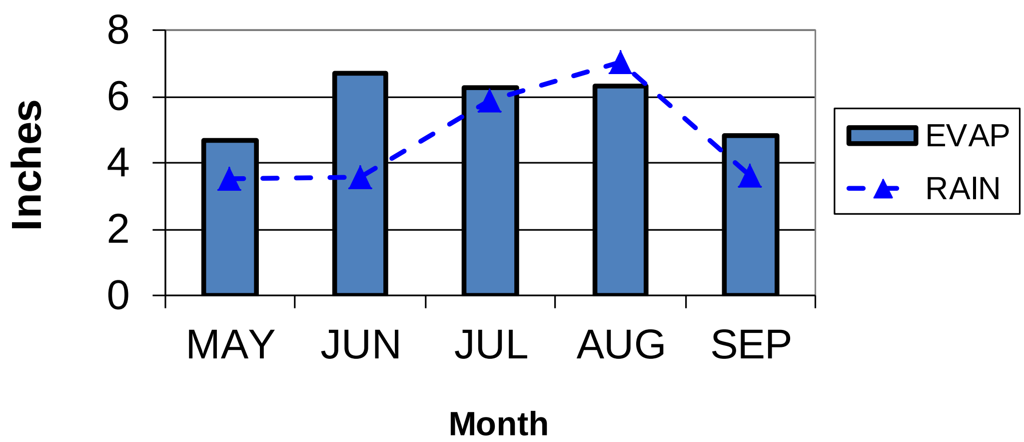
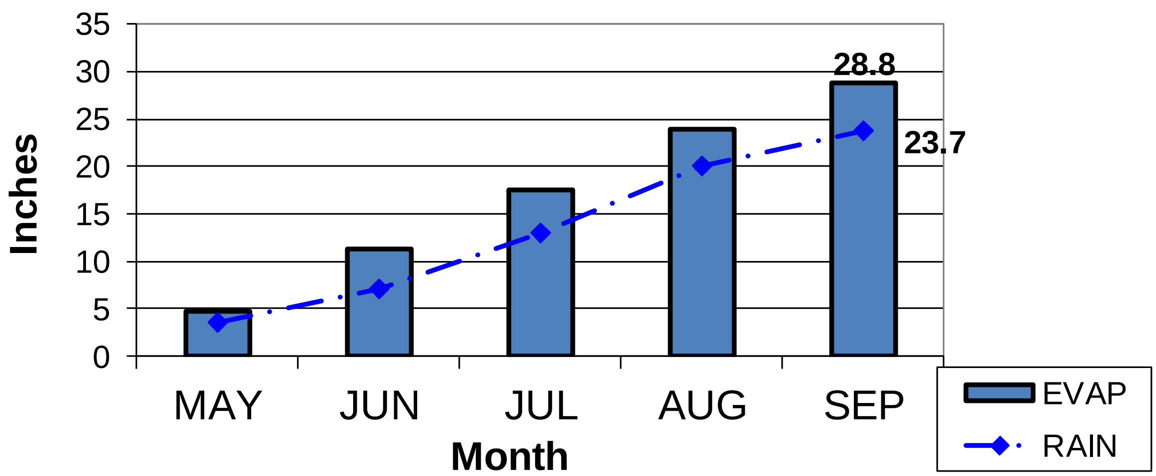


Figure 7. 2015 Growing Season
Cumulative Rainfall vs. Evaporation
Southeast Farm



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Evaluation of Multi-Line Seeding for Corn and Soybeans in Southeastern South Dakota – Year 3

Peter Sexton*, Douglas Prairie, Barry Anderson, Doug Johnson, Brandon Goette, and Dustin Theis.

INTRODUCTION

This report very briefly reviews our third season of trials looking at variable-line seeding of corn and soybeans using a multi-hybrid planter. Where previously we had used a smaller 6-row prototype unit developed in collaboration with Raven Industries and Pioneer Hi-Bred; in 2015, Kinze Manufacturing kindly provided a 16-row planter which they have made commercially available. In the first season (2013) at the Tripp and Beresford sites we found on average a 5 bushel per acre yield gain with variable line planting in corn and a 3 bushel per acre yield gain in soybeans. In the second year of the study, we again found a 6 bushel yield advantage with corn with the right pairing of lines, but no advantage with corn or soybeans if the lines didn't fit well. In this third year of the study we conducted we had 5 sets of plots for corn (all on-farm), and three sets for soybeans (two on-farm, and one at the research station).

The basic logic behind this approach is that given our rainfall distribution (which peaks in May and June) versus the water requirements of corn and soybean crops (which peak in August) there is a good chance that in the same field in the same season the lowland parts of the field may be yield limited by excess moisture early in the season, while the upland positions on the landscape will be yield limited by drought stress in late July and August. It seems logical that gains in productivity within a field might be achieved by using lines with a more horizontal root profile and tolerance to wet conditions in lowland portions of the landscape, and switching to lines with a more vertical root profile and resistance to drought conditions in the upland portions of the landscape. The primary objective of this project is to make an initial evaluation of improvements in grain yield for corn and soybeans grown with a variable-genotype planting system versus planting a single line across the landscape.

METHODS

This project was partially supported by the South Dakota Soybean Research and Promotion Council. Pioneer Hi-Bred provided materials to test, and Raven Industries and Kinze Manufacturing provided equipment. Field maps were developed for each test site by personnel from SDSU, CHS, or Country Pride Cooperative. Agronomists from Pioneer Hi-

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Bred selected the lines to be used in the upper and lower landscape positions for the study. The project looked at three pairs of corn lines and two pairs of soybean lines with only one given pair being tested at each site (Table 1). At each site treatments were upland line, lowland line, variable-line seeding according to landscape position, and variable-rate with variable line seeding. For corn, the standard and variable seed rates were: 30,000 and 26/34,000 at Beresford and Marion sites; 25,000 and 22/28,000, respectively, at the Tripp and Freeman sites. For soybeans, the standard and variable seed rates were 150,000 and 120/180,000, respectively, at all locations. All individual treatments were planted in field-length plots, a minimum of 40' wide. The number of replications at each site is given in Table 1.

Table 1. List of sites, lines used, number of replications per site, and method of collecting yield data for corn and soybean trials conducted in southeast South Dakota to evaluate use of a multi-hybrid planter for these crops in the 2015 growing season. All plots were seeded with a Kinze 4900 Multi-hybrid planter.

Crop	Cooperator Location	Upland Line	Lowland Line	Number of Replications	Yield Data
Corn	Freeman	P0533AM1	P0636AM	4	yield monitor
Corn	Tripp	P0533AM1	P0636AM	2	weigh wagon
Corn	Beresford	P0297AMX	P0157AMX	2	weigh wagon
Corn	Marion/Freeman	P0297AMX	P0157AMX	1	yield monitor
Soybean	Lennox	92Y51	92Y70	3	yield monitor
Soybean	Beresford	92Y51	92Y70	3	yield monitor
Soybean	SDSU Southeast Farm	P22T69	92Y70	4	weigh wagon

Yield data were subjected to analysis of variance with SAS statistical software using Proc GLM with all factors considered as fixed effects for each site. There were no significant site by treatment interaction for sites that shared the same lines, so data was pooled across sites where the lines were the same and there was more than one replication per site.

RESULTS AND DISCUSSION

In the previous two seasons, we have seen the Pioneer corn lines show an average of a 6 bushel per acre yield advantage ($P<0.10$) with variable line seeding of corn hybrids versus when lines were sole-seeded across the landscape. However, in the 2015 season there was no significant effect of multi-hybrid planting observed on corn yield (Tables 2 and 3). At the Beresford site, conditions were exceptionally good through the season and yields were higher than average and numerically similar across all treatments – it may be that these exceptional conditions, with the absence of any drought stress, that favored all the lines and also made population a more limiting factor at these particular sites.Yield effects from the multi-hybrid planter were perhaps somewhat masked by other factors. At the Freeman and Tripp sites, the lines were reversed apparently due to a loading error at planting – while this frustrates the measurement of positive impacts of multi-hybrid planting, on the other hand, it is an occasion to observe a "worst-case" scenario, and in this situation we did not observe any negative impacts when the lines were reversed.

Similarly to corn, we did not observe an impact of variable-line seeding with soybeans at Lennox or Beresford in the on-farm studies with ‘92Y51’ and ‘92Y70’ as the upland and lowland lines, respectively (Table 4). The trial at the research farm which used ‘P22T69’ as an upland line also did not show a yield response to variable line seeding (Table 5). Therefore, looking across seasons we have some mixed results as some of these same two lines (‘92Y51’ and ‘92Y70’) showed a significant 3 bu/ac benefit from variable-line seeding in the 2013 season, but did not show an advantage in 2015. The environment during seed-filling was remarkably good in our area in 2015, with adequate moisture and mild temperatures. Most years late-July and August are marked by more days with higher maximum temperatures and also some period of drought stress. The relatively ideal conditions in our area may have equally benefited all the lines, lessening the differences between them across the field.

Table 2. Average corn yields with multi-hybrid planting in an on-farm trials at Beresford, SD and Marion, SD. The lowland line was ‘P0157AMX’ and the upland line was ‘P0297AMX’ in this study. The “VLR” treatment was variable line and rate.

Treatment	**Stand**	**Test Wt**	**Beresford Yield**	**Marion Yield***
	(plants/ac)	(lb/bu)	(bu/ac)	(bu/ac)
Lowland	28314	57.9	222	203
Upland	33396	57.9	221	212
Variable-Line	32670	57.5	220	205
VLR	33396	58.7	221	184
Mean	*31940*	*58.0*	*221*	*201*
CV (%)	*4.1*	*1.0*	*3.0*	---
LSD (0.05)	*NS*	*NS*	*NS*	---

* Note – there was only one replicate at this site.

Table 3. Average corn yields for trials conducted with multi-hybrid planting at Freeman and Tripp, SD in the 2015 growing season. The upland line was ‘P0636AM’ and the lowland line was ‘P0533AM1’ in these plots. The original intention was to put ‘P0636AM’ in as the lowland line and ‘P0533AM1’ as the upland line; however, due to planting error the two lines were reversed. The “VLR” treatment was variable line and rate.

Treatment	**Yield**
Upland	190
Lowland	184
Variable-Line	189
VLR	185
Mean	187
CV (%)	3.5
LSD (0.05)	NS

Table 4. Average soybean yields from trials conducted at Lennox and Beresford, SD in 2015 using a variable line planting of ‘92Y70’ (lowland) and ‘92Y51’ (upland) lines of soybean. The ‘VLR’ treatment was “variable-line and rate” seeded with a seedrate of 180,000 seeds per acre in the upland portions of the plot and 120,000 seeds per acre in the lowland portions of the plot. Each plot was 40’ wide and ran the length of the field. There was no site by treatment interaction, so data was pooled across sites.

Treatment	**Yield**
VLR	62.7
Lowland	62.3
Upland	61.9
Variable-Line	60.7
Mean	*61.9*
CV (%)	*2.9*
LSD (0.05)	*NS*
Site x Treatment Interaction	*NS*

Table 5. Average soybean yields from a trial conducted at the SDSU Southeast Research Farm in Beresford, SD in 2015 using a variable line planting of '92Y70' (lowland) and 'P22T69' (upland) lines of soybean. The 'VLR' treatment was "variable-line and rate" seeded with a seedrate of 180,000 seeds per acre in the upland portions of the plot and 120,000 seeds per acre in the lowland portions of the plot. The 'VLRR' treatment was the reverse of this for population. Each plot was 40' wide and ran the length of the field (approximately 1700').

Treatment	**Stand**	**100 Seed-Wt**	**Moisture**	**Test Wt.**	**Yield**
		(g)	(%)	(lb/bu)	(bu/ac)
VLR	130680	15.3	10.1	57.1	63.5
Upland	137940	14.8	10.2	57.7	63.1
VLRR	122694	15.8	10.3	56.9	62.4
Variable-Line	133584	15.6	10.2	57.0	60.9
Lowland	118338	17.0	10.1	56.6	60.0
Mean	*128647*	*15.7*	*10.2*	*57.1*	*62.0*
CV (%)	*18.0*	*3.5*	*3.2*	*1.0*	*2.5*
LSD (0.05)	*NS*	*0.8*	*NS*	*0.6*	*2.2*

ACKNOWLEDGEMENTS

The authors would like to recognize Mr. Les Mehlhaff, Mr. Lee Brockmueller, Mr. Gordon Andersen, Mr. Jason Hausman, Mr. Jamie Tieszen, and Mr. Matt Loewe for being willing to put trials on their operations and for their work in implementing these trials. The efforts of the crew at the SDSU Southeast Research Farm, particularly Mr. Doug Johnson, were critical for the successful completion of this project. The authors wish to gratefully acknowledge the funding support from South Dakota Soybean Research and Promotion Council; as well as Pioneer Hi-Bred, Raven Industries, Kinze Manufacturing, and SDSU, CHS, and Country Pride Cooperative field personnel for supporting this project.

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Evaluation of Effect of Cover Crops on Corn N Requirements in 2015

Peter Sexton[*], Doug Johnson, and Brad Rops

INTRODUCTION

Interest and use of cover crops in South Dakota continues to increase with farmers employing them to improve soil quality and to provide forage for cattle. One question that is raised with use of cover crops is their effect on the N requirements of the following crop. Our objective in this study was to evaluate several cover crop species of interest for growth and influence on N requirements of the next season's corn crop.

METHODS

Four different cover crop treatments were direct seeded into winter rye stubble on August 13, 2014, in a randomized complete block design with three replications (Table 1). Two control strips (no cover crop) were included in each block. Plots were 30 feet wide by 230 feet in length. Glyphosate was applied to the field at a rate of 32 oz/ac the same day the cover crop was seeded.

Corn (Pioneer 9917AMX) was planted in these plots on May 1, 2015 at a seed rate of 26,900 s/ac seeds per acre.

Nitrogen treatments of 0, 50, 100, 150, and 200 lb N per acre were applied as urea-ammonium-nitrate (UAN) before planting in 45' strips perpendicular to the direction of the cover crop plots. At maturity, a 10' by 35' area was harvested for yield measurement. Data was analyzed as a strip-split-plot design with the SAS GLM procedure considering all variables as fixed effects.

RESULTS AND DISCUSSION

There was no statistically significant effect of cover crops on yield of the following corn crop in this year of the study (Table 2). The cover crop blends with a high proportion of cool-season broadleaves tended to show the best yields in this study, and the better of these treatments were numerically about 5 to 7 bushels per acre greater in yield than was the control treatment. Corn following the high residue (mostly grasses) cover crop blend, yielded almost identical to the control. These trends are consistent with observations from previous seasons, where corn following a cool-season broadleaf cover crop blend tended to yield better than did corn following a grass-based cover crop blend. Corn nitrogen response is generally thought to follow a linear plateau pattern, with initial yield response to N being linear and then as N rates increase it levels off. A graphical analysis of the data, with yield fit to a linear plateau model, is shown in Fig. 1. Note that the high-residue (mostly grass) cover crop treatment behaved similarly to the controls, while the broadleaf cover crops showed a slightly greater yield plateau (ca. 12 bu/ac). This is a preliminary analysis, and where the optimum N rate falls depends very much on the type of

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analysis or model that is chosen – nevertheless, at this point it appears that the cover crop treatments evaluated will not spare any N fertilizer requirements for the following corn crop. This does not mean there is no N benefit, but it may take time for it to accrue enough to substantially decrease N requirements, or it may mean that we need more legumes in the cover crop blend if N is what one wants.

Acknowledgements: Support for this project provided in part by the South Dakota Ag Experiment Station, Brookings, SD.

Table 1. List of cover crops planted on August 13, 2014 at the Southeast Research Farm for evaluation of effects on N requirements for the following corn crop. Values given in the table are lb/ac for each individual component.

Cover Crop Blend	hairy vetch	radish	pea	lentil	flax	sorghum-sudangrass	oat	cowpea	seed rate
									(lb/ac)
Hairy Vetch Blend	10.5	0.8	0	0	1	1.25	7	0	20.6
Low Residue Blend	0	3.2	10.5	4.5	1	2.5	7	2.5	31.2
Broadleaf Blend**	2.3	1.9	3.9	2.8	0	1.4(millet)	7	1.4	22.0
High Residue (mostly grass) Blend	0	0.8	3.5	1.5	1	5	35	2.5	49.3
Control	0	0	0	0	0	0	0	0	0.0

**Broadleaf blend also included 0.3 lb/ac turnip and 1.1 lb/ac rapeseed.

Table 2. Corn yield in the 2015 season following 5 different cover crop treatments (including two controls strips per block) from the previous season in a study conducted at the SDSU Southeast Research Farm, Beresford, SD. Data are means across 5 different N rates (including unfertilized check plots), so they are less than the farm average.

Cover Crop	Yield	Test Wt.	100-Seed Wt.	Stand
	(bu/ac)	(lb/bu)	(g)	(plants/ac)
Broadleaf Blend	147	58.0	29.9	32912
Hairy Vetch Blend	145	57.4	28.3	34122
High Residue (grass)	143	57.7	29.6	31218
Control 1	142	57.9	27.4	31218
Low Residue	142	57.9	29.5	32307
Control 2	140	57.8	29.6	30734
Mean	*143*	*57.8*	*29.1*	*32072*
CV (%)	*13.2*	*1.2*	*12.0*	*11.5*
LSD (0.05)	*NS*	*NS*	*NS*	*NS*

Table 3. Corn yield in 2015 across a range of rates of applied N applied in a study following 5 different cover crop treatments which were seeded following winter rye in August of 2014. This trial was conducted at the SDSU Southeast Research Farm, Beresford, SD. Data are means for each N treatment across all the different cover crop treatments evaluated.

N Rate	Yield	Test Wt.	100-Seed Wt.
	(bu/ac)	(lb/bu)	(g)
0	87	55.9	30.1
40	110	57.0	28.7
80	140	58.0	29.6
120	166	58.4	29.0
160	176	58.5	27.9
200	182	58.9	29.0
Mean	*143*	*57.8*	*29.1*
CV (%)	*13.2*	*1.2*	*12.0*
LSD (0.05)	*12.6*	*0.5*	*NS*

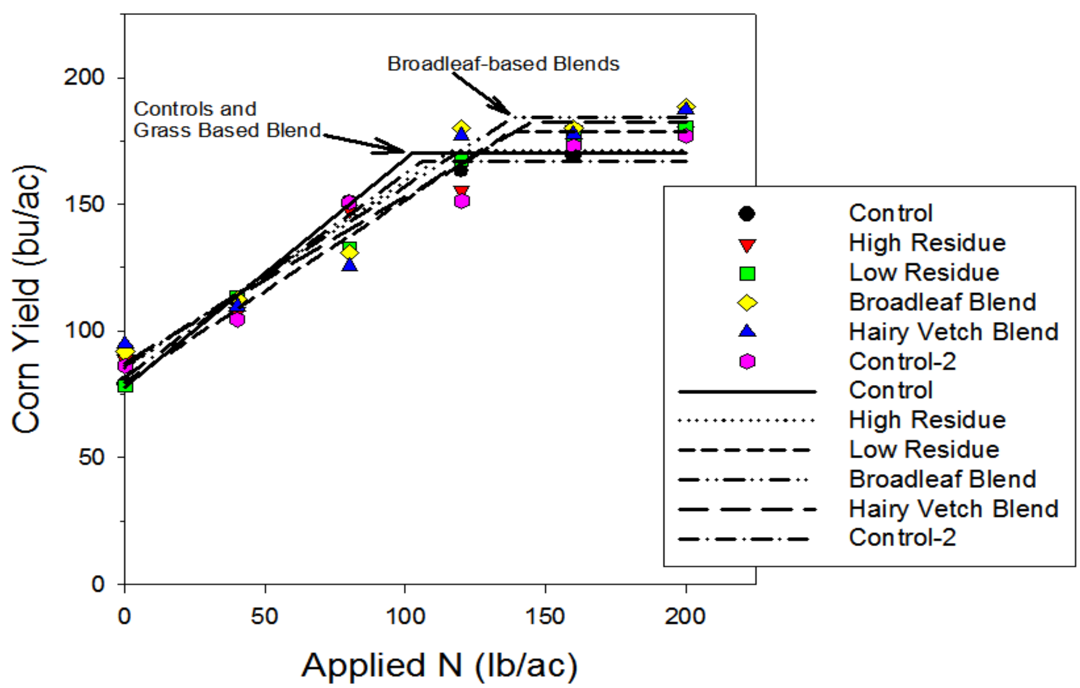

Fig. 1. Corn N response for 6 cover crop treatments (the control was duplicated) in a study conducted at the SDSU Southeast Research Farm in 2015. Each point shown is the average of three replicates of the cover crop treatments at a given level of N. Nitrogen rates tested were 0, 50, 100, 150, and 200 lb N/ac. Data points from each cover crop treatment were fit to a linear plateau model using “R” statistical software.

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Preliminary Results Comparing Grass and Broadleaf Based Cover Crop Blends For Livestock Performance and Effect on the Following Crop

Peter Sexton*, Elaine Grings, Brad Rops, Sandeep Kumar, and Sara Berg

INTRODUCTION

As interest in cover crops grows, the question is raised about what types of blends to use and how these may influence performance of cattle grazing these blends, and also of how they impact the yield of the following crop. To begin to address this, we decided to compare two contrasting blends: one with a high proportion of broadleaves which will leave less residue the following year, and the second with a high proportion of grasses which we expect will leave more residue on the ground the following year. Cattle were grazed on these replicated blocks in the fall of 2014, and corn was raised with and without applied N in 2015. Exclusion blocks were included in the study to allow for non-grazed check treatments. This report focuses on the performance of the 2015 corn crop.

METHODS

Two cover crop blends were seeded on August 19 & 20, 2014, on a field that previously produced a small grain crop (oats on the west side and rye on the east). Each 580' x 720' field was divided into 4 paddocks of 580' x 180' and seeded to either a low or high residue blend of cover crops (Table 1).

Table 1. Seed mixes used for high or low residue cover crop blends.

Blend	Radish	Turnip	Pea	Lentil	Cowpea	Millet	Sorg/Sudan	Oat	Seed Rate
									(lb/ac)
Low residue: Broadleaf Dominated	35.2	17.6	264	99	22	11	30.8	264	33.8
High residue: Grass Dominated	8.8	4.4	77	44	22	11	50.6	990	54.9

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Paddocks were fenced with double-strand high tensile wire on the exterior and double-strand poly-wire internally. Within each larger paddock, exclusion plots of 50' x 50' were laid out along the fence to provide the following treatments: 1) no cover crop control – area was sprayed with glyphosate after cover crop emergence; 2) Non-grazed control – area with cover crop was fenced out to allow no grazing; 3) Partial grazing – area was fenced out with the intention idea of excluding cattle during the latter half of the grazing period; 4) fully grazed plot – grazed along with the rest of the larger paddock.

Before grazing, standing biomass was estimated by clipping 5-0.125 m^2 plots to the ground in each paddock. Samples were sorted by species functional group (grass and grass-like, legume, brassica), dried at 65 C for 48 hours and weighed. On October 17, 32 heifer calves (average weight = 567 lbs, 60 lbs standard deviation) were weighed and allocated to paddocks with 4 calves per paddock. However, calves crossed through the electric fence, creating a different grazing pressure in each paddock. All calves were removed from the field on November 12 and weighed.

Corn (Pioneer P0533AM1) was direct seeded on May 05, 2015. Nitrogen treatments of 0 and 160 lb N per acre (applied pre-emergence as UAN) were imposed in large strips across the field, and also across the smaller exclusion plots described above. At harvest, the larger +/- N plots were harvested using a 6-row combine with a plot size of 12 rows by 400' and the grain being weighed in a weigh wagon. Yield data from the inner part of each exclusion plot (4 rows by 35') was taken with a Kincaid plot combine. Effect of small grain stubble (oat vs. winter rye) was not significant, so data were analyzed across the two types of small grain stubble.

RESULTS AND DISCUSSION

This report focuses on yield data from corn following grazing of the two cover crop blends. The reader is referred to last year's annual report for information on cover crop growth and composition. Overall biomass production for the cover crop treatments ranged from 3220 to 5600 lb per acre, with greater biomass found where grasses were a greater proportion of the cover crop stand, and also where oats were the previous crop (due to volunteers). At the end of the grazing period there was about 2500 lb per acre of cover crop left as residue, so about half to three-quarters of the cover crop biomass was consumed by the cattle.

The cattle in this study were difficult to manage and sometimes crossed between plots. Also the trial was ended earlier than intended due to the advent of cold weather. So the results need to be interpreted in that light, particularly with the "partially grazed" treatment.

Excluding the control treatment and looking at the main effects of cover crop type, full grazing versus ungrazed, and plus/minus N fertilizer application 0 versus 160 lb N per acre in the small plot portion of the study shows greater yield with use of broadleaf-based cover crop blend versus a grass-based one (181 vs. 166 bu/ac, respectively, averaged across N and grazing treatments); no significant effect of grazing versus non-grazed (179 vs. 175 bu/ac, respectively, averaged across cover crop and N treatments) and a strong impact of N fertilizer application versus no N fertilizer (198 vs. 149 bu/ac, respectively, averaged across cover crop and grazing treatments) (Fig. 1). Yields from the large strip plots (which were all grazed) show similar results to the small plots for N and cover crop blends. There was a strong N response and a trend for greater corn yield with a broadleaf-based cover crop blend in the large plot study (Table 2). Seed size (g per 100 seeds) was also greater with N fertilizer and with use of a broadleaf cover crop blend.

Parsing out individual treatments from the larger main effects and comparing broadleaf versus grass-based cover crop blends, corn following the broadleaf blend tended to outperform corn following grass-based blends; this effect was stronger where no N fertilizer was applied and no grazing was imposed (Fig. 2). The full-grazing plots showed greater yields than did the ungrazed plots in the grass-based cover crop blend without fertilizer, but this was not true for the broadleaf-based blend, nor was it true where N fertilizer was applied (Fig. 2). Application of N fertilizer appeared to overcome the other treatment effects and decreased or eliminated differences due to grazing as well as choice of cover crop blend. The control (no cover crop, no grazing) plots were not significantly different from the broadleaf cover crop treatments. They were numerically higher where no N was applied. This may be because less C was added to the system and so less N was immobilized by soil microbes (lower soil microbial activity).

Seed size, as measured by 100-seed weight, tended to be greater where cover crops were grazed than in the no-grazing treatment, particularly with the grass-based cover crop blend (Fig. 3). As with yield, application of N appeared to level out differences due to cover crop type or grazing management. None of the treatments imposed had a significant effect on corn population at harvest (Fig. 4).

One hypothesis to explain these results is that the differences between the broadleaf and grass-based cover crop treatments were largely related to differences in rate of decomposition and nutrient cycling between the various treatments. Where no N fertilizer was applied, the no cover crop control plots may have done did relatively well because they did not add any C to the system. Whatever organic N that mineralized in the control plots was then available to the following corn crop – this represents a more extractive system and may well mine the soil in the long run, but it didn’t significantly impact corn yield in the short run in this experiment. The grass-based cover crop provided greater biomass and had higher fiber than did the broadleaf cover crop, so it would have decomposed slower and perhaps sequestered more N into the following growing season resulting in lower yield in the absence of N fertilizer. Grazing, however, would have accelerated the rate of nutrient cycling with the cattle digesting the fiber and pressing the residue into contact with the soil. This would explain why in the absence of N fertilizer, corn yield following a grass-based cover crop showed a significant yield improvement from grazing (Fig. 2). Application of N fertilizer tended to dampen out these effects and lessen their impact on corn yield.

ACKNOWLEDGEMENT:

Funding and assistance for this project provided in part by the South Dakota Agricultural Experiment Station, SDSU Plant Science and SDSU Animal Science; Brookings, SD.

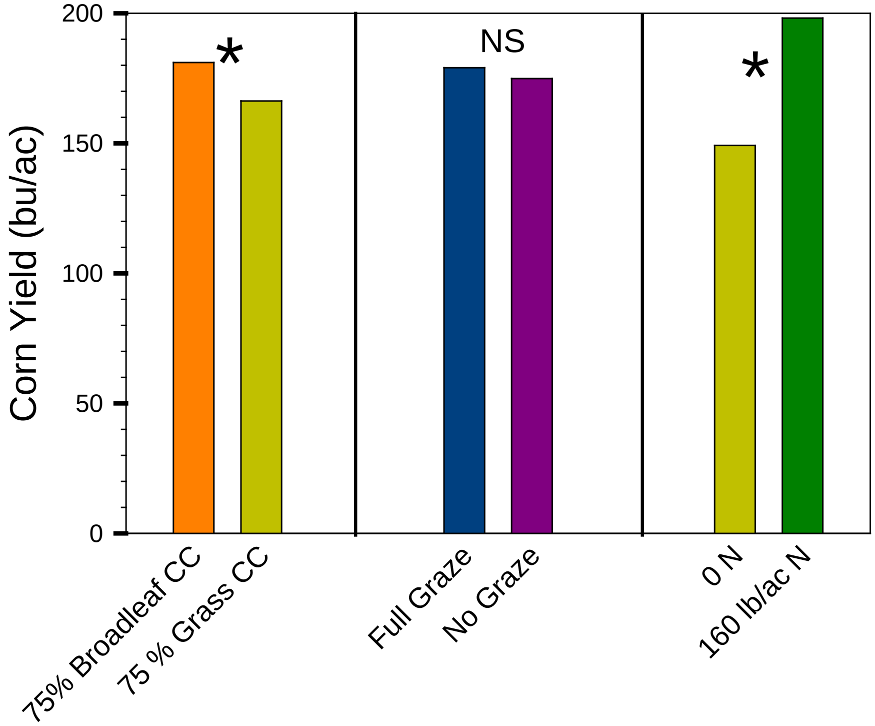

Fig. 1. Main effects on corn yield following different cover crop, grazing treatments and N application rates (0 and 160 lb N/acre). In this figure each of the bars represents data for that treatment averaged across the other main effects (e.g. for cover crop comparisons, the yields were averaged across the grazing and N treatments for each cover crop blend). Interactions between treatments were not statistically significant.

Table 2. Yields from large strip plots (approximately 400' in length) comparing broadleaf and grass-based cover crop blends with and without 160 lb per acre applied N. All these plots were grazed. This study was conducted at the SDSU Southeast Research Farm in Beresford, SD, in 2015.

N Rate	**Cover Crop Blend**	**Yield**	**100-Seed Wt.**	**Stand**
0	Broadleaf	146	29.2	27346
0	Grass	131	28.0	28798
160	Broadleaf	217	34.3	29282
160	Grass	202	32.8	28556
Mean		*174*	*31.1*	*28496*
CV (%)		*12.3*	*3.8*	*8.0*
N Rate		**	**	*NS*
Cover Crop		*P=0.18*	*	*NS*
N x Cover Crop		*NS*	*NS*	*NS*

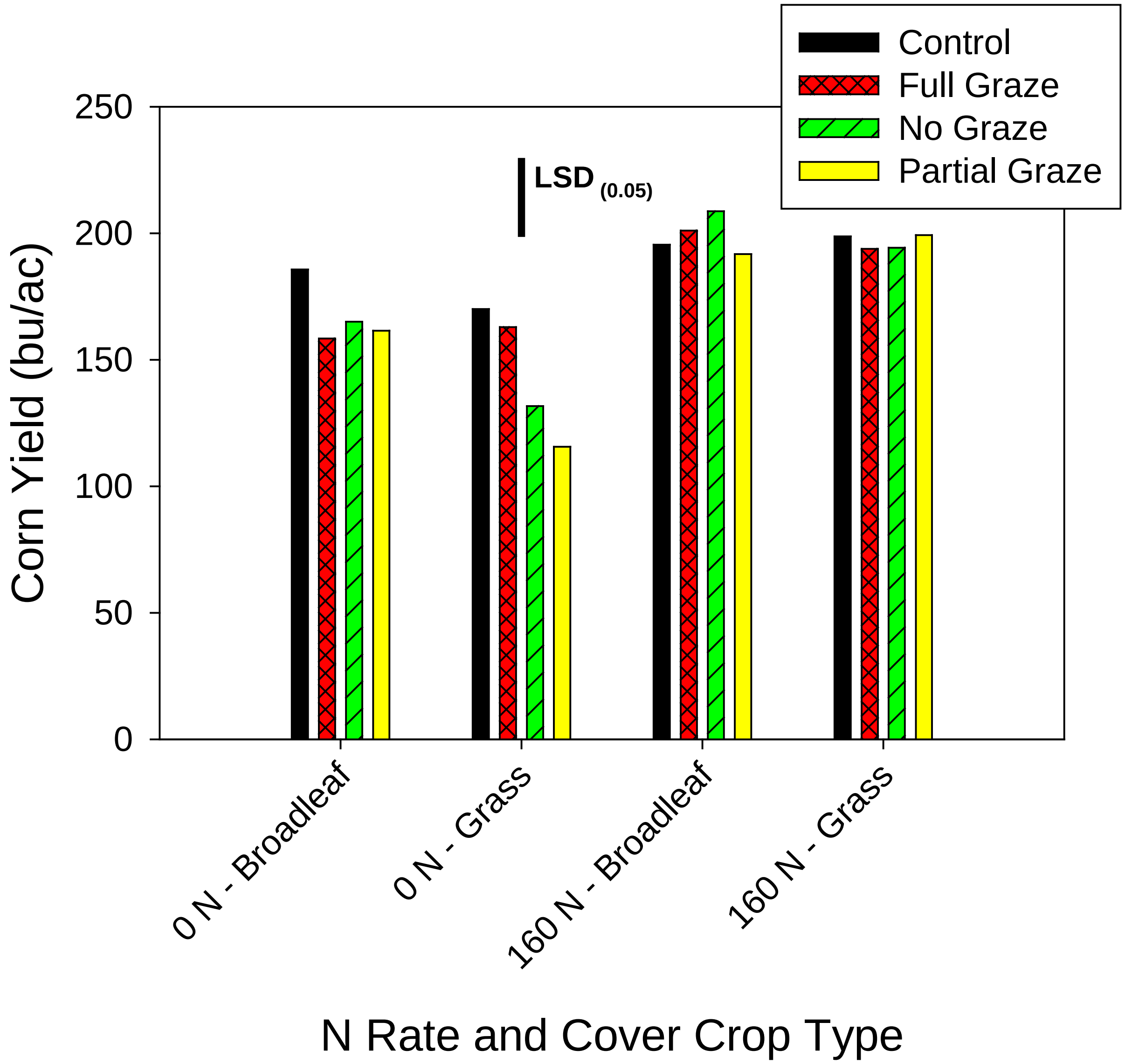

Fig. 2. Corn yield following different cover crop and grazing treatments with 0 and 160 lb/acre N fertilizer rates. The terms “Broadleaf” and “Grass” refer to cover crop blends seeded the previous fall. The “control” treatment had no grazing and no cover crop (it was sprayed out there shortly after emergence).

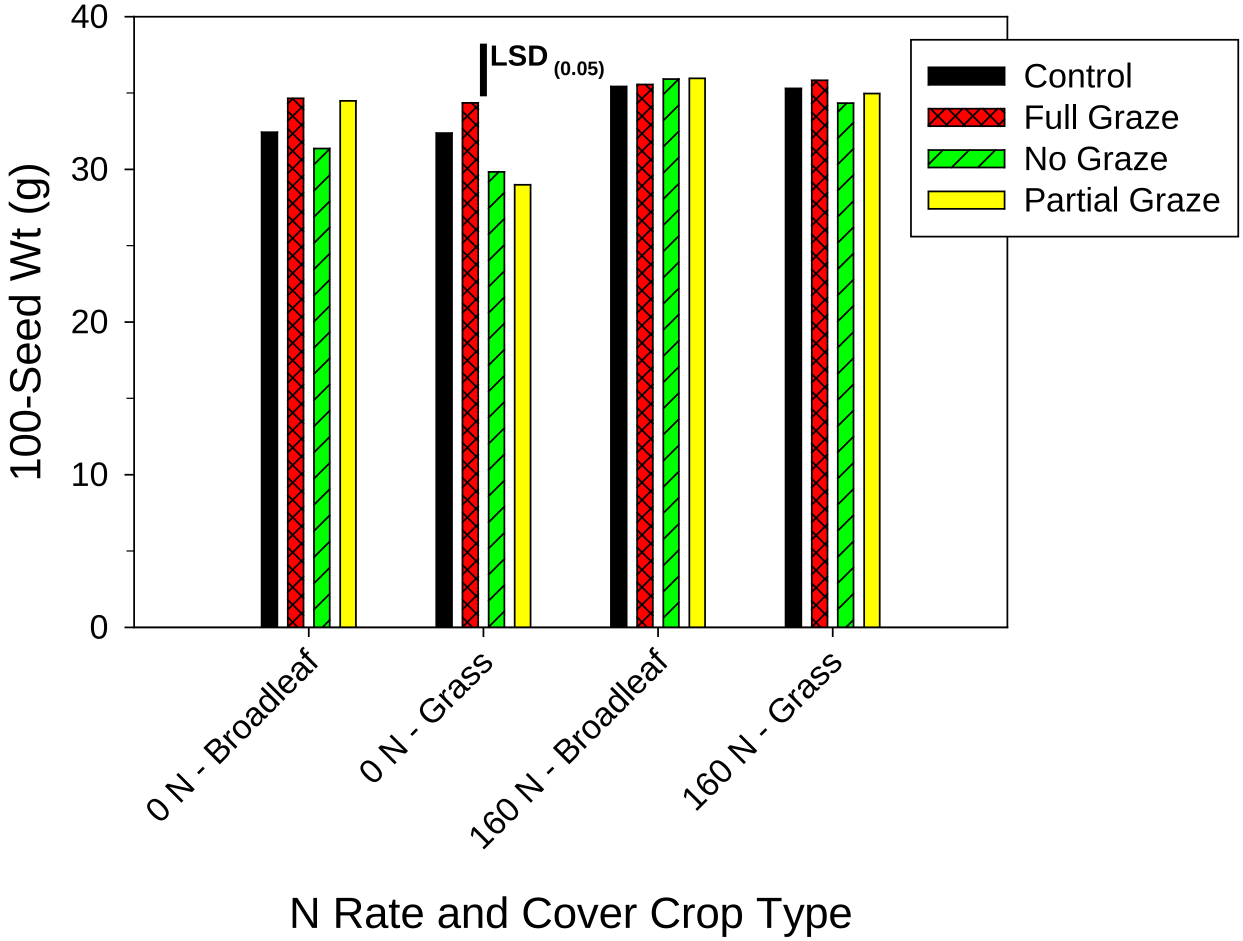

Fig. 3. 100-seed weight for corn raised following different cover crop and grazing treatments with 0 and 160 lb/acre N fertilizer rates. The terms "Broadleaf" and "Grass" refer to cover crop blends seeded the previous fall. The "control" treatment had no grazing and no cover crop (it was sprayed out there shortly after emergence).

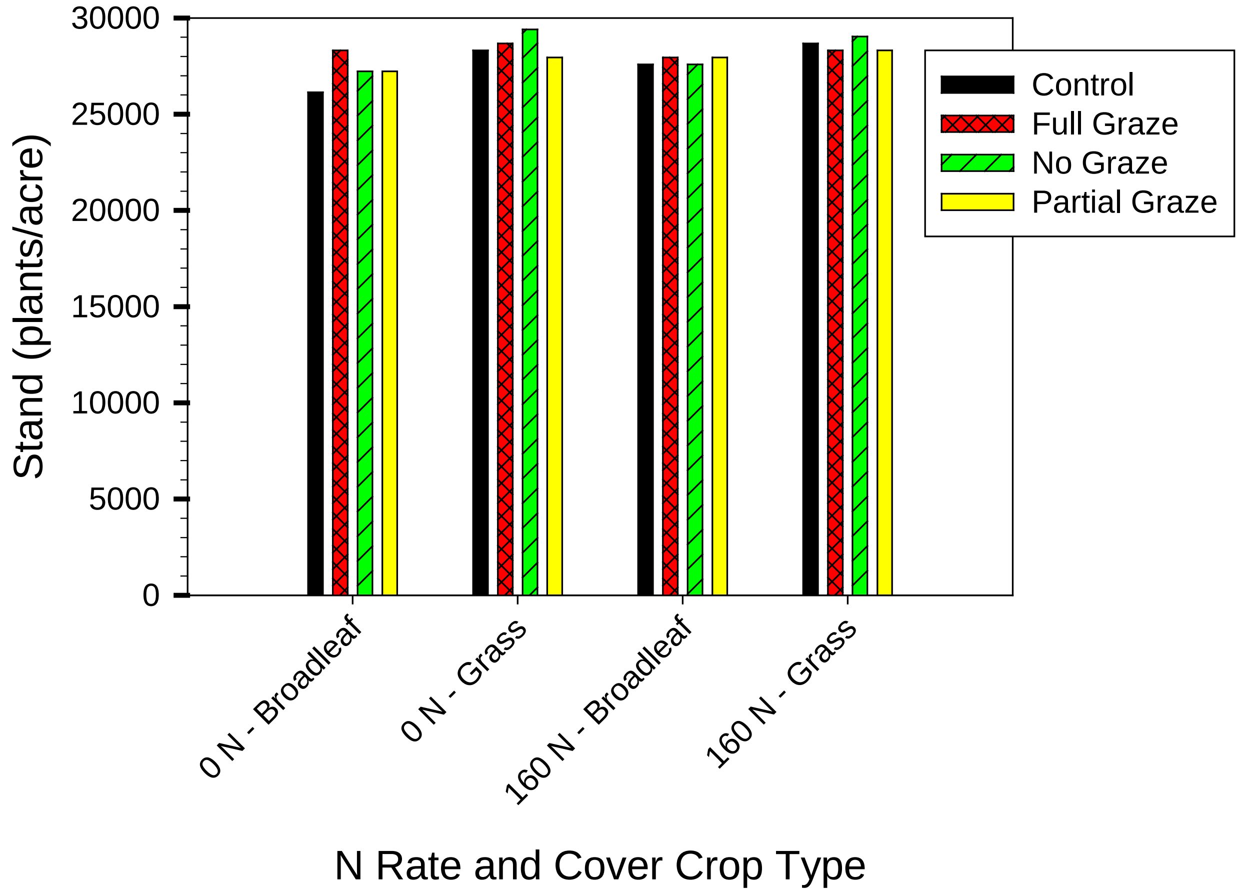

Fig.4. Corn stand at maturity following different cover crop and grazing treatments with 0 and 160 lb/acre N fertilizer rates. The terms “Broadleaf” and “Grass” refer to cover crop blends seeded the previous fall. The “control” treatment had no grazing and no cover crop (it was sprayed out there shortly after emergence). There no significant treatment effect on corn population at maturity in this study.

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Grazing Cover Crops Following a Small Grain Crop

Brad Rops*, Sheila Price,

Peter Sexton, and Sara Berg

INTRODUCTION:

With the scarcity and rising cost of pastureland in southeastern South Dakota, grazing resources have become more difficult to obtain and increasingly expensive. Due to this, there has been increased interest in utilizing cover crops to extend fall grazing on crop ground. In an effort to provide information on the economics and sustainability of such a system, grazing studies are being conducted at the Southeast Research Farm.

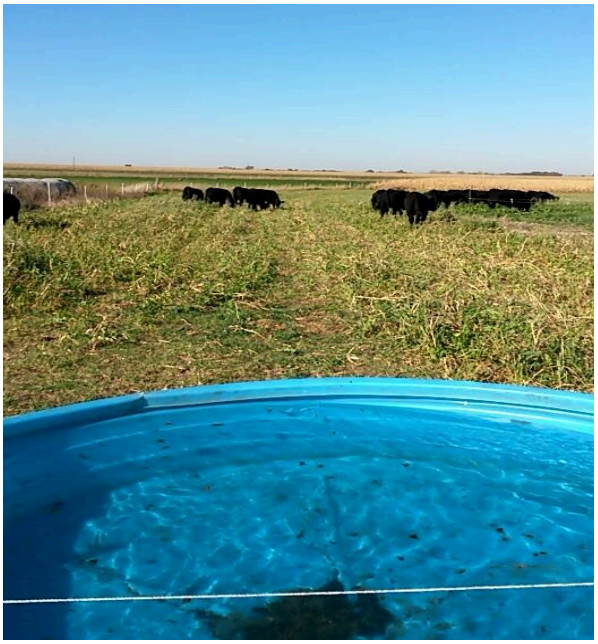
METHODS:

A cover crop mix including radish, peas, lentils, cowpeas, sorghum/sudan, and oats was drilled into 14 acres of rye stubble on August 7th, 2015. The approximate seed blend is shown in Table 1. On October 19, nineteen yearling heifers weighing 730 pounds were placed in the field. Water was hauled to the field and stored in a stock tank. The heifers had continuous access to water and a commercial loose mineral mix. The field was open grazed versus strip grazed. Several exclusion blocks were fenced off that will be used to compare the effects of grazed versus non-grazed cover crops on the subsequent crop. Clippings were taken to estimate the available forage per acre.

Table 1. Cover Crop Blend

Cover Crop	Blend
Radish	2
Peas	7
Lentils	3
Cowpeas	2.5
Sorghum/Sudan	3.5
Oats	26
Seed Rate Per Acre	44

On November 17 the heifers were moved to corn stalk residue which they grazed for an additional 10 days. Muddy conditions and a heavy wet snow led to the termination of the grazing period on November 27.



Cattle on Cover Crops, Week 1

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RESULTS AND DISCUSSION:

The heifers grazed a total of 29 days on cover crops and 10 days on corn stalks. The cover crops had 73 days of growth prior to grazing. Some areas of the field were excessively wet, and cover crop growth was stunted. The estimated forage available was 2630 pounds per acre on a dry matter basis. The goal was to remove about 60% of the available forage. The heifers had prior cover crop grazing experience. No preference for one type of vegetation over another was observed. When the heifers were removed from the field, 1238 pounds of residue dry matter per acre remained. 53% of the available forage was removed. Health of the cattle was good with the exception of two cases of foot rot. The addition of Chlortetracycline (CTC) to the mineral was able to clear that up without the need to administer injectable antibiotics. Cattle performance is summarized in Table 2.

Table 2. Cattle Performance

Avg Start Weight, lbs.	729
Avg End Weight, lbs.	781
Total Gain per Head	52
Days	39
Avg Daily Gain, lbs.	1.33
Total Gain, lbs	980
Total Acres	20
Gain per Acre	49
Grazing Days per Head per Acre	39

The average daily gain for the group was 1.33 pounds per day. The total gain over the 39 day period was 980 pounds, or 49 pounds per acre grazed. Using a value of $150/cwt, this represents an extra $73.50 in gross returns per acre. Each acre of cover crop in this particular field supported 39 grazing days for one head. Comparisons will be made following next year's corn crop to measure differences in the grazed versus ungrazed blocks.

Heifers on Corn Stalks after 8 inches of Snow

Acknowledgement: Funding for this project provided in part by the South Dakota Agricultural Experiment Station.

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Project Title: Critically evaluating the interpretation of soybean plant tissue analysis in the 21st century to help maximize grower profitability.

Investigators: Nathan Mueller, Peter Sexton*, Jixiang Wu, Anthony Bly, and Rebecca Helget.

Note: Nathan Mueller is currently working with UNL; the other investigators are working with SDSU.

This work was completed with support from the South Dakota Soybean Research and Promotion Council.

INTRODUCTION

Maintaining soil fertility is an important component of profitable crop production. Among the macronutrients, P is the most likely to limit soybean yields in our production area as this crop will fix its own N, and in general soil levels of K, S, Ca, and Mg are such that they are less likely to limit crop growth as compared to P. Leaf tissue analysis is sometimes promoted as a tool that can be used to help identify when P, and other nutrients, are limiting soybean yields, so that farmers can take leaf samples and make adjustments to their fertility program accordingly. However, critical values used in interpretation of tissue analysis data are largely based on old research (pre-1980's), which was not conducted in South Dakota. The primary objective of this project was to evaluate tissue analysis as a tool for identifying P deficient sites in South Dakota and update critical values used for interpreting leaf P levels as needed. To accomplish this goal, it was decided to conduct a series of on-farm trials to evaluate P yield response of soybeans across a range of initial soil P levels. This was done in order to see how well leaf P levels would predict yield responses to P application across a broad range of soil P availability. As ancillary information, leaf samples were taken on a weekly basis for 12 different soybean lines raised at Volga, SD, in order to observe how P levels varied between different soybean lines and to see how leaf P levels changed over the course of the season.

METHODS

Replicated trials where P was applied at rates of 0, 20, 40, 60, and 80 lb P_2O_5 per acre were conducted at 10 sites in 2013 and at 10 sites in 2014. One site (# 11) had a treatment structure of 0, 30, 60, and 120 lb P_2O_5 per acre in the 2013 season. Plot size was 10 by 30 feet and each treatment was replicated four times in a randomized complete block design. Information on site locations, previous crop, and initial soil nutrient levels is given in Tables 1, 2, 3, and 4. Leaf and petiole (youngest fully expanded leaf) samples were taken at the V4 and R2 growth stages and analyzed for total P. Biomass samples were taken at the R6 to R7 growth stage, dried, and ground for nutrient analysis.

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Grain yield was determined using small plot combines, grain samples for each plot were used to calculate yield on a per acre basis, and subsamples were analyzed for grain P concentration. Note at site # 18, the field was harvested before the crew with the small plot combine could get to the location – so there is no yield data from that particular site. At the SDSU Volga Research Farm a study was conducted where repeated leaf samples were taken on a weekly basis from July 3 through August 29, 2014 for 12 different soybean lines. This provided a data set for observing changes in leaf P concentration over time and for comparing varietal differences in leaf P concentration.

Observed yield response to P was used to estimate optimum P fertilizer rates at each site. Soybean yield was regressed against applied P using a quadratic function for each site in the project. The optimum rate of applied P was then estimated as the point on the curve where the last lb of fertilizer paid for itself assuming a 20:1 ratio of soybean value to P fertilizer cost (e.g. soybeans at $11 per bushel with a P fertilizer cost of $0.55 per lb). Sites that returned a negative value or negative response (unprofitable to apply P) were given a rate of 0 as the optimum fertilizer rate. The estimated optimum P rate for each site was then compared with initial soil test levels, and with leaf P values from the unfertilized check plots (no fertilizer applied) in order to observe how well the soil and leaf P analysis were able to distinguish or identify sites that did show a positive grain yield response to applied P.

In order to look at critical thresholds for leaf and grain P concentration across sites, yield data at each site was normalized by dividing the yield values for each site by the highest yielding treatment at that site – this effectively put everything on a zero to one scale where the highest yielding plots at each site have a value of 1 and all the other plots are expressed as a fraction of that. The normalized yield data was then plotted against V4 leaf P concentration, R2 leaf P concentration, and grain P concentration.

The data on leaf P concentration as well as other nutrients over time for 12 different soybean lines at Volga, SD in 2014, was plotted against days after planting to provide a visual observation of how concentrations varied over time for each line. The data across the whole season on leaf P levels was subjected to standard ANOVA, assuming all variables as fixed effects, to compare nutrient levels across the 12 lines. Grain P concentration at harvest was also compared between the 12 lines using ANOVA.

Table 1. Locations and soil type for soybean P response trials conducted in the 2013 and 2014 growing season to evaluate yield response and associations of yield response with tissue P levels.

Site	Town	County	Soil Type
1	Aurora	Brookings	Brandt silty clay loam, coteau
2	Bancroft	Kingsbury	Houdek-Stickney complex
3	Freeman	Hutchinson	Alcester silty clay loam
4	Geddes	Charles Mix	Highmore silt loam
5	Mitchell	Davidson	Houdek-Prosper loams
6	South Shore	Codington	Vienna-Brookings complex, coteau
7	Tripp	Hutchinson	Dudley-Stickney complex
8	Wagner	Charles Mix	Eakin silt loam
9	Wessington-1	Jerauld	Eakin-Ethan-Onita complex
10	Wessington-2	Jerauld	Houdek-Prosper loams
11	Beresford	Clay	Egan-Trent silty clay loams
12	Aurora	Brookings	Brandt silty clay loam, coteau
13	Doland	Spink	Kranzburg-Cresbard silt loams
14	Flandreau	Moody	Wakonda-Chancellor silty clay loams
15	South Shore	Codington	Kranzburg-Brookings silty clay loams
16	Ward	Moody	Lamo silty clay loam
17	Beresford	Clay	Egan-Clarno-Trent complex
18	St. Lawrence-1	Hand	Houdek-Prosper loams
19	St. Lawrence-2	Hand	Durrstein silty clay loam
20	Wessington-1	Beadle	Hand-Bonilla loams
21	Wessington-2	Beadle	Prosper-Stickney loams

Table 2. Previous crop, line planted, planting and harvest dates for soybean P response trials conducted in the 2013 and 2014 growing season to evaluate yield response and associations of yield response with tissue P levels.

Location	Year	Previous Crop	Variety	Planting Date	Harvest Date
1	2013	corn	AG1431	6/2	10/8
2	2013	corn	Stine 16RA02	6/5	10/10
3	2013	corn	Pioneer92Y51	6/3	9/30
4	2013	winter wheat	Pioneer92Y70	6/4	10/2
5	2013	corn	Curry1289	5/13	9/30
6	2013	corn	AG1431	6/4	10/25
7	2013	corn	Pioneer93M11	5/20	10/23
8	2013	corn	Wensman3230	6/3	9/25
9	2013	corn	Pioneer90M80	5/9	9/13
10	2013	corn	CroplanR2C2200	6/4	10/2
11	2013	soybean	AG2433	5/16	9/23
12	2014	corn	SD2101R2Y	5/15	10/1
13	2014	CRP	Wensman3178	5/23	10/2
14	2014	corn	Pioneer25T51	5/20	10/16
15	2014	fallow	AG0634	5/25	10/10
16	2014	corn	AG0832	5/6	9/22
17	2014	corn, rye	AG2733	5/20	10/14
18	2014	corn	Croplan1572	5/20	NR
19	2014	corn	Croplan1750	5/20	10/2
20	2014	corn	Wensman3230	5/17	10/7
21	2014	corn	Wensman3230	5/17	10/15

CRP: Conservation Reserve Program
NR: Not recorded

Table 3. Results of soil tests (soil OM, pH, Bray Olsen and Mehlich P, K, Zn, cation-exchange-capacity (CEC)) soybean P trials conducted in the 2013 and 2014 growing seasons.

Location	Year	OM	pH	Bray P	Olsen P	Mehlich P	K	Zn	CEC
		(%)		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	meq/100g
1	2013	3.50	5.73	20.25	10.75	21.50	368.00	2.45	20.23
2	2013	4.10	6.12	27.30	18.66	27.35	401.75	1.75	17.53
3	2013	4.65	5.67	34.50	15.52	29.25	172.00	2.97	25.38
4	2013	3.84	6.28	18.65	9.75	18.30	443.90	1.42	18.14
5	2013	4.05	5.73	22.75	11.44	22.20	223.30	1.22	19.86
6	2013	3.70	6.18	9.64	12.25	16.13	139.75	0.98	NR
7	2013	2.65	6.00	18.75	7.75	19.00	191.75	0.58	16.18
8	2013	4.42	6.62	24.17	16.17	30.50	479.20	1.54	19.22
9	2013	5.58	6.26	13.80	8.50	19.80	512.35	2.18	19.37
10	2013	3.19	6.07	13.00	7.32	15.35	284.15	1.02	16.93
11	2013	4.15	6.03	12.25	4.50	9.50	216.75	1.26	19.98
12	2014	4.10	5.70	19.00	10.05	19.43	155.00	2.05	19.87
13	2014	3.02	8.00	11.00	7.98	16.31	388.00	0.89	25.19
14	2014	4.96	7.50	7.35	5.00	7.14	170.00	1.23	29.60
15	2014	4.74	5.10	63.90	46.62	66.03	201.00	0.87	23.05
16	2014	5.87	7.00	33.45	22.73	40.64	156.00	1.37	28.44
17	2014	4.66	5.70	15.65	10.21	15.30	232.00	4.87	22.69
18	2014	3.44	5.90	17.29	12.51	21.08	283.00	0.57	16.73
19	2014	4.69	5.50	19.30	12.98	24.81	420.00	1.50	17.35
20	2014	4.16	5.40	18.25	11.73	21.49	305.00	0.91	17.29
21	2014	2.89	5.60	17.15	11.74	18.41	316.00	1.26	15.82

Table 4. Results of soil tests (Fe, Mn, Cu, Ca, Mg, and Na) for soybean P trials conducted in the 2013 and 2014 growing seasons.

Location	Year	Fe	Mn	Cu	Ca	Mg	Na
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	2013	73.55	52.65	1.08	2054.00	388.25	14.40
2	2013	62.08	101.24	1.33	2015.65	539.00	17.28
3	2013	79.23	41.55	2.17	2679.75	720.25	24.38
4	2013	47.27	53.26	1.12	2307.30	524.15	43.64
5	2013	83.61	78.06	1.67	1814.25	672.50	26.25
6	2013	76.35	32.83	0.98	NR	NR	NR
7	2013	51.15	53.35	1.44	1608.00	766.75	16.90
8	2013	26.75	66.98	1.20	2709.67	527.67	17.05
9	2013	63.14	87.24	0.97	2376.35	471.20	8.82
10	2013	43.15	112.04	1.17	2004.80	502.30	16.91
11	2013	64.68	66.55	1.55	2214.25	666.50	18.58
12	2014	65.10	39.34	1.13	2271.70	493.90	24.01
13	2014	9.42	23.18	1.20	3732.70	590.95	139.71
14	2014	27.41	15.29	1.17	3895.10	1116.10	62.81
15	2014	119.19	87.15	1.46	2110.55	571.05	31.81
16	2014	28.51	30.66	1.35	4099.05	893.15	35.51
17	2014	110.86	60.14	1.59	2353.65	565.85	58.52
18	2014	55.85	44.98	1.01	1788.90	589.45	28.39
19	2014	100.91	74.54	0.91	1710.40	421.05	28.79
20	2014	73.97	64.69	0.93	1689.40	389.55	21.75
21	2014	100.29	69.88	1.04	1634.65	415.55	18.99

RESULTS AND DISCUSSION

Plotting the estimated optimum fertilizer rate versus initial Olsen P soil-test level, the soil test was able to explain a little over 50 % of the total variation in estimated optimum fertilizer rate (Fig. 1). The regression predicts 15 lb P_2O_5 per acre as the optimum rate at 11 ppm Olsen soil test P, and a zero response to applied P at 14.8 ppm Olsen P. This trend line agrees reasonably well with the current recommendations (for a 60 bu/ac yield goal) which call for 80 lb P_2O_5 at less than 4 ppm Olsen P, 47 lb per acre between 4 and 8 ppm Olsen P, and 13 lb per acre between 8 and 12 ppm Olsen P. On one hand the trend line for the response runs slightly higher than the current recommendations, but on the other hand there were also a number of sites with less than 12 ppm Olsen P that did not show any response to applied P. Overall, the data from this study appears to fit reasonably well with current SDSU recommendations for P fertilizer application on soybeans.

The relationships involved between fertilizer application and yield response are very complex. Factors which promote good root growth and mycorrhizal development, such as no-till and use of cover crops or green manures, may improve efficiency of root function and in a positive way lessen response to applied P. On the other hand, weed pressure, insect pests, white mold, soil compaction, and drought may all impact the relationship of yield with applied P, even at low soil test levels. Given the complex nature of the soil and all the factors impacting soybean yield, the variation observed is not surprising. Perhaps the take-home message here is that there is very little likelihood of seeing a practical response to applied P when soil test levels are greater than 12 ppm Olsen P, and that as soil test level drops below 12 ppm there is an increasing likelihood of a yield response to applied P, but it's not guaranteed.

The Mehlich test was only slightly weaker than the Olsen test at predicting optimum P rates, and the Bray test showed a very weak relationship in these trials (data not shown). Based on the results from this study, current recommendations based on soil test Olsen P do not need to be modified. The Mehlich test performed similarly to the Olsen test.

Looking at leaf P concentrations, neither leaf P level at the V4 nor at the R2 stages were able to explain variation in estimated optimum P fertilizer among the sites in this study (Fig. 2 and 3). The V4 leaf sample did not show even a remote relationship with estimated optimum P fertilizer rate across sites (Fig. 2), while the samples at the R2 showed a very weak relationship with response to applied P (Fig. 3). Note that the leaf samples shown in Fig. 2 and 3 are from the unfertilized control plots at each site. What this means is that in this study, leaf sampling was unable to discriminate between sites that showed a yield response to applied P versus from those that did not. The critical concentration for leaf P in soybeans is considered to be near 2.6 g/kg (Mills and Jones, 1996). The lowest value observed in this study was 2.5 g/kg and all other points were greater than that for leaf P concentration. It may be that at lower levels of leaf P, a more consistent relationship would be observed between foliar P concentration and yield response. In other words, leaf testing would probably identify severe P deficiencies, but in the range of initial soil P levels used in this study it was not able to efficiently identify those sites that would have benefited from applied P versus those that would not.

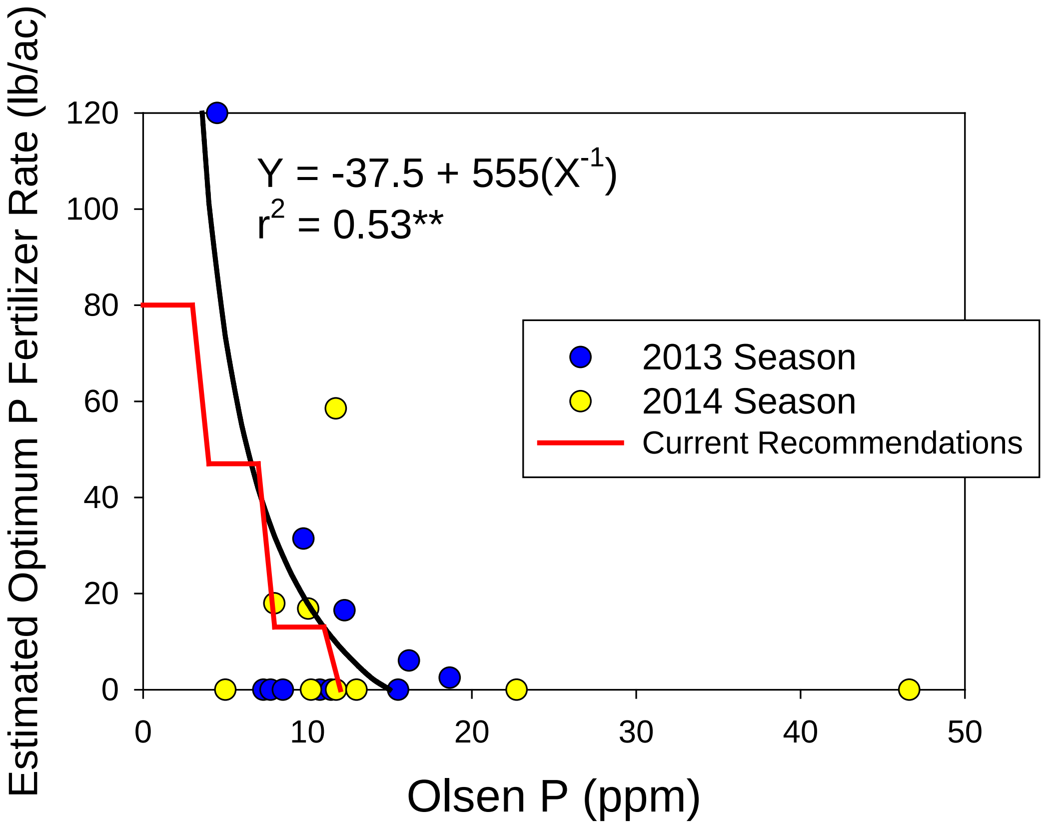

Fig. 1. Estimated optimum P fertilizer rate versus initial Olsen P soil test for each site. The estimated optimum rate was calculated from yield response data from 20 sites where soybeans were grown with 0, 20, 40, 60, and 80 lb per acre applied P2O5 in eastern South Dakota over the 2013 and 2014 growing seasons. One site had a treatment structure of 0, 30, 60, and 120 lb applied P_2O_5 per acre in the 2013 season.

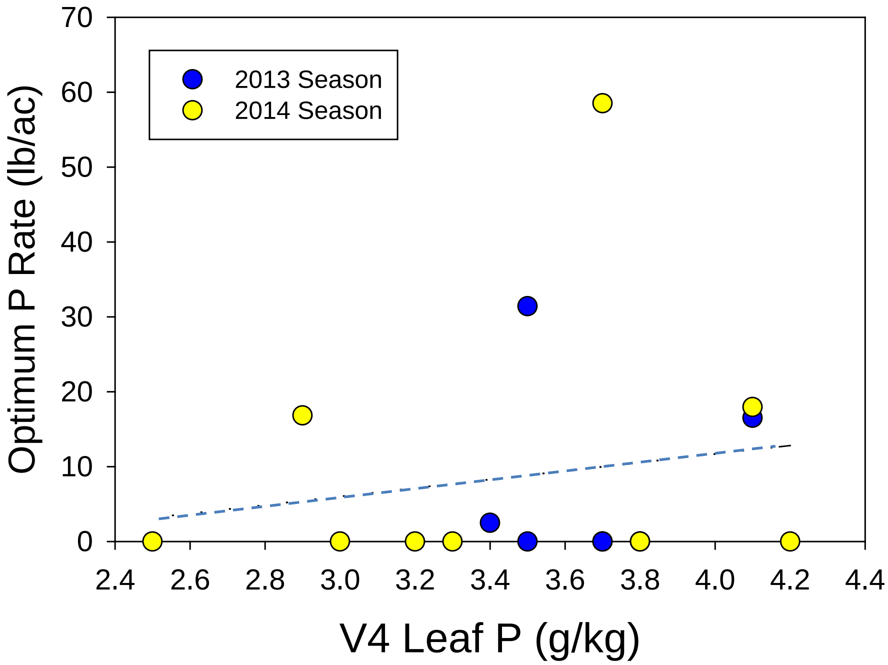

Fig. 2. Estimated optimum P fertilizer rate versus V4 leaf P concentration for the control treatment at each site. The estimated optimum rate was calculated from yield response data from 17 sites where soybeans were grown with 0, 20, 40, 60, and 80 lb per acre applied P_2O_5 in eastern South Dakota over the 2013 and 2014 growing seasons. One site had a treatment structure of 0, 30, 60, and 120 lb applied P_2O_5 per acre in the 2013 season.

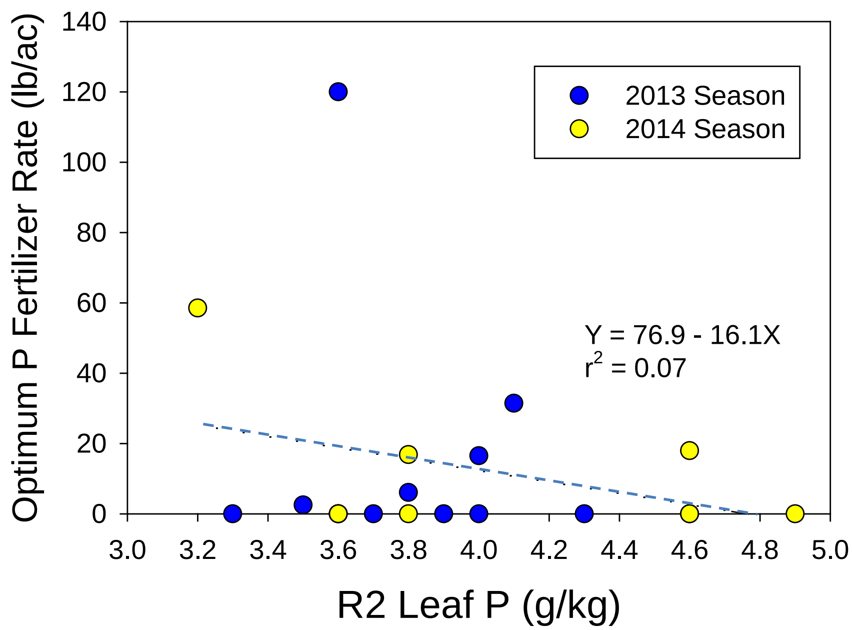

Fig. 3. Estimated optimum P fertilizer rate versus R2 leaf P concentration for the control treatment at each site. The estimated optimum rate was calculated from yield response data from 20 sites where soybeans were grown with 0, 20, 40, 60, and 80 lb per acre applied P2O5 in eastern South Dakota over the 2013 and 2014 growing seasons. One site had a treatment structure of 0, 30, 60, and 120 lb applied P_2O_5 per acre in the 2013 season.

There was a weak relationship ($r^2 = 0.22*$) across sites between grain P concentration in the control treatment and estimated optimum P fertilizer rate (Fig. 4). Grain P concentration integrates P availability and yield potential across the whole growing season. It seems to be a more sensitive indicator of crop P status; however, it comes after the fact as far as contributing to in-season fertility recommendations. It may have utility in predicting P response of the following crop. However, that is a topic that needs more research before conclusions can be drawn.

Combining all the data across sites on a relative yield basis– including both fertilized and control treatments – there was no relationship observed between relative yield and leaf P concentration at either the V4 or at the R2 growth stage in this study (Fig. 5 and 6). Plotting data on a relative yield basis puts all the sites on a comparable scale and avoids confounding factors across sites where yields at one site may be higher or lower than other sites due to factors other than P availability. There was not a strong relationship observed between relative yield and grain P; however, at the lower end of the range in grain P concentration there did appear to be an association between yield and grain P concentration (Fig. 7 and 8). Regressing relative yield versus grain P concentration for site # 11 (which had the least grain P concentration in the study), suggests a critical grain P concentration of 4.0 mg/kg P (Fig. 8). However, there were very few points at this end of the scale so more work needs to be done to substantiate this value.

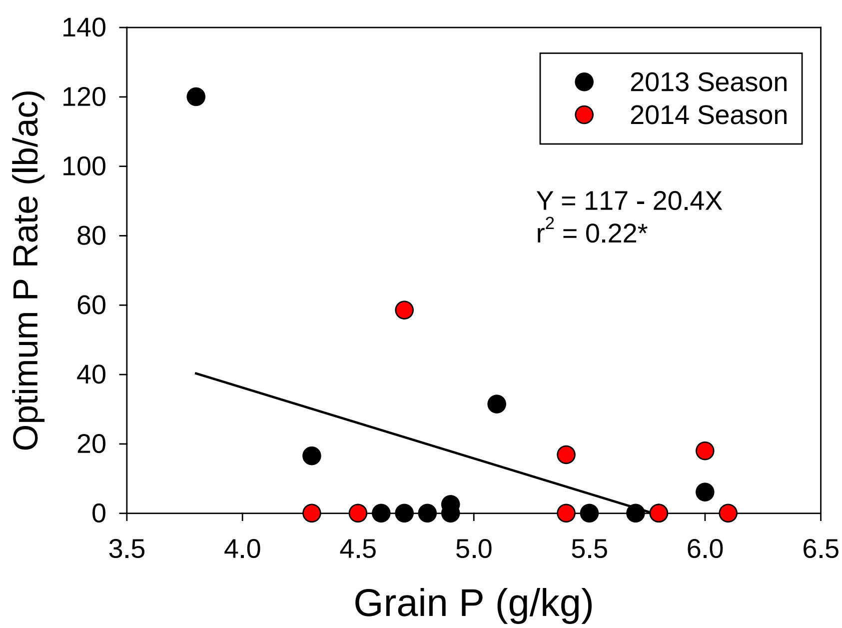

Fig. 4. Estimated optimum P fertilizer rate plotted against grain P concentration in the control treatment at each site. The estimated optimum rate was calculated from yield response data from 20 sites where soybeans were grown with 0, 20, 40, 60, and 80 lb per acre applied P2O5 in eastern South Dakota over the 2013 and 2014 growing seasons. One site had a treatment structure of 0, 30, 60, and 120 lb applied P_2O_5 per acre in the 2013 season.

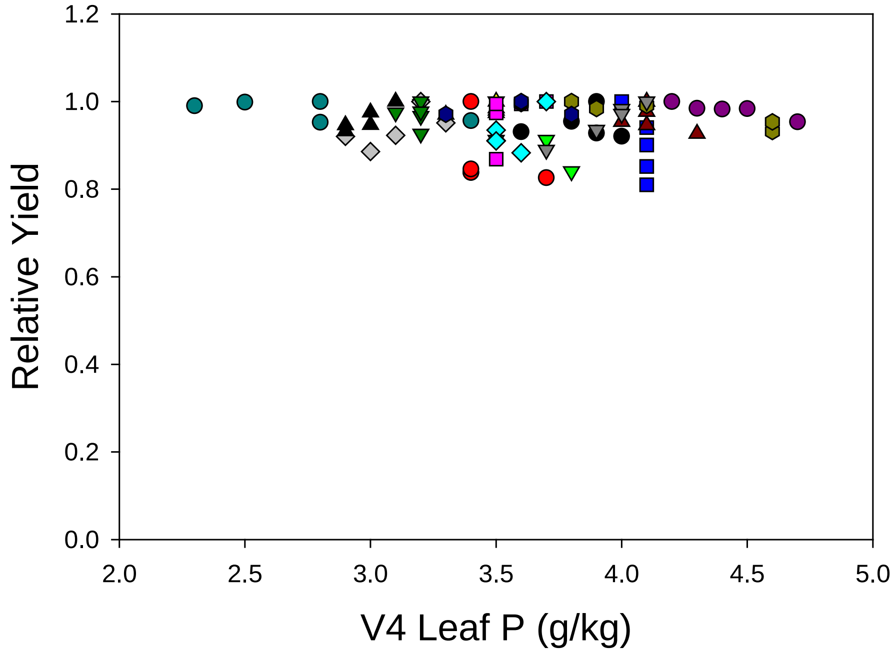

Fig. 5. Relative yield for all treatments and sites plotted versus leaf P concentration at the V4 growth stage. Each point represents one level of applied P at a given site. Data are from 17 sites where soybeans were grown with 0, 20, 40, 60, and 80 lb per acre applied P2O5 in eastern South Dakota over the 2013 and 2014 growing seasons. One site had a treatment structure of 0, 30, 60, and 120 lb applied P_2O_5 per acre in the 2013 season.

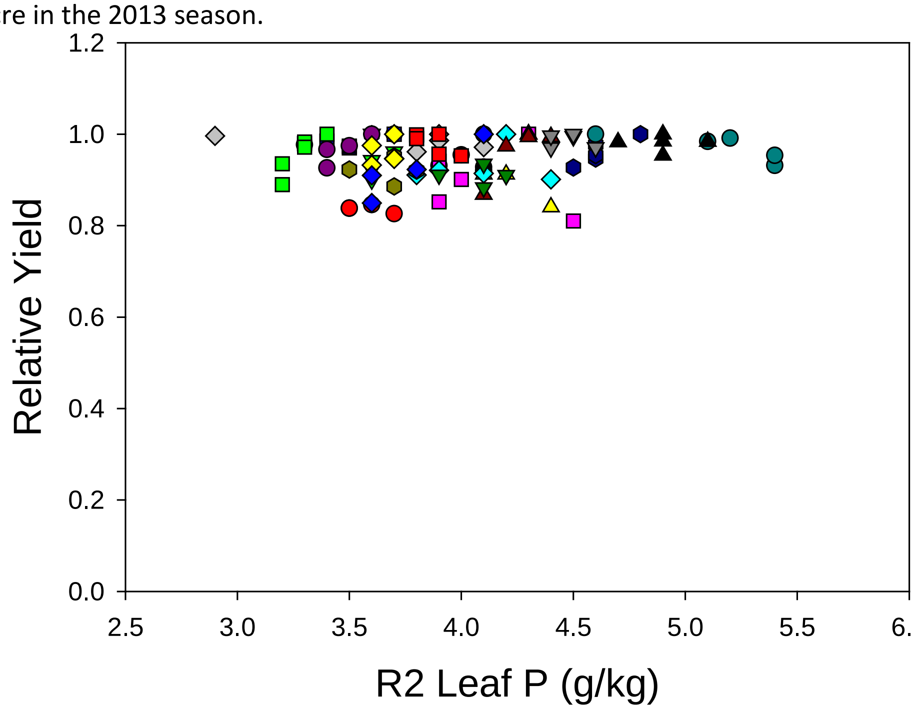

Fig. 6. Relative yield for all treatments and sites plotted versus leaf P concentration at the R2 growth stage. Each point represents one level of applied P at a given site. Data are from 20 sites where soybeans were grown with 0, 20, 40, 60, and 80 lb per acre applied P2O5 in eastern South Dakota over the 2013 and 2014 growing seasons. One site had a treatment structure of 0, 30, 60, and 120 lb applied P_2O_5 per acre in the 2013 season.

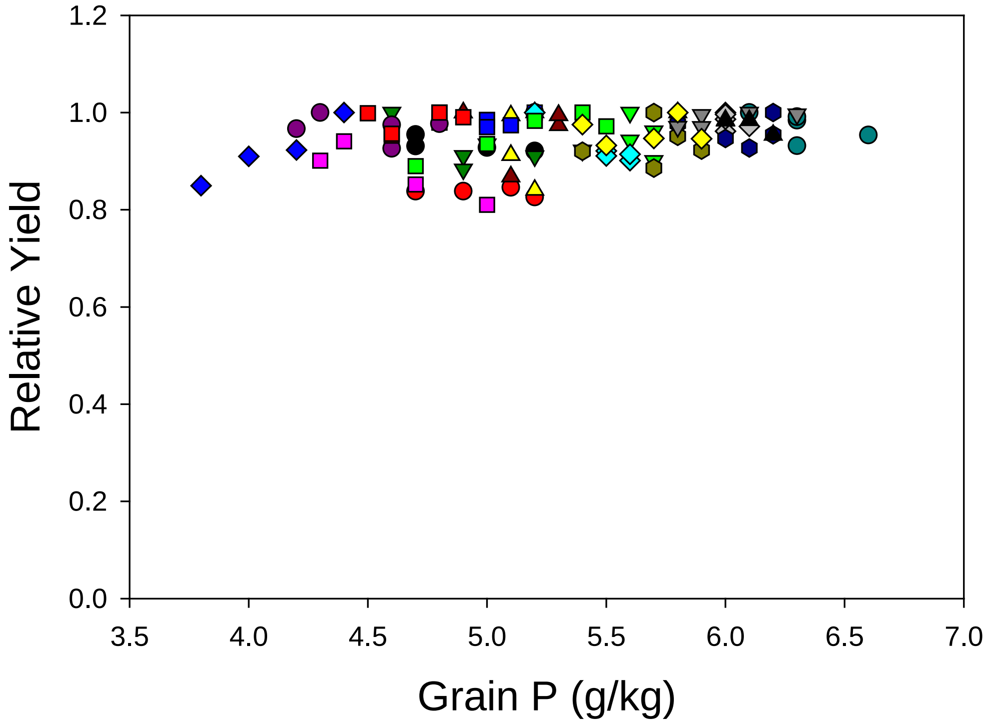

Fig. 7. Relative yield for all treatments and sites plotted versus grain P concentration at harvest. Each point represents one level of applied P at a given site. Data are from 20 sites where soybeans were grown with 0, 20, 40, 60, and 80 lb per acre applied P2O5 in eastern South Dakota over the 2013 and 2014 growing seasons. One site had a treatment structure of 0, 30, 60, and 120 lb applied P_2O_5 per acre in the 2013 season.

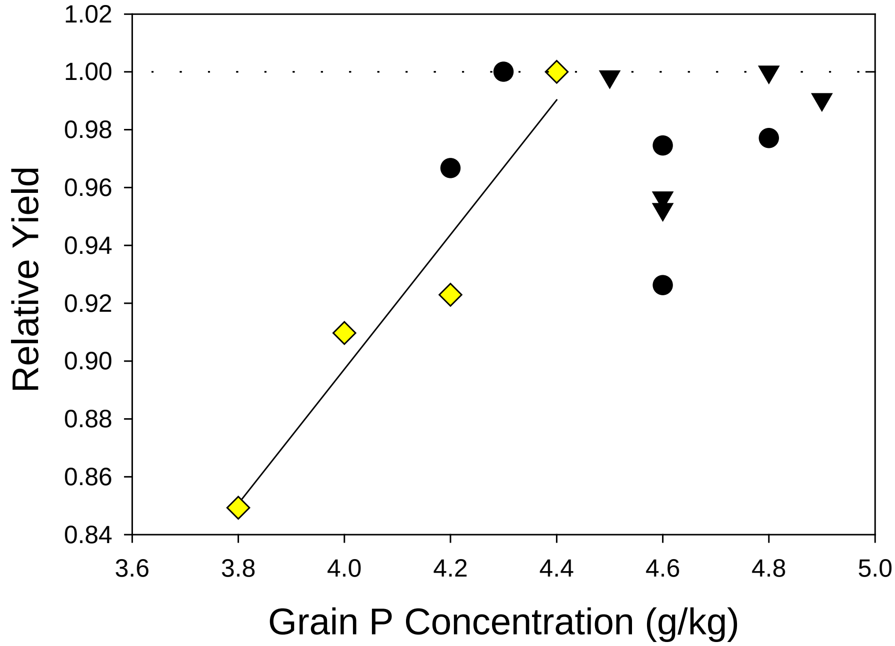

Fig. 8. Close up of relative yield for the lower end of the grain P concentrations observed in this study. The regression is for the points from site # 11 only, and would suggest a critical grain P concentration of 4.0 g/kg. However, more data needs to be collected to substantiate this. Each point represents one level of applied P from a trial. Data are from three sites in eastern South Dakota (a subset of the data shown in Fig. 7 above); the regression line shown is calculated only on data from site # 11.

Leaf nutrient concentrations of P, N, K, S, Ca, Mg, Zn, Cu, Mn, and B for 12 different soybean lines grown at Volga, SD in the 2014 growing season are shown in Fig. 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18, respectively. Comparing average nutrient concentrations for each line across sample dates shows significant differences between lines (Table 5) with no variety by sample date interaction for most of the nutrients evaluated. Only Ca and Mn (both relatively immobile nutrients within the plant) showed a significant variety by sample date interaction. Looking at concentrations over time, Ca, Mn, and B, all tended to increase in concentration towards the end of the season. These nutrients are relatively immobile in the plant. Leaf P tended to increase with time from 43 to 65 DAP and then tended to slowly decline after 65 DAP. One would expect nutrients such as N and P which are highly mobile to decline in the leaf as the plant matures and moves nutrients from the leaves to the developing seeds. In this case sampling ceased in the latter part of August – this effect might have been more apparent if the plants had been sampled later in the season. The most striking variety differences were for B – with two groups of lines, one consistently showing about 10 ppm greater B concentration than the other (Fig. 18 and Table 5). It appears that there is a genetic angle to consider with tissue analysis, particularly for B. While there were statistically significant differences among soybean lines for leaf P concentration (Table 5), the differences were not as great as in B and they weren't as clear cut over time.

At harvest, lines from this same trial were sampled for seed nutrient concentration. This data is shown in Table 6. There was no difference in grain P concentration observed between the lines evaluated.

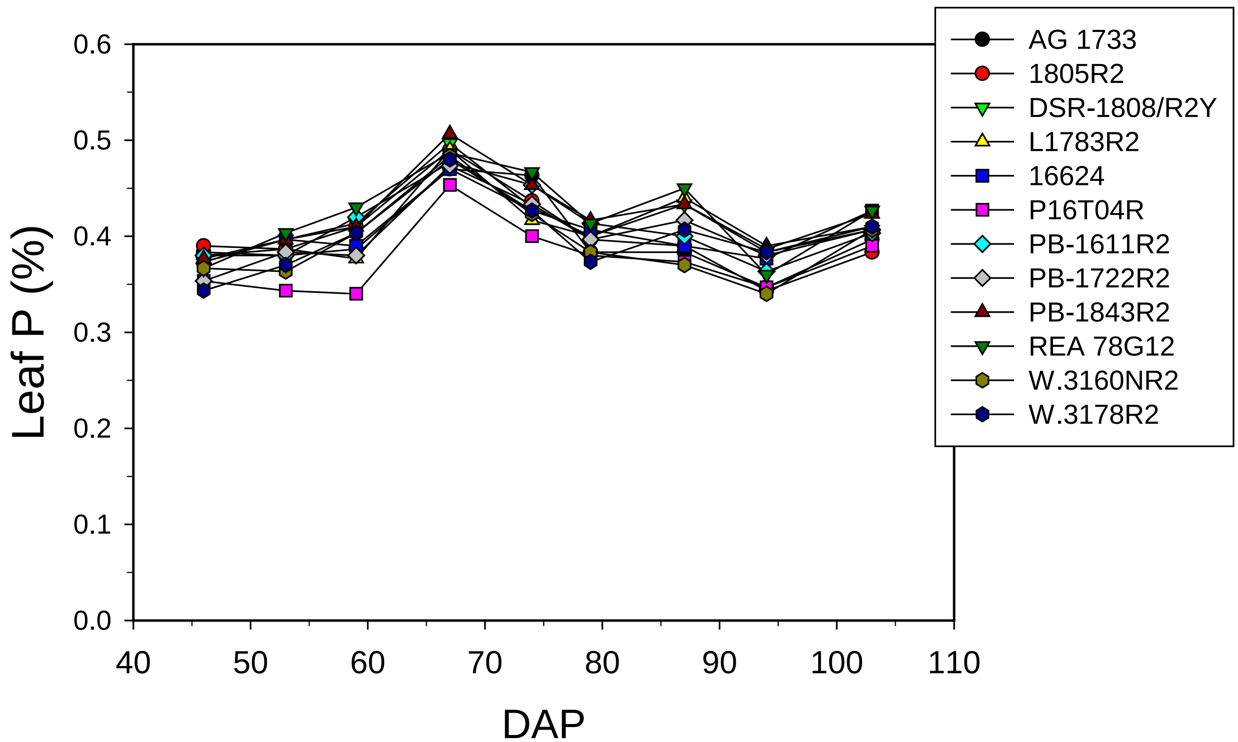

Fig. 9. Leaf P concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

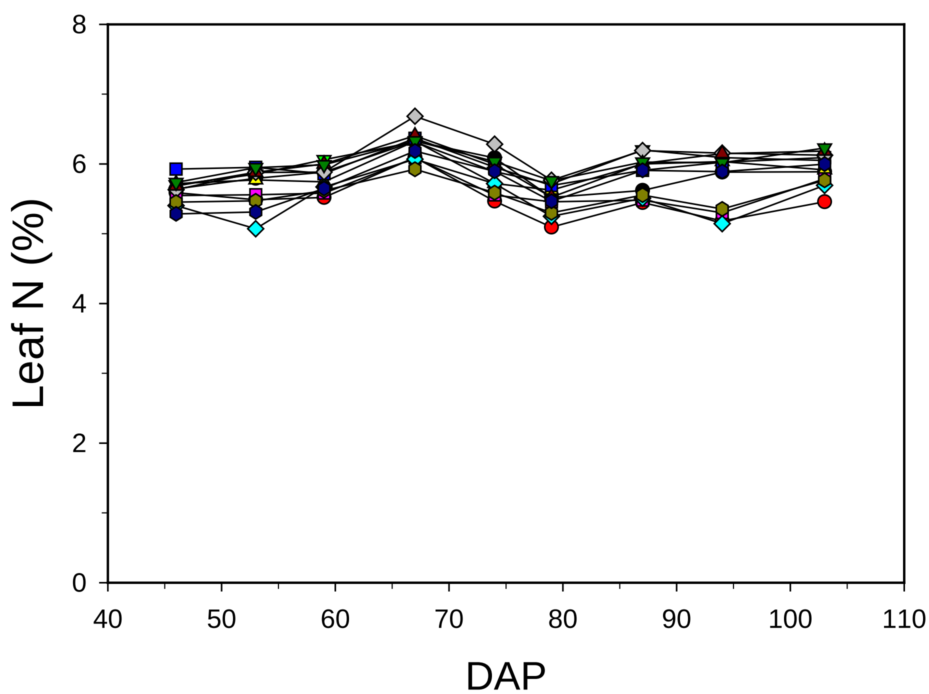

Fig. 10. Leaf N concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

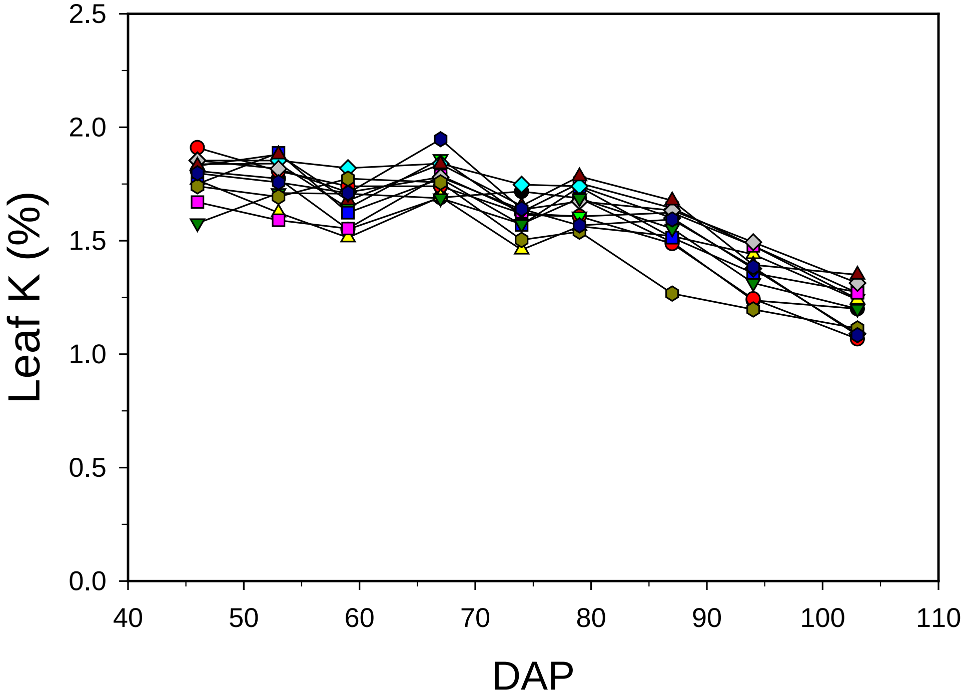

Fig. 11. Leaf K concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

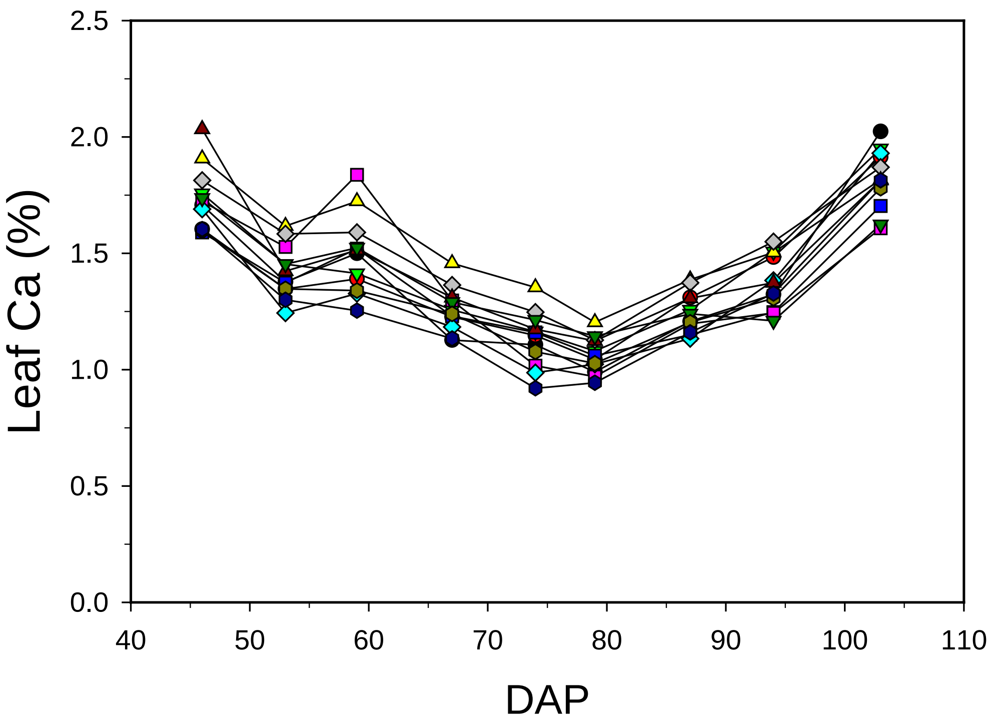

Fig. 12. Leaf Ca concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

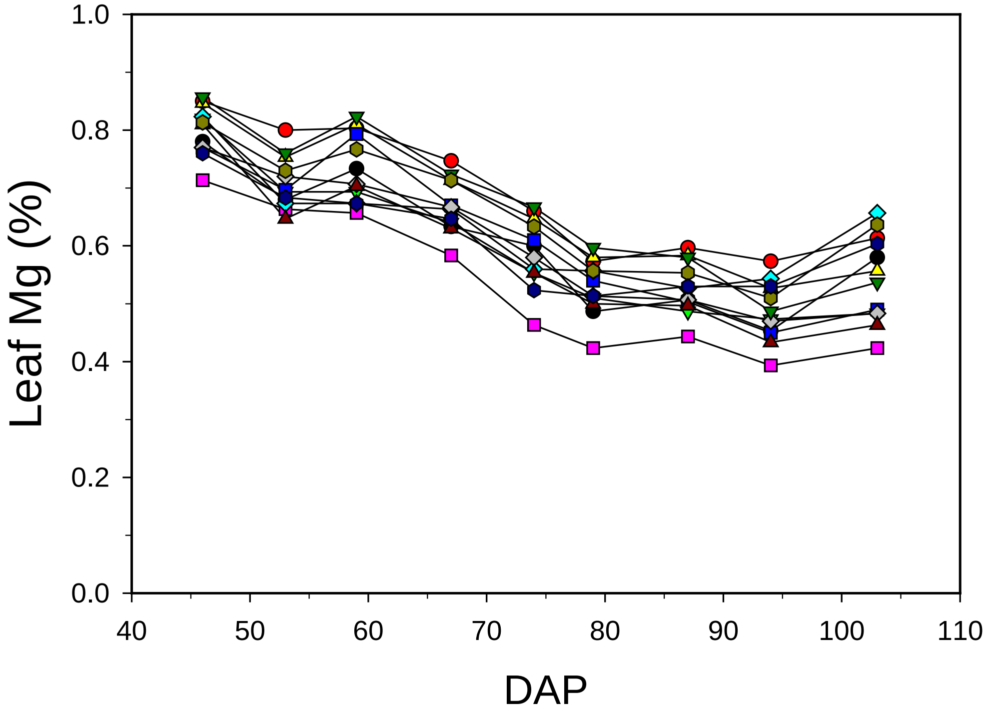

Fig. 13. Leaf Mg concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

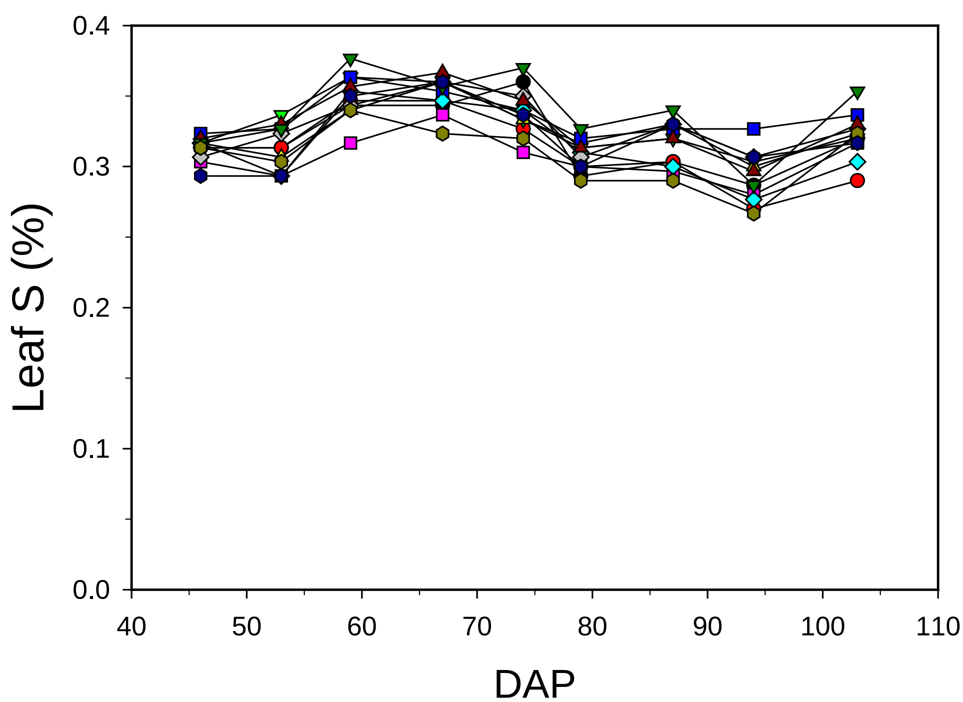

Fig. 14. Leaf S concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

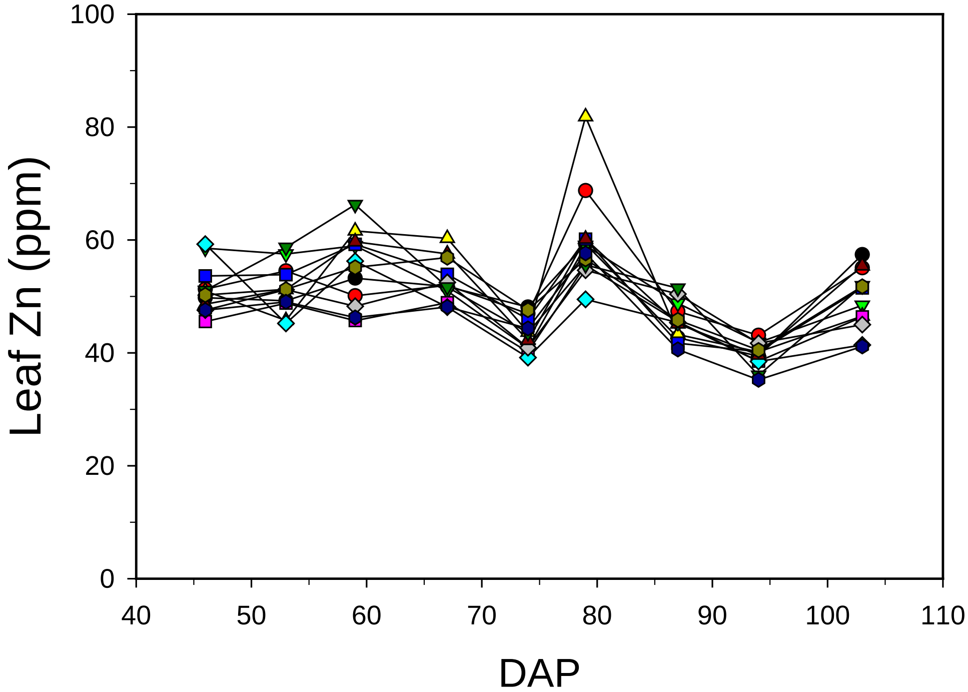

Fig. 15. Leaf Zn concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

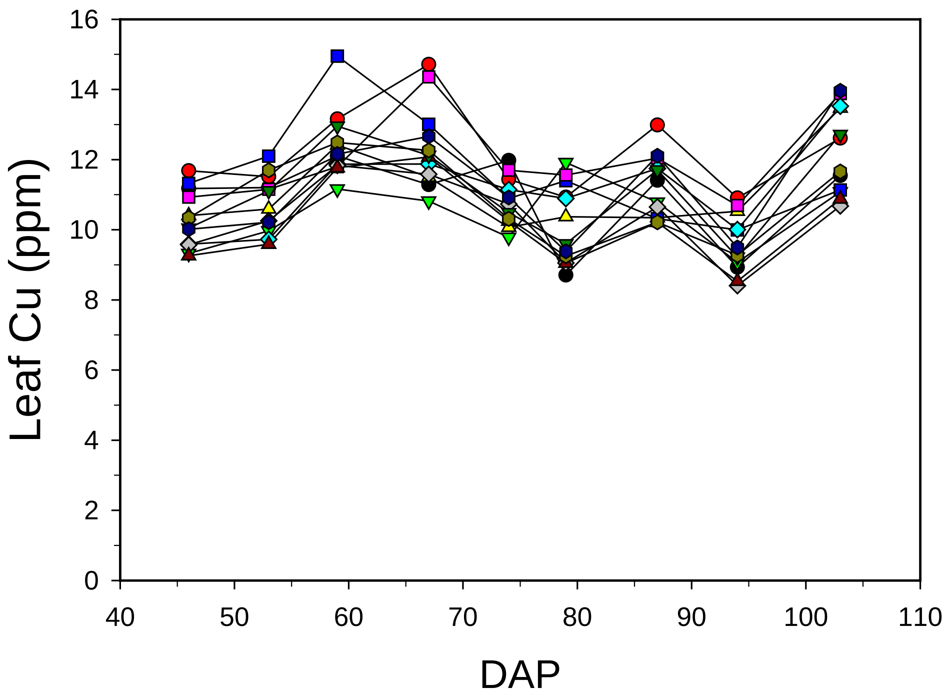

Fig. 16. Leaf Cu concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

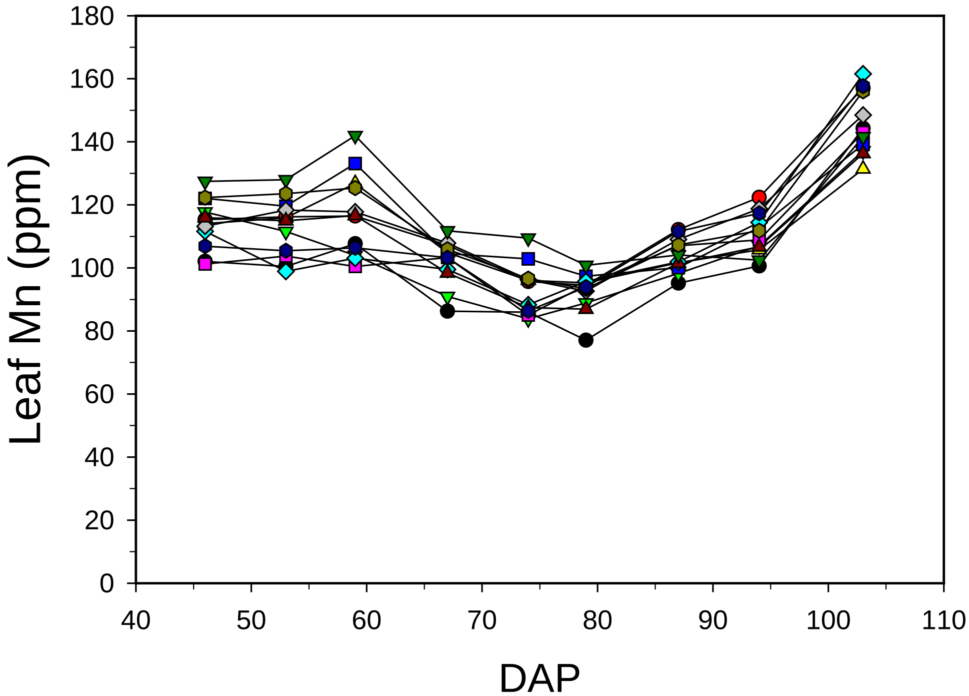

Fig. 17. Leaf K concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

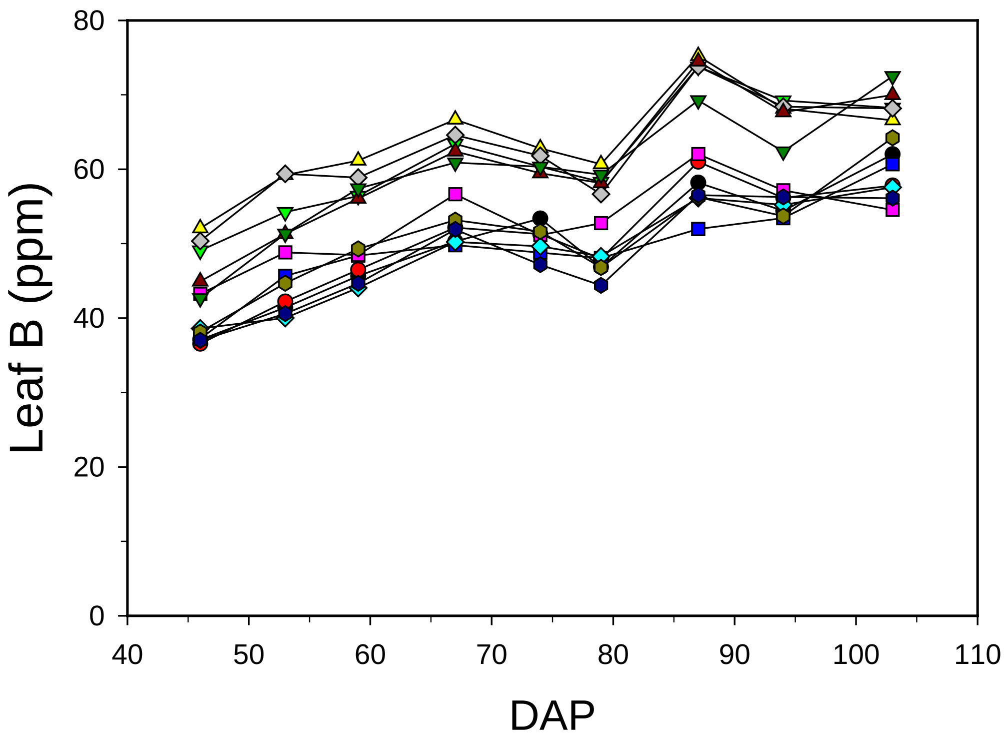

Fig. 18. Leaf B concentration over time for 12 soybean lines grown at Volga, SD, in 2014. Each point is the mean of three replicates.

SUMMARY AND CONCLUSIONS

Soybean yield response to applied P was measured across 20 sites with a wide range in soil P availability over the 2013 and 2014 growing seasons. Soil test P was measured using Bray, Olsen, and Mehlich extracts. Leaf samples were taken at the V4 and R2 growth stages to observe how well they predicted or gave an indication of the responsiveness of the site to P application. An ancillary study was conducted at the SDSU Volga Research Farm to compare concentration of nutrients among 12 different soybean lines over the course of the season from early July to late August.

From this data, the author of this report draws the following conclusions:

1. In this study, soil test P (particularly the Olsen P and Mehlich tests) was superior to tissue analysis for discriminating between sites that could benefit from P fertilizer application versus those that would not.

2. In the range of leaf P concentrations observed in the control plots (2.5 to 4.9 g/kg P), leaf P concentration was not able to distinguish between responsive and unresponsive sites. Under more severe P deficiency it would probably have worked better, but in this set of experiments it would not have been an efficient means for identifying sites that would benefit from P application.

3. More work is needed, but at the low end of the grain P concentrations observed in this study there was a trend for relative yield to drop as grain P declined. Regression analysis of the site with the lowest grain P concentration suggests a critical concentration of 4.0 g/kg; however because there were only a few points in this range more work needs to be done to substantiate this. If a reliable critical P concentration were determined for grain, it might be useful for the following crop season, but it would of course be too late for the current crop.

4. There were significant differences observed between varieties in foliar nutrient concentrations, particularly for B, in the trial conducted at Volga in 2014.

5. For all the lines tested, leaf P concentration tended to increase with time up to about 65 DAP and then tended to slowly decline as the season progressed in the trial at Volga.

ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the support of the South Dakota Soybean Research and Promotion Council, without which this work would not have been completed.

Table 5. Average leaf nutrient concentration from 46 to 103 days after planting for 12 soybean lines raised in a replicated study at Volga, SD, in 2014. The interaction term shown is for the interaction between line and sample date. Samples were taken on a weekly basis during this period.

LINE	N	P	K	S	CA	MG	ZN	MN	B	CU
	(%)	(%)	(%)	(%)	(%)	(%)	(ppm)	(ppm)	(ppm)	(ppm)
1	5.85	0.399	1.573	0.320	1.373	0.606	50.1	100.0	49.9	10.9
2	5.48	0.403	1.580	0.312	1.385	0.691	52.1	115.2	50.2	12.2
3	5.99	0.415	1.638	0.330	1.426	0.595	51.6	104.4	61.4	10.4
4	5.87	0.410	1.536	0.325	1.552	0.669	52.7	110.2	63.6	11.1
5	5.97	0.406	1.609	0.335	1.337	0.614	51.1	114.6	49.3	11.7
6	5.59	0.376	1.597	0.306	1.380	0.529	46.1	105.3	52.7	12.0
7	5.50	0.410	1.658	0.316	1.322	0.631	47.0	108.3	48.9	11.2
8	6.06	0.403	1.657	0.328	1.502	0.602	48.0	113.6	62.4	10.3
9	5.98	0.423	1.676	0.331	1.452	0.582	51.1	107.2	60.5	10.2
10	6.01	0.423	1.556	0.339	1.381	0.670	51.8	118.6	59.6	11.1
11	5.56	0.393	1.509	0.308	1.324	0.657	50.6	115.8	50.9	10.8
12	5.73	0.400	1.609	0.321	1.273	0.607	45.5	109.9	48.3	11.2
Mean	*5.80*	*0.405*	*1.600*	*0.323*	*1.392*	*0.621*	*49.8*	*110.3*	*54.8*	*11.1*
CV (%)	*3.6*	*7.2*	*8.7*	*6.6*	*9.8*	*7.9*	*16.2*	*8.3*	*7.6*	*12.8*
LSD (0.05)	*0.113*	*0.016*	*0.075*	*0.011*	*0.073*	*0.026*	*4.3*	*4.9*	*2.2*	*0.8*
Interaction	*NS*	*NS*	*NS*	*NS*	*	*NS*	*NS*	**	*NS*	*NS*

Table 6. Grain nutrient concentration for 12 soybean lines raised in a replicated study at Volga, SD, in 2014. The interaction term shown is for the interaction between line and sample date.

LINE	N	P	K	S	CA	MG	ZN	MN	B	CU
	(%)	(%)	(%)	(%)	(%)	(%)	(ppm)	(ppm)	(ppm)	(ppm)
1	5.93	0.593	1.847	0.293	0.203	0.223	36.9	24.3	35.2	11.6
2	6.17	0.607	1.827	0.307	0.220	0.223	38.1	27.4	34.8	13.2
3	6.08	0.613	1.837	0.313	0.240	0.220	34.5	27.2	37.7	10.1
4	6.21	0.650	1.813	0.307	0.287	0.230	36.6	31.9	38.9	11.5
5	6.10	0.630	1.863	0.310	0.207	0.230	36.9	29.8	31.1	12.1
6	6.25	0.623	1.837	0.323	0.183	0.217	36.3	27.2	41.0	14.4
7	6.26	0.640	1.867	0.343	0.220	0.237	37.7	28.5	34.5	12.3
8	6.33	0.623	1.807	0.300	0.257	0.223	35.6	30.2	38.1	10.6
9	6.15	0.623	1.867	0.317	0.253	0.227	35.7	28.3	37.7	10.3
10	6.37	0.680	1.923	0.323	0.217	0.233	36.8	29.6	31.2	11.9
11	6.22	0.637	1.823	0.310	0.237	0.220	37.0	29.0	34.6	11.7
12	6.59	0.600	1.793	0.337	0.210	0.220	35.8	27.6	33.0	11.8
Mean	*6.22*	*0.627*	*1.840*	*0.315*	*0.228*	*0.225*	*36.5*	*28.4*	*35.6*	*11.8*
CV (%)	*1.70*	*5.800*	*2.500*	*2.300*	*5.100*	*3.600*	*3.8*	*4.5*	*3.5*	*6.3*
LSD (0.05)	*0.18*	*NS*	*NS*	*0.013*	*0.020*	*NS*	*NS*	*2.1*	*2.1*	*1.3*

SOUTHEAST RESEARCH FARM ANNUAL REPORT
South Dakota State University
2015 Progress Report
Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

High Tunnel Fruit Production – The Beginning

Brad Rops*, Peter Sexton, Doug Johnson, Sara Berg, Sheila Price, Garold Williamson, Kevin Henseler, and Claire Derdall

INTRODUCTION

Land costs, and the competition for land, are high, whether you are buying or renting. How can a producer generate a cost of living income when dealing with a limited land base? By increasing the value of production per acre (or square foot). One potential way to accomplish this is to grow high-value fruit and vegetable crops. Additionally, raising them in a high tunnel allows for earlier marketing in the spring, and an extended growing season in the fall. The Southeast Research Farm purchased a high tunnel utilizing an IPM Grant and Ag Experiment Station funds to evaluate and demonstrate production methods and management practices.

CONSTRUCTION

A high tunnel is essentially an unheated greenhouse. Growers utilizing high tunnels add about six weeks to their growing season – starting about 3 weeks before the last frosts of spring and extending about 3 weeks beyond the first frosts in the fall. A 20' x 48' high tunnel kit was purchased and erected. We chose a Gothic arch frame with a peaked top and 4 foot vertical side walls, versus a round hoop or Quonset style. The Gothic arch is better at shedding snow loads than the flatter topped Quonset style.

Construction of High Tunnel

The site selected for the high tunnel was well drained, with a gradual slope to the south. There is full sun exposure with some wind protection to the west and north. The rafter frames are spaced 4 foot apart which adds to the strength of the structure. Because the high tunnel is situated on a certified organic plot, we used cedar lumber for the baseboards and end walls rather than treated lumber. A water hydrant was installed on the end of the high tunnel for the drip tape irrigation system. The frame was covered with a double layer of 6 mil poly, one layer clear and the second layer a sunlight diffusing poly. The poly is attached to the frame with wiggle wire and U-channel. A small blower is used to inflate the air space between the two layers. This air pocket adds insulation plus rigidity, which extends the life of the poly cover.

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The side walls have manual cranks and can be opened in warm weather. It is important to monitor the temperature and humidity in the high tunnel. The temperature can rise quickly on a warm day and damage the plants. High humidity can lead to increased disease pressure. Adequate ventilation by opening the sides and end walls is a must.

PLANTING

A variety of fruit trees and berries were planted to see what works well and what doesn't. The east side was planted to red raspberries, the west side to strawberries. There are three rows of dwarf fruit trees in the middle of the high tunnel with a 4 foot spacing between rows. There are rows of apple, peach and sweet cherry trees all with hardiness ratings of zone 5. There are also a pair of plum and pear trees and four honey berry plants, which are similar to blueberries. Bumble bees will be purchased this spring and placed in the high tunnel during flowering for pollination. Honey bees cannot function in a high tunnel because the diffused light disrupts their orientation.

Planting in High Tunnel

Half of the apple and peach trees were planted with an in-row spacing of 3 feet, and the other half with a spacing of 18 inches. Production per foot of row will be measured between the two spacings in the coming years. Identical varieties of all the fruit trees were also planted outdoors so production, hardiness, and disease and pest pressure can be compared between conventional and high tunnel growing environments.

Irrigation System on Strawberries

Fruit Trees Growing in High Tunnel

SOUTHEAST RESEARCH FARM ANNUAL REPORT
South Dakota State University
2015 Progress Report
Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

Long-Term Rotation Study: Observations on Corn and Soybean Yields – 2015 Season

Peter Sexton*, Brad Rops, Ruth Stevens, Doug Johnson, Garold Williamson, Sara Berg, and Kevin Henseler.

INTRODUCTION

In 1991, Dale Sorensen initiated a long-term rotation study at the Southeast Farm including comparison of no-till and conventional till under two year (corn-soybean), three year (corn-soybean-small grain), and four year rotations (currently corn-oat-winter wheat-soybean – this rotation has not been constant over the years). The advantages of no-till are many: residue on the surface protects the soil from erosion; it helps to maintain soil organic matter which is important for good tilth; conserves moisture and limits run-off; requires fewer trips across the field. The disadvantages are the loss of tillage as a tool for weed control and slower warming of the soil in the spring. In 2013 a plus/minus cover crop component was added to the study with cover crops being winter rye seeded after corn harvest, and a broadleaf blend after small grain harvest. This report provides a brief overview of how the corn and soybean crops yielded under tilled and no-till management for the 2015 season in the Southeast Farm's long-term rotation study. It includes yield data on plots that had cover crops in the fall of 2014.

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METHODS

As mentioned earlier, this set of plots was first established in 1991. The corn-soybean and corn-soybean-small grain rotation have been consistently followed. The four year rotation initially included alfalfa, then after some years was changed to include peas, and lastly was changed again to include two soybean crops (corn-soybean-winter wheat-soybean), which was the case until the 2013 season. Therefore when the data presented here refers to a four-year rotation, it doesn't mean that a fixed set of crops has been grown in a four-year sequence; it means that corn has been grown once every four years and the other crops in the rotation have varied over the years based on the researcher's interest and judgment at the time. At this point, the four-year rotation is in a corn-oat-winter wheat-soybean sequence.

Insertion of a cover crop is being investigated at two points in the crop sequence. The first is use of winter rye grown after corn harvest and sprayed out ahead of soybean planting. The second point is a cover crop blend (radish, 2.1 lb/ac; dwarf essex, 1.3 lb/ac; turnip, 0.3 lb/ac; peas, 4.4 lb/ac; lentil, 3.2 lb/ac; oat, 4.8 lb/ac; cowpea, 1.6 lb/ac; millet, 1.6 lb/ac; hairy vetch, 2.6 lb/ac), seeded after small-grain harvest with corn being the following crop. Note that we have more small-grain volunteers in cover crops following oats than cover crops following winter wheat.

This trial is laid out in a randomized complete block design with four replications. Plot size is

60 by 300 feet. Corn (Pioneer 1151AM) was planted on May 5, 2015 in 30” rows at a population of 27,900 seeds per acre. Due to problems with stand establishment and cutworm issues, most of the corn plots were sprayed out and replanted. To be consistent, all of the corn in the three and four year rotations was sprayed out and replanted. As the two-year rotation happened to have less damage, these plots were split in two and half of each two-year plot was replanted and half left in place to provide a point of reference in terms of planting date. Corn (Pioneer 9188AMX) was replanted on June 2, 2015 at a seeding rate of 32,000 seeds per acre. Soybeans (Pioneer 25T51) were planted on May 22, 2015 in 30” rows at a population of 150,000 seeds per acre. Fertilizer application in 2015 included 150 lb/ac MAP to all plots on March 24, 2015. April 17, 2015 UAN was applied at a rate of 160 lbs/ac to four crop rotation; the subdivided N plots (2 and 3 crop rotation) received N application per N Rate Study Protocol (*SERF AR1509 Preliminary Report of Evaluation of Tillage and Cover Crop Impacts on Corn N Requirements in Southeastern SD).*

For all the soybean plots, and for corn in the four year rotation, yield was measured from the center 30’ of corn plots and from the center 20’ of soybean plots, running the whole length of the plot; this was combined and the weight determined with a weigh wagon. The two and three year corn plots were subdivided for an N rate study, which will be the subject of another report (*SERF AR1509*). In these plots, yield was measured from an area of 20 by 35 feet taken from the middle of each subplot. A sample was kept for determination of moisture and test weight. Data was analyzed for main effects of rotation and tillage on yield using Proc GLM in SAS statistical software.

There were significant rotation by tillage and rotation by cover crop interactions observed on soybean yields in this season (2015). Because of this, in addition to the overall analysis, effects of tillage and cover crop use on soybean yield data were also analyzed separately for each of the three rotations studied. There were no significant treatment interactions observed for corn yield. So that the reader can see data on each individual treatment, the data was also analyzed as a simple randomized complete block design with each combination treated as an individual treatment and an LSD value obtained for comparing individual means that may be of interest.

RESULTS AND DISCUSSION

Because of issues with cutworms and with poor emergence, most of the corn in this study was in a replant situation. As it turned out, stand loss within the two-year rotation was minor so a decision was made to split these plots in two and keep half and replant the other half of each plot, so the corn in the two-year rotation provides a point of reference for planting date effect and yield loss due to replanting as it contains both planting dates. All of the corn in the three and four year rotations was sprayed out and replanted.

Corn Yields. The average yield for the corn plots in the rotation trial was 208 bushels per acre with normal planting, versus 170 bushels per acre with delayed planting – so there was almost a 20 % yield loss due to delayed planting (Table 1). There was no significant difference in corn yield between the no-till and conventional till systems in the 2015 season. In the two-year corn/soybean rotation with normal planting date, no-till yielded 209 bu/ac where conventional tillage yielded 207 bu/ac – virtually no difference in yield. There was a significant influence of rotation interval on corn yields with the four year rotation showing an advantage of 18 bushels per acre over the two year corn/soybean rotation, and the three-year rotation showing a trend for a 4 bu/ac yield advantage over the two year system. Last year the advantages were greater (37 bu/ac advantage for a four-year rotation and 18 bu/ac for the three-year system). Cover crops did not significantly impact corn yields in this trial, with average yields of 184 bu/ac with a cover crop, versus 181 bu/ac without, for equivalent rotation cycles (Table 1). Yields in the tilled plots were essentially the same with or without a cover crop. In the no-till plot the four-year rotation showed a numeric advantage of 12 bu/ac with a cover crop, while the three year rotation did not – part of the explanation for this may be the heavy population of volunteer oats in the latter's cover crop. This suggests that more attention needs to be paid to controlling volunteer oats, and/or more N should be put on corn following a heavy grass cover crop.

Soybean Yields. Overall, soybean yields averaged 66 bushels per acre in this study (Table 2). There was a significant interaction between tillage system and rotation length, and also between cover crop use and rotation length in this season of the trial. In a two year rotation, there was a significant yield advantage of 3.8 bu/ac with use of rye cover crop in the two-year rotation (Table 3); however, this difference was not observed in the three and four year rotations. A number of trials have been conducted out of the Southeast Farm with winter rye as a cover crop following corn; this is the strongest response that we have seen from this practice. There may be a number of factors at work here: the weather and high yield potential of the 2015 season; the match between the particular rye and soybean lines used; the timing of when the rye was sprayed out relative to its growth stage versus soybean planting date. Clearly this is a point (management of the rye cover crop) that could use more scrutiny and research.

The two year rotation also showed greater soybean yields in the no-till plots than in the conventional plots (67 vs. 62 bu/ac, respectively) for the 2015 season (Table 3). The three and four year rotations did not show a yield difference between tillage systems in 2015. There was a trend for soybean yield to increase slightly with longer rotation intervals, but in 2015 this was not a strong effect (Table 2). These differences vary somewhat from year to year – at least in part due to weather. Last season (2014) with the extremely wet June, the conventional soybeans tended to yield more than did the no-till soybeans. In 2012, with extremely dry weather, the no-till beans clearly out-yielded the conventional till beans. In this season (2015) with good weather and exceptional yield potential, the two tillage systems behaved similarly with a slight trend for no-till to show a small yield advantage for soybeans.

ACKNOWLEDGEMENT:

Support for this project provided in part by the South Dakota Agricultural Experiment Station in Brookings, SD.

Table 1. Corn yield data from the 2015 season in a long term tillage by rotation study conducted at the SDSU Southeast Research Farm. Tillage treatments are abbreviated as follows: "CT" = conventional tillage; "NT" = no-till. There were no significant tillage by rotation interactions in this data set.

Tillage Regime	Rotation	Previous Cover Crop	Planting Time	Test Wt.	Yield	Stand
				(lb/bu)	(bu/ac)	(plants/ac)
CT	corn-soy	No	Early	58.7	207	25265
NT	corn-soy	No	Early	58.3	209	24176
CT	corn-soy	No	Replant	57.2	172	30492
CT	corn-soy-oat	No	Replant	56.8	178	32235
CT	corn-soy-oat	Yes	Replant	56.5	178	30056
CT	4-year	No	Replant	57.4	189	31944
CT	4-year	Yes	Replant	58.0	192	29040
NT	corn-soy	No	Replant	56.4	167	29403
NT	corn-soy-oat	No	Replant	56.6	169	30056
NT	corn-soy-oat	Yes	Replant	57.2	168	29839
NT	4-year	No	Replant	57.6	187	30855
NT	4-year	Yes	Replant	58.0	198	31581
			Mean	*57.4*	*185*	*29578*
			CV(%)	*1.1*	*5.2*	*10.5*
			LSD (0.05)	*0.9*	*14*	*4489*
Cover Crop Comparison (within 3 and 4 year rotations)						
	W/ Cover Crop			57.4	184	30129
	No Cover Crop			57.1	181	31272
			P-value	NS	NS	NS
Rotation with no cover crop - across tillage treatments						
	corn-soy			56.8	170	29948
	corn-soy-oat			56.7	173	31145
	4-year			57.5	188	31400
			LSD (0.05)	NS	14	NS
Tillage across all rotations (replant only)						
	Till			57.1	180	31557
	No-till			56.9	174	30105
			P-value	NS	NS	NS
Early vs Replant (within corn/soy rotation only)						
	Early			58.5	208	24720
	Replant			56.8	170	29948
			P-value	**	**	**

Table 2. Soybean yield data from the 2015 season in a long term tillage by rotation study conducted at the SDSU Southeast Research Farm. Tillage treatments are abbreviated as follows: "CT" = conventional tillage; "NT" = no-till. Cover crops refers to winter rye seeded into corn stubble. There were significant interactions between rotation system and cover crop effect on yield (see Table 3).

Tillage	Rotation	Previous Cover Crop	Test Wt.	Stand	100-Seed Wt.	Yield
			(lb/bu)	(plants/ac)	(g)	(bu/ac)
CT	corn-soy	N	57.3	129954	17.5	59.2
CT	corn-soy	Y	57.3	122694	18.0	65.6
CT	corn-soy-oat	N	57.6	135762	17.8	65.3
CT	corn-soy-oat	Y	57.2	135036	17.5	66.1
CT	4-year	N	57.4	119790	18.3	67.9
CT	4-year	Y	57.3	131406	17.8	65.6
NT	corn-soy	N	56.9	120516	17.9	66.8
NT	corn-soy	Y	56.8	113982	18.5	68.0
NT	corn-soy-oat	N	56.9	123420	18.0	64.0
NT	corn-soy-oat	Y	57.0	133584	17.3	66.0
NT	4-year	N	56.2	124872	18.8	66.6
NT	4-year	Y	56.0	120516	18.5	64.8
		Mean	*57.0*	*125961*	*18.0*	*65.5*
		CV (%)	*1.1*	*11.4*	*3.8*	*4.8*
		LSD (0.05)	*0.9*	*NS*	*NS*	*4.5*
Cover Crop Comparison (across rotations and tillage systems)						
	With Cover Crop		56.9	126203	17.9	66.0
	No cover crop		57.0	125719	18.0	65.0
	P-value		*NS*	*NS*	*NS*	*NS*
	interactions		*NS*	*NS*	*NS*	*
Comparison of rotations (across tillage and cover crop treatments)						
	corn-soy		57.1	121787	18.0	64.9
	corn-soy-oat		57.2	131951	17.6	65.3
	4-year		56.7	124146	18.3	66.2
	LSD (0.05)		*NS*	*NS*	*0.5*	*NS*
	interactions		*NS*	*NS*	*NS*	*
Tillage comparison (across rotations and cover crop treatments)						
	Tilled		57.3	129107	17.8	64.9
	No-Till		56.6	122815	18.1	66.0
	P-value		**	*NS*	*NS*	*NS*
	interactions		*NS*	*NS*	*NS*	*

Table 3. Soybean yield data from the 2015 season in a long term tillage by rotation study conducted at the SDSU Southeast Research Farm. Tillage treatments are abbreviated as follows: "CT" = conventional tillage; "NT" = no-till. Cover crops refers to winter rye seeded into corn stubble. There were significant interactions between rotation system and cover crop effect on yield (see Table 3).

	ROTATION		
	corn-soy	**corn-soy-oat**	**4-year**
Treatment	**Yield**	**Yield**	**Yield**
	(bu/ac)	(bu/ac)	(bu/ac)
With Cover Crop	66.8	66.0	64.8
No Cover Crop	63.0	64.6	67.3
P-value	*	*NS*	*NS*
No-Till	67.4	65.0	66.7
Tilled	62.4	65.7	65.7
P-value	**	*NS*	*NS*

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Preliminary Report of Evaluation of Tillage and Cover Crop Impacts on Corn N Requirements in Southeastern South Dakota

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ABSTRACT

Nitrogen is a vital factor of corn production. There is uncertainty whether nitrogen (N) requirements are the same for corn raised under no-till versus tilled production systems. The objective of this study is to evaluate N fertilizer requirements for long term no-till soils versus conventionally tilled soils in southeastern South Dakota, while also considering effects from cover crops and crop rotation. This is a two year study at the SDSU Southeast Research Farm near Beresford, SD on long term no-till plots established in 1991. Treatments included N rates of 0, 40, 80, 120, 160, and 200 lbs. N/acre. Rotations were: corn-soybean and corn-soybean-small grain; the 3 year rotation was split additionally by 'cover crop' and 'no cover crop' treatments. Parameters measured included: SPAD meter readings, NDVI readings, ear leaf N content, total plant N uptake, yield, test weight, moisture, and grain protein. 2014 small plot results were quite variable due to 13.5" of rainfall in June; the 2015 growing season was mild, producing more impressive yields. Both N rate and tillage showed significant impacts on yield in 2014 and 2015. In 2014, spring soil nitrate levels were 80 lbs/acre less in the 'cover crop' verses 'no cover crop' treatments. In 'cover crop' plots, significantly higher yield differences occurred ($p<0.10$) verses 'no cover crop' plots; N that was not available at the beginning of the growing season likely became available later, when cover crop residue decomposed. The second year of data is currently being analyzed and will help assign the proper N credit held in the cover crop blend.

INTRODUCTION

This is a preliminary report of a work in progress. As soil 'health' and 'structure' have become buzz words in South Dakota agriculture, the use of no-till and cover crop farming practices have increased immensely, resulting in a continued expansion of no-till crop production in South Dakota. As this upward trend continues, many questions arise regarding nitrogen fertilizer application, usage, and waste in regards to maximum yields and financial potential under no-till management. The current South Dakota State University Soil Testing Lab recommendations are based on research done on 'short-term' no-till fields. These recommendations call for an additional 30 lbs. of N per acre for no-till or strip till cropping systems due to increased organic matter in such systems (SDSU, 2005). However, recent studies have shown the nutrient needs for a 'long-term' no-till field is not consistent with those of a 'short-term' no-till system. This study has been designed to address the nitrogen fertilizer

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requirements for 'long-term' no-till corn in eastern South Dakota, as well as look at the effects that cover crops, tillage, and crop rotation have on that need. The trial was conducted at the Southeast Research Farm located near Beresford, SD on a long term rotation/tillage study that was established in 1991.

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MATERIALS AND METHODS

Item	Description
Location	Southeast Research Farm, Beresford, SD
Crop[1]	2014: Corn, Pioneer 0193AM 2015a: Corn, Pioneer 1151AM; '15b: Corn, Pioneer 9188AMX
Other Fertilizer Applied	2014: 2 April- 133#/a 0-0-60 2015: 24 March- 150#/a MAP
Nitrogen Treatments Applied	0, 40, 80, 120, 160, 200#/ac N applied as UAN with streamer bars- 2014: 10 April 2015: 15 April
Description	See Table 1
Tillage	No-till, Conventional till- spring field cultivated
Rotation	2 year rotation: corn/soybean; 3 year rotation: corn/soybean/oat (changed from wheat to oats in 2014)
Cover Crop	Cover Crops were added to the 3 year rotation after small grain/before corn beginning in 2013. 2013 fall blend: 1.9 lbs/ac radish, 1.1 lbs/ac dwarf essex, 0.3 lbs/ac turnip, 3.9 lbs/ac pea, 2.8 lbs/ac lentil, 7 lbs/ac oat, 1.4 lbs/ac cowpea, 1.4 lbs/ac millet, 2.3 lbs/ac vetch. 2014 fall blend: 2.1 lbs/ac radish, 1.3 lbs/ac dwarf essex, 0.3 lbs/ac turnip, 4.4 lbs/ac pea, 3.2 lbs/ac lentil, 4.8 lbs/ac oat, 1.6 lbs/ac cowpea, 1.6 lbs/ac millet, 2.6 lbs/ac vetch.
Planting Date	2014: 16 May- 32,300 seeds/ac 2015a: 5 May- 27,900 seeds/ac; '2015b: 2 June- 32,000 seeds/ac
Soil	EhA (Egan-Trent silty clay loam, 0 to 2% slope)
Plot Size	2 year rotation: 45'x 60' 3 year rotation: N treatments split by cover crop treatment, making sub-plots 45'x30'
Harvest Date	2014: 30 October 2015a/b: 22 October
Experimental Design	RCBD with N rate as split, CC strip in 3 year rotation
Stats	SAS GLM- RCBD split strip plot design; R Studio- linear plateau lines.

[1]"'2015a" refers to May 5, 2015 planting, "'2015b" refers to June 2, 2015 planting. Due to cutworms and poor stand establishment, the east ½ of all 2015, 2-year rotation plots and all of the 2015 3-year rotation plots were sprayed out with SelectMax on May 27, 2015 and replanted June 2, 2015.

Table 1. Fertilizer treatments applied to corn near Beresford, SD, 2014-2015.

Rot.	N Rate[1]	Till[2]	C. Crop[3]	Rot.[4]	N Rate	Till	C. Crop
C/S	0	NT	N	C/S/O	0	NT	N
							Y
		CT				CT	N
							Y
C/S	40	NT	N	C/S/O	40	NT	N
							Y
		CT				CT	N
							Y
C/S	80	NT	N	C/S/O	80	NT	N
							Y
		CT				CT	N
							Y
C/S	120	NT	N	C/S/O	120	NT	N
							Y
		CT				CT	N
							Y
C/S	160	NT	N	C/S/O	160	NT	N
							Y
		CT				CT	N
							Y
C/S	200	NT	N	C/S/O	200	NT	N
							Y
		CT				CT	N
							Y

[1]Applied as UAN using streamer bar application method; 4/10/14; 4/15/15.
[2]'NT' indicates no-till since 1991, 'CT' indicates conventional till since 1991.
[3]'N' and 'Y' indicate 'no cover crop' and 'cover crop' respectively.
[4]3 year rotation was switched from wheat to oat in 2013.

RESULTS

Table 2. Pre-plant Soil Nitrate Nitrogen and Ammonium Nitrogen, 2014.

		2 year rotation		3 year rotation	
Till	CC[1]	NO_3-N	NH_4-N	NO_3-N	NH_4-N
		-----------lbs/ac from 0-2ft----------			
NT	N	98.3	54.9	122	54.5
	Y	-	-	47.1	57.0
CT	N	75.7	47.1	145	45.6
	Y	-	-	61.4	56.6

[1]'N' indicates no cover crop, 'Y' indicates cover crops present.

Table 3. Anova[1] Table by Rotation, 2014-2015.

Source of Var.	---------------------2 year-------------------			--------------3 year--------------	
	2014	2015a[2]	2015b[3]	2014	2015
N Rate	0.0444	<0.0001	0.0005	<0.0001	<0.0001
Till	0.0109	0.0035	0.0061	<0.0001	<0.0001
CC	-	-	-	0.0514	0.2897
Till*CC	-	-	-	0.9629	0.6403
N Rate*Till	0.3402	0.2436	0.1591	0.0468	0.6564
N Rate*CC	-	-	-	0.7562	0.8096
N Rate*Till*CC	-	-	-	0.9939	0.9717

[1]Proc glm was used to run preliminary statistics.
[2]'2015a' refers to May 5, 2015 planting date.
[3]'2015b' refers to June 2, 2015 planting date.

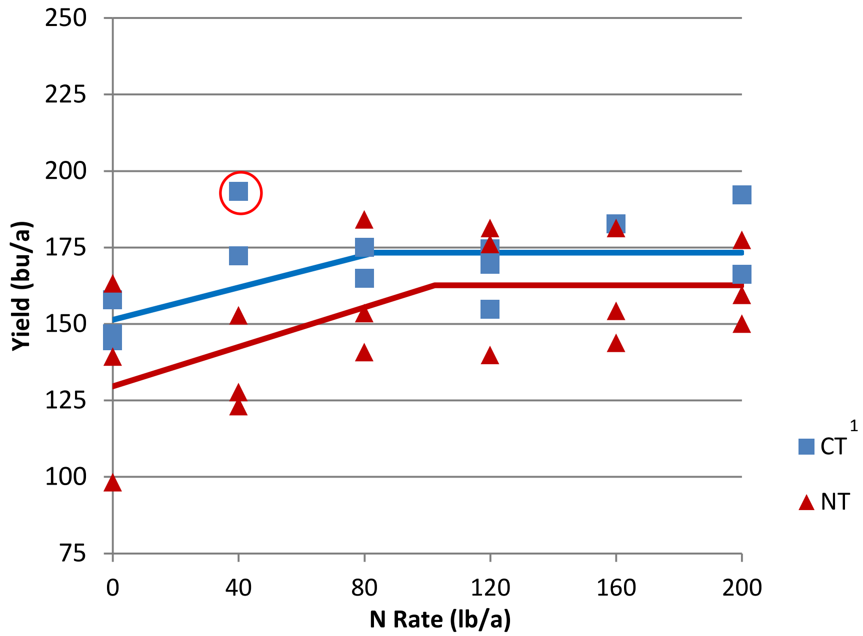

Figure 1. 2 Year Crop Rotation Corn Yields[2] by Tillage Treatment, 2014.

[1]"CT" refers to conventional till, "NT" refers to no-till.

[2]Data point circled is an outlier that has been excluded from linear plateau statistical analysis.

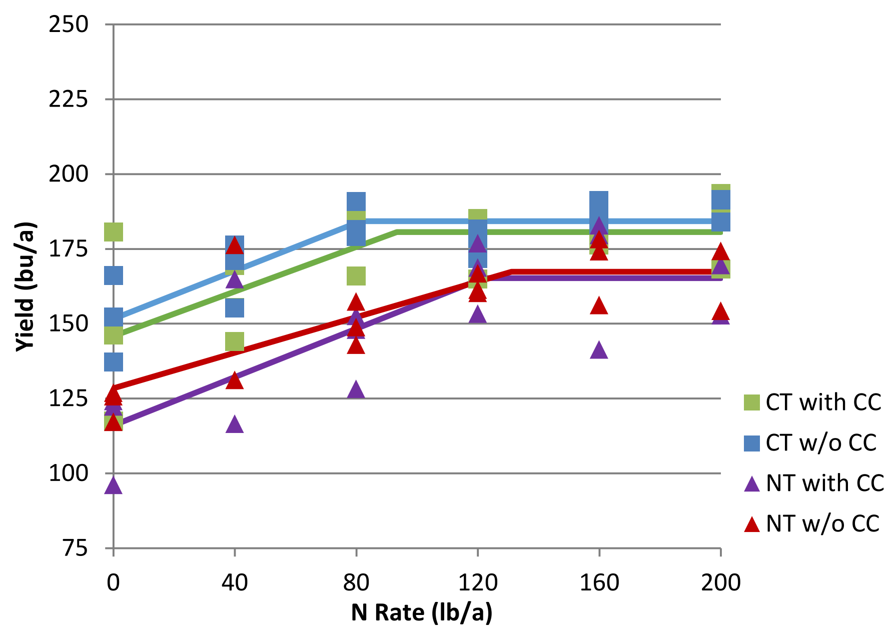

Figure 2. 3 Year Crop Rotation Corn Yields by Tillage and Cover Crop Treatment, 2014.

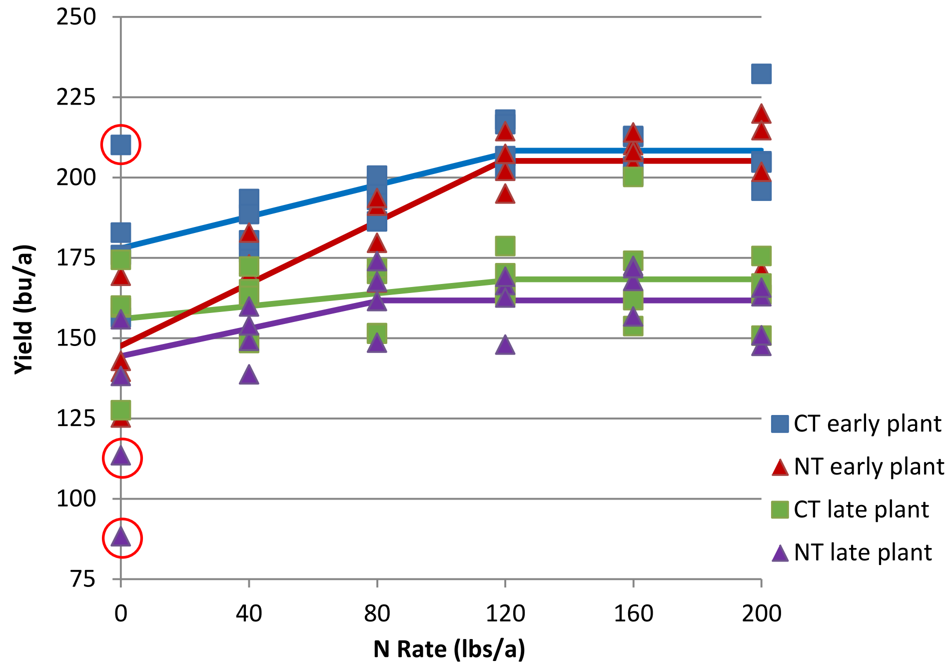

Figure 3. 2 Year Crop Rotation Yields[1] by Tillage Treatment and Planting Date, 2015.

[1]Data points circled are outliers that have been excluded from linear plateau statistical analysis.

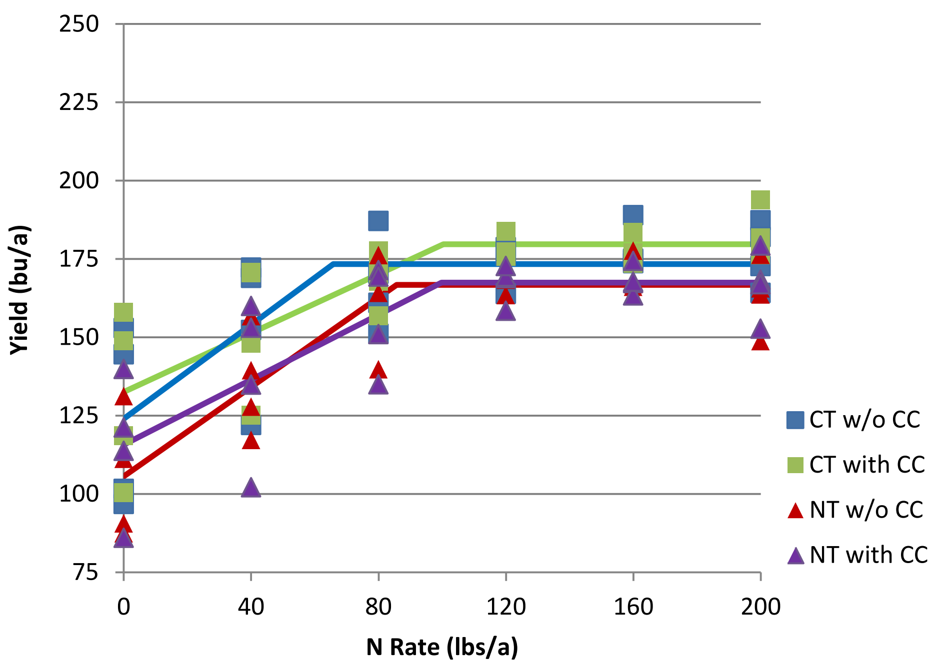

Figure 4. 3 Year Crop Rotation Corn Yields by Tillage Treatment and Cover Crop Treatment, 2015.

SUMMARY

The 2014 season at the Southeast Research Farm was marked by cool weather in May followed by the wettest month on record in June, receiving 13.5” in the month, most of which came in a eight day period. The heavy June rainfall resulted in large variation associated with small differences in elevation cross the field. However, with better weather in July and August the condition of the crop improved considerably and at the end of the season it provided a reasonable yield averaging 172 bu/acre across the entire field. In 2015, the field season was quite favorable throughout the summer with fair temperatures and average rainfall; with delayed planting (June 2) the average yield of the field in 2015 was 171 bu/acre. Yields in plots that were planted earlier (May 5) and did not need replanting averaged 208 bu/acre with application of 160 lbs. N/acre, showing a yield loss of about 37 bu/acre due to delayed planting in the replant area.

In 2014 and 2015, both N rate and tillage regime showed statistically significant impacts on yield (P<0.01) (Table 3). In the first year of the study, marked by excessive rainfall, the conventional tilled plots tended to yield more than did the no-till plots (Figure 1 and Figure 2). 2015 data is still being reviewed, but it appears that there was little, if any, difference in maximum yield between the tillage systems where adequate N was provided (Figure 3, Figure 4). In 2015, it appears that the 2 year rotation, no-till plots responded to nitrogen application rate more sensitively than conventional till plots, inferring that optimum nitrogen rate is crucial in this no-till system (Figure 3). The optimum nitrogen rate appears to be very similar between no-till and conventional till systems in 2014 for the 3-year crop rotation as well as the 2015 2-year - early planting crop rotation, inferring that no-till soils may not consistently require 30 lbs. more nitrogen than conventional tillage systems (Figure 2, Figure 3). These results need to be further evaluated with data from the 2015 season before firm conclusions are drawn.

The cover crop treatment did not appear to have a significant effect on N response in either year of the study (Table 3). It is interesting to note that 2014 spring soil nitrate levels were about 80 lbs/acre less in the cover crop versus the non-cover crop plots (Table 2), presumably because this N was taken up and held by the cover crop. The fact that 2014 corn yield in the cover crop plots did not differ in N response, despite having lower initial soil N levels, suggests that the N the cover crops took up became available later in the 2014 season as the cover crop residue decomposed. As this research progresses, we hope to be able to assign an appropriate credit for the N held in the cover crop using both 2014 and 2015 data– clearly in this case, with a low-residue broadleaf cover crop, the N did become available in a useful manner for the following corn crop. Further analysis of this project data is a work in progress.

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Micro Nutrient (Boron, Copper, and Manganese) Effect on Soybean and Corn Grain Yield in Eastern South Dakota during 2015

Anthony Bly* and David Karki

INTRODUCTION

Soybean and corn micro nutrient deficiency symptoms are rare to non-existent in eastern South Dakota. Zinc deficiency is more common in corn and infrequently seen on poor, low organic matter, and coarse texture soils. Corn responses to zinc applications have occurred when zinc soil test is below 1 ppm. Field research investigating the other micro-nutrients (Boron, Copper, and Manganese) has been small. No visual boron, copper, or manganese deficiencies have been recorded in South Dakota. However, much like zinc, soybean and corn could respond to boron, copper, and manganese field applications without the visual deficiency symptoms. For this reason, an on-farm research project was initiated to measure the influence of pre-emerge soil applications of boron, copper, and manganese on soybean and corn yield in eastern South Dakota.

Table 1. Materials and Methods

Item	Description
Soybean locations	Crooks, Garretson 1 and 2, Arlington, NE Farm
Corn locations	SE Farm, Crooks, Garretson, Sinia, NE Farm
Boron rate and source	2 lbs B/ac as Solubor
Copper rate and source	2 lbs Cu/ac as copper sulfate
Manganese rate and source	20 lbs Mn/ac as manganese sulfate
Application method/timing	Surface broadcast prior to crop emergence (pre-emerge)
Tillage methods	All no-till except South Shore soybeans
Pre-project soil samples	Composite 0-6 inch for each location analyzed for B,Cu and Mn.
Soybean row spacing (inches)	Crooks(15), Garretson1(7.5), Garretson2(30), Arlington(7.5), South Shore(30)
Corn row spacing (inches)	All were 30
Plot size	10 x 20 ft
Plot design	RCBD – randomized complete block design
Soil test level interpretations	EC-750, Fertilizer Recommendations Guide, SDSU
Replications	4
Statistics	ANOVA, Pr>F with treatment as dependent variable

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SUMMARY

Boron, copper, and manganese soil test levels at all sites were in the high category (EC-750), and therefore, no micro nutrient applications would be recommended (Tables 2 and 3). Boron soil test levels ranged from 0.61 to 1.22 ppm. Copper soil test levels ranged from 0.49 to 1.5 ppm. Manganese soil test levels ranged from 3.4 to 30.9 ppm.

Grain yields at all sites were very good for soybeans and corn (Table 4 and 5). The micro nutrient treatment applications did not significantly influence soybean or corn grain yields.

Post-harvest soil samples analyzed for boron, copper, and manganese showed that most all treatment plots had higher soil test levels for boron, copper, and manganese when compared with the control plots (Tables 6 and 7). Even though the boron and copper application rates were only 2 lbs/ac surface broadcast before crop emergence, and good grain yields were removed, the B and Cu treated plots generally had higher soil test levels except for copper at Garretson2 and NE farm (Tables 6 and 7). Soil test boron was increased from B treatment application between 9 and 113 %. Soil test copper was increased from Cu treatment application between 0 and 103%, and manganese was increased between 0 and 11%. Despite the 20 lbs Mn/ac application rate, soil test manganese increase was the lowest.

ACKNOWLEDGMENTS

The soybean portion of this research work was partially funded by the South Dakota Soybean Research and Promotion Council. Other contributors were SDSU Extension, the South Dakota Ag. Experiment Station, and the Southeast and Northeast Research Farms.

Table 2. Soil test boron, copper and manganese at soybean micro nutrient research locations in eastern South Dakota during 2015.

Nutrient	Crooks	Garretson1	Garretson2	Arlington	NE Farm
	------------------------------ ppm (soil test level) ---------------------------------------				
Boron (B)	1.22 H	0.61 H	0.91 H	0.89 H	0.95 H
Copper (Cu)	0.68 H	0.58 H	0.49 H	0.88 H	0.76 H
Manganese (Mn)	3.4 H	16.1 H	11.4 H	18.5 H	25.5 H
Boron soil test levels: Low (<0.25 ppm), Medium (0.25-0.50 ppm), High (>0.50 ppm) (EC-750)					
Copper soil test levels: Low (<0.10 ppm), Medium (0.10-0.20 ppm), High (>0.20 ppm) (EC-750)					
Manganese soil test levels: Low (<0.50 ppm), Medium (0.50-1.0 ppm), High (>1.0 ppm) (EC-750)					

Table 3. Soil test boron, copper and manganese at corn micro nutrient research locations in eastern South Dakota during 2015.

Nutrient	SE Farm	Crooks	Garretson	Sinia	NE Farm
	------------------------------ ppm (soil test level) ---------------------------------------				
Boron (B)	0.92 H	0.82 H	0.68 H	0.90 H	0.70 H
Copper (Cu)	1.50 H	0.71 H	1.09 H	0.68 H	0.70 H
Manganese (Mn)	21.3 H	5.1 H	30.9 H	14.3 H	18.5 H
Boron soil test levels: Low (<0.25 ppm), Medium (0.25-0.50 ppm), High (>0.50 ppm) (EC-750)					
Copper soil test levels: Low (<0.10 ppm), Medium (0.10-0.20 ppm), High (>0.20 ppm) (EC-750)					
Manganese soil test levels: Low (<0.50 ppm), Medium (0.50-1.0 ppm), High (>1.0 ppm) (EC-750)					

Table 4. Influence of boron, copper and manganese on soybean grain yield at several locations in eastern South Dakota during 2015.					
Nutrient	Crooks	Garretson1	Garretson2	Arlington	NE Farm
	---------------- bu/ac----------------				
Control	76.3	67.1	67.6	42.3	45.6
Boron (B)[A]	77.4	62.3	56.9	41.9	43.5
Copper (Cu)[B]	76.5	65.8	58.1	43.9	44.7
Manganese (Mn)[C]	78.3	66.8	57.3	43.5	44.3
CV %	4.4	20.2	8.6	5.6	5.6
Pr>F	0.83	0.62	0.69	0.62	0.72
LSD (.05)	NS	NS	NS	NS	NS
[A] 2 lbs B/a surface broadcast spread as Solubor before crop emergence.					
[B] 2 lbs Cu/a surface broadcast spread as copper sulfate before crop emergence.					
[C] 20 lbs Mn/a surface broadcast spread as manganese sulface before crop emergence.					

Table 5. Influence of boron, copper and manganese on corn grain yield at several locations in eastern South Dakota during 2015.					
Nutrient	SE Farm	Crooks	Garretson	Sinia	NE Farm
	---------------- bu/ac----------------				
Control	158.1	210.8	185.2	203.8	110.4
Boron (B)[A]	161.3	197.2	202.3	206.1	110.4
Copper (Cu)[B]	155.0	203.5	191.6	209.0	107.5
Manganese (Mn)[C]	161.4	202.9	181.6	217.5	113.1
CV %	3.1	3.1	8.6	4.7	6.3
Pr>F	0.27	0.08	0.35	0.28	0.73
LSD (.05)	NS	NS	NS	NS	NS
[A] 2 lbs B/a surface broadcast spread as Solubor before crop emergence.					
[B] 2 lbs Cu/a surface broadcast spread as copper sulfate before crop emergence.					
[C] 20 lbs Mn/a surface broadcast spread as manganese sulface before crop emergence.					

Table 6. Influence of boron, copper and manganese soil applications on post-harvest soil test levels at the soybean research projects at several locations in eastern South Dakota during 2015.

Nutrient	Crooks	Garretson1	Garretson2	Arlington	NE Farm
	------------------- ppm -------------------				
Control[A]	1.35, 0.98, 6.3	0.67, 1.03, 13.2	0.65, 1.21, 14.0	0.68, 0.89, 19.9	1.07, 0.92, 19.7
Boron (B)[B]	1.96	1.43	0.74	1.0	1.17
Copper (Cu)[C]	1.75	2.09	1.20	1.73	0.91
Manganese(Mn)[D]	6.4	14.1	15.1	20.0	20.0

[A] Control treatment shows results for B, Cu and Mn.

[B] 2 lbs B/a surface broadcast spread as Solubor before crop emergence.

[C] 2 lbs Cu/a surface broadcast spread as copper sulfate before crop emergence.

[D] 20 lbs Mn/a surface broadcast spread as manganese sulface before crop emergence.

Table 7. Influence of boron, copper and manganese soil applications on post-harvest soil test levels at the corn research projects at several locations in eastern South Dakota during 2015.

Nutrient	SE Farm	Crooks	Garretson	Sinia	NE Farm
	------------------- ppm -------------------				
Control[A]	0.94, 1.17, 7.8	0.79, 0.85, 5.0	0.82, 1.36, 16.3	0.76, 0.87, 16.5	0.81, 0.89, 18.9
Boron (B)[B]	1.13	1.19	1.38	1.47	1.33
Copper (Cu)[C]	1.27	1.14	2.53	1.03	1.50
Manganese(Mn)[D]	8.63	5.7	16.3	16.8	19.2

[A] Control treatment shows results for B, Cu and Mn.

[B] 2 lbs B/a surface broadcast spread as Solubor before crop emergence.

[C] 2 lbs Cu/a surface broadcast spread as copper sulfate before crop emergence.

[D] 20 lbs Mn/a surface broadcast spread as manganese sulface before crop emergence.

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Influence of Several West Central Products Applied In-Furrow, Foliar, and Sidedress on Corn at the SDSU Southeast Research Farm near Beresford SD in 2015.

Anthony Bly*, David Karki,
Sara Berg, and Brad Rops

INTRODUCTION

Several products intended to increase yield are available for corn producers to choose from for use in their corn production enterprises. A research project investigated the influence of several corn products provided by West Central, and applied as in-furrow, foliar, and sidedress application methods.

SUMMARY

Grain yields from the in-furrow product study were limited by poor plant population and not influenced by the products applied in the treatments (Table 2). Plant stand reductions were similar for treatments; therefore, it was determined that valid treatment comparisons could be made from the lower plant population even though it was not adequate for optimum yield. Treatment application did not significantly influence grain moisture, test weight, or yield (Table 2). No plant growth differences were noted during the growing season between treatment plots. Grain yields from the foliar and sidedress product study were much better than the in-furrow study (Table 3). However, no significant differences were measured from the treatment product applications.

Table 1. Materials and Methods

Item	Description
Location	SDSU Southeast Research Farm, Beresford, SD
Hybrid/Seeding rate	Dekalb 41-32 (28,000 seeds/ac)
Planting date	5-13-15
Nitrogen application	125 lbs N/ac as preplant surface applied urea.
Phosphorus application	100 lbs MAP fall applied (2014)
Treatment Products In-furrow	10-34-0, WC216, Blue Tsunami, Aventine, Redline
Treatment Products Foliar and SideDress	Copperfield, WC101, Jackhammer, EBmix, Levisol
Treatment Product rates	Table 2 and 3.
Plot size	10 x 40 ft.
Harvest date	November 4
Experimental design	RCBD – randomized complete block design
Replications	4
Statistics	ANOVA, Pr>F

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Table 2. In-Furrow Placement of several West Central products and 10-34-0 for corn at Southeast Research Farm in 2015.

Treatment Products	Product rate/ac				Plant Pop	H_2O	Grain Test wt	Yield
	1	2	3	4	No./ac	%	Lbs/bu	Bu/ac
Water	6 gpa				15626	15.1	58.4	115.3
10-34-0, water	5 gpa	1 gpa			15188	15.2	58.5	124.5
10-34-0, water, WC216	5 gpa	2 gpa	64 oz		15313	15.0	57.8	117.7
10-34-0, water, BT	5 gpa	3 gpa	32 oz		16125	14.9	58.2	124.7
10-34-0, water, BT, WC216	5 gpa	1 gpa	32 oz	64 oz	16563	14.9	57.7	120.2
10-34-0, water, Aventine	5 gpa	64 oz	64 oz		13500	15.1	58.3	108.7
10-34-0, WC216,Aventine	5 gpa	64 oz	64 oz		14938	15.1	57.8	118.8
Redline, water	3 gpa	3 gpa			13625	14.9	58.0	112.2
Redline, 10-34-0	3 gpa	3 gpa			12500	15.0	58.3	104.5
			CV%		13.1	1.5	1.1	7.8
			Pr>F		0.11	0.63	0.59	0.06
			LSD (.05)		NS	NS	NS	NS

BT = Blue Tsunami, gpa = gallons/ac, oz = ounces/ac

Table 3. Foliar and side-dress application of several West Central products for corn at Southeast Research Farm in 2015.

Application Timing Method[A]	Treatment Products	Product rate/a				H_2O	Grain Test wt	Yield
		1	2	3	4	%	Lbs/bu	Bu/ac
Foliar	water	10pga				14.6	58.0	164.7
Foliar	water, Copperfield, Jackhammer	8gpa	2 gpa	0.5%		14.6	57.9	155.7
Foliar	water, WC101, Jackhammer	9.9gpa	16oz	0.5%		14.5	57.6	160.1
Foliar	water, EB mix, Jackhammer	9.5gpa	32oz	0.5%		14.6	57.6	150.5
Foliar	water, EB mix, WC101, Jackhammer	9.4gpa	32oz	16oz	0.5%	14.6	56.9	163.4
Side-dress	water, Copperfield	18gpa	2gpa			14.6	57.6	162.1
Side-dress	water, Copperfield, Levisol	17.9gpa	2gpa	16oz		14.6	57.5	156.0
Side-dress	water, EB mix	19.5gpa	32oz			14.6	57.8	156.2
Side-dress	water, EB mix, Levisol	17.4gpa	32oz	16oz		14.6	57.9	163.1
				CV %		1.3	0.84	6.4
				Pr>F		0.97	0.11	0.55
				LSD(.05)		NS	NS	NS

[A] foliar and side dress treatments applied at V5 (6-18-15), sidedress 2-3 inch depth one coulter/row, spaced 6 inches from row.

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Influence of N Timing and Rate on Corn near Crooks, SD in 2015.

Anthony Bly* and Al Miron

INTRODUCTION

Nitrogen application near the time in the growing season when corn plant nitrogen demand is the greatest is considered a best management practice known as side-dressing. The benefits of side-dress N application are from shortening the time period when nitrate-N (NO_3-N) is vulnerable to leaching and denitrification as compared with applying N before the corn seeds are planted or emerge. Despite the perceived benefits of side-dressing N, small amounts of research data for South Dakota are available because South Dakota typically receives less precipitation when compared with other corn belt regions. Less precipitation reduces the chances of leaching and de-nitrification. Therefore, a field scale research project was conducted to determine the effectiveness of side-dress N application on corn in eastern South Dakota.

Table 1. Materials and Methods

Item	Description
Location	SW Crooks, SD
Soil Nitrate samples	Composite sample of 65 a field (0-2 ft)
Hybrid	Dekalb 49-72
Planting Date/seeding rate	May 1, at 32,000 seeds/ac
N rates	140 or 190 lbs N/ac
N application timing	Pre- emerge or sidedress with coulter every other row.
Tillage Method	No-Till
Other nutrients	P, K, S and Zn applied equally to all plots at 60 lbs P2O5/ac, 60 lbs K2O/ac, 25 lbs S/ac and 2 lbs Zn/ac.
Plot size	8 – 30 inch rows, field length
Plot configuration	Alternating treatments across field.
Plant tissue	N concentration at V6 and ear leaf.
Harvest date	Oct 16
Grain yield	Combine Yield monitor average for each treatment determined with AgLeader SMS advanced software.
Statistical Analysis	SAS – Anova of yield values from 10 replications.

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SUMMARY

Corn yield in this field was excellent. Precipitation events were well distributed throughout the growing season and temperatures were not too cool or hot. Despite all the effort invested into this huge on-farm research project, no significant treatment effects were measured for any of the variables that were tested (Table 2). Side-dressing 50 lbs of N/ac was not beneficial on this field during 2015. One reason for the lack of side dress N yield influence might have been due to adequate N supply, as supported by the yield data which showed the low N rate with similar yield to the high N rate. If side dressing N is beneficial to corn productivity, N use efficiency of the corn is improved. Therefore, if adequate or excessive amounts of N are present, the improved N efficiency cannot be measured or detected.

Table 2. Influence of N timing and rate on corn near Crooks, SD in 2015.

		Plant tissue N[B]			
Treatment	N Rate/Timing[A]	V6	Ear Leaf	Stalk Nitrate[C]	Grain Yield[D]
	Lbs N/ac	------- % -------		ppm	bu/ac
Low N	30 starter + 110 Pre	4.79	3.15	711	214.0
Sidedress	30 starter + 110 pre + 50 V6		3.32	678	215.2
High N	80 starter + 110 pre	4.45	3.30	695	216.2

[A] Low and Sidedress received 30 lbs N/ac in starter 3x2 from seed at planting, High received 80 lbs N/ac in starter 3x2, and all plots received 110 lbs N/ac as UAN (28%) over the top with herbicide before plant emergence. Sidedress plots received 50 lbs N/ac at V6 knifed in UAN (28%) with one knife coulter/2 - 30 inch rows.
[B] One composite plant tissue sample obtained from each treatment.
[C] lower stalk samples obtained from 6-12 inches from soil surface 2 weeks after harvest.
[D] grain yield not significantly different (Pr>F = 0.456)
Pre plant soil test nitrate (0-2 ft = 54 lbs/ac), soil test extractable K = 175-225 ppm (Very High)
Soil test Olsen P=20 ppm (very high)

ACKNOWLEDGEMENTS

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Nitrogen Timing and Product Effects on No-till Corn

Anthony Bly*

Corn nitrogen use efficiency is greatly influenced by the environment. Since the corn plant takes up a majority of nitrogen later in the growing season, nitrogen loss potential after application is very possible. Side-dress or top-dress nitrogen applications have been shown to improve grain yield over pre-plant. Fertilizer nitrogen additives that slow urease activity to prevent urea volatilization and nitrification inhibitors to keep the N as ammonium and prevent leaching or denitrification as nitrate are available for nitrogen application management. Slow release polymer coated urea is another option to delay nitrogen availability for the corn until later in the growing season. Therefore, a research project investigating these nitrogen fertilizer additives and polymer coated urea, along with application timing and blend combinations was conducted in a long term no-till field.

Table 1. Materials and Methods

Item	Description
Location	Eastern Minnehaha county
Tillage method	No-till (22 years)
Crop rotation	Corn/Soybeans
Hybrid (seeding rate)	DKC 46-10 (30,500/ac)
Nitrogen Fertilizer materials	Urea
	ESN (polymer coated, slow release) urea
	SuperU (Agrotain and DCD)
Agrotain	NBPT – urease inhibitor – volatilization reduction
DCD	Dicyandiamide – nitrification inhibitor
Nitrogen Application treatments	Table 2
Pre-pant nitrogen application date	5-15-15
Nitrogen fertilizer application method	Surface broadcast
Planting date	5-8-15
Top-dress (V5-V6) nitrogen application date	6-23-15
Plot size	15 ft x 30 ft
Replications	4
SPAD meter readings	Ear leaf relative greenness
Grain harvest	October 12th
Statistical analysis	SAS – Anova of SPAD and yield.

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SUMMARY

The SPAD meter reading values and grain yield were statistically significant (Table 2). Only the control plot had significantly lower SPAD and grain yield. Nitrogen product and timing had less influence on SPAD and grain yield as compared with 2014 results (*see 2014 report in Southeast Farm annual report - SERF AR 1418).*

A nitrogen response curve was developed from the data, pooling all of the 80 lbs N/ac treatment yields and plotting the data with the control (0 lbs N/ac), the grower rate (150 lbs N/ac) and the high rate (200 lbs N/ac) (Figure 1). Using a simple linear/plateau method for determining estimated optimum N rate, this showed that it took about 136 lbs N/ac to maximize yield (fertilizer + soil test N).

Table 2. Influence of Nitrogen fertilizer and application timing on no-till corn ear leaf greenness (SPAD) and grain yield near Garretson SD in 2015.

		% Fertilizer Material			% Timing Applied			
Trt	N Rate	urea	ESN[A]	SuperU[B]	Pre-plant[C]	Top-dress[D]	SPAD[E]	Grain Yield[F]
	lbs/ac							bu/ac
1	0						37.3 b	119.4 b
2	80	100			100		54.4 a	189.8 a
3	80	100			50	50	52.4 a	172.7 a
4	80	50	50		100		52.4 a	168.4 a
5	80			100	100		57.6 a	169.7 a
6	80			100	50	50	53.6 a	170.3 a
7	80		50	50	100		54.8 a	175.9 a
8	200			100	100		57.4 a	185.2 a
9[G]	150			100	100		57.3 a	181.5 a
						CV	8.3	9.8
						Pr>F	0.001	0.002
						LSD(.05)	6.4	24.3

[A] ESN – Environmentally Sensitive Nitrogen (polymer coated urea, slow release)
[B] SuperU – Urea treated with NBPT (urease inhibitor) and DCD (nitrification inhibitor)
[C] pre-plant surface broadcast fertilizer application (5-15-15)
[D] top-dress surface broadcast fertilizer application at V5-V6 (6-23-15)
[E] SPAD meter reading (relative leaf greenness)
[F] grain yield adjusted to 15% moisture
[G] cooperator N rate

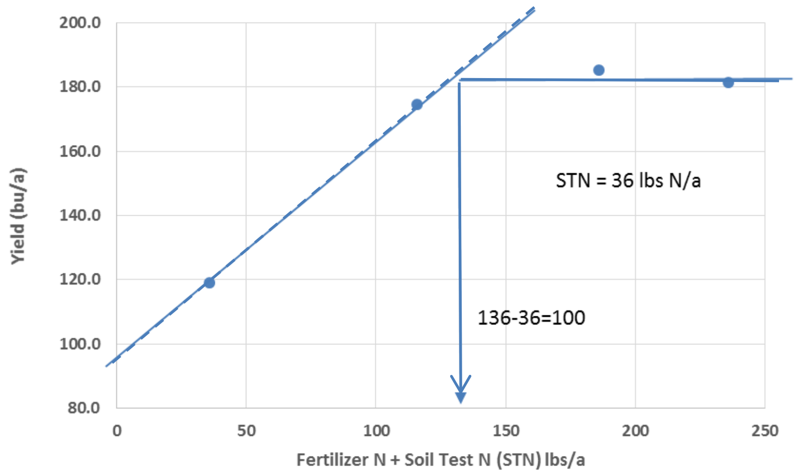

Figure 1. Corn Yield N rate response, Garretson SD in 2015.

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Nitrogen Management and Instinct Effects on Corn Grain Yield

Anthony Bly*, Sara Berg,
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Additives to control N losses through volatilization, denitrification, and leaching are widely used in the Corn Belt particularly with surface applications of urea and in wet springs. Slowing the conversion of fertilizer products to nitrate may lessen leaching and/or denitrification losses if precipitation and/or soil water content is high. The long term yield and economic response to these additives is highly dependent on the amount and timing of precipitation events. Therefore, a corn nitrogen management study was conducted to evaluate the influence of the nitrification inhibitor, Instinct®* on corn grain yield.

Table 1. Materials and Methods

Item	Description
Previous crop/tillage	Soybean, no-till
Begin nitrate-N soil test (0-2ft depth)	50 lbs N/ac
Plot size	20 x 400 ft
Hybrid	Dekalb 41-31
Seeding Rate	32,000
Planting date	May 13, 2015
Starter fertilizer	none
Other fertilizer applied	Previous Fall applied MAP (100 lbs/ac)
Treatments	Tables 1 and 2.
Nitrogen sources	Urea
Nitrogen application date Pre-plant	May 8, 2015
Topdress N application date	June 2, 2015
Topdress N application method	Surface broadcast
Harvest Date	November 4, 2015
Replications	4
Experimental design	Randomized Complete Block Design

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RESULTS AND DISCUSSION

Grain yield was not significantly influenced by Instinct application (Table 1). Grain yield was increased with N rate but statistics were not conducted for this specific comparison due to the lack of control treatment plots. Precipitation records showed well-spaced events during the growing season. The growing corn crop was able to use soil moisture as it was received, therefore negating the possibility that leaching might occur and the positive benefits of having Instinct applied with the urea to keep it in the ammonium nitrogen form.

*Instinct® is a registered product of Dow AgroSciences, Indianapolis, Indiana.

ACKNOWLEDGEMENTS

This project funded by Dow AgroSciences. Thank you to Southeast Research Farm Staff for assistance in conducting this research!

Table 1. Influence of Urea N rate, timing and Instinct on corn grain yield at SE Research Farm, Beresford SD, 2015.

Trt. #	N rate	N Timing[A]	Instinct[B]	Grain Yield[C]
	lbs/ac			bu/ac
1	0	na	None	172.1
2	100	Pre	No	185.6
3	100	Pre	Yes	178.4
4	100	Topdress @ V3	No	189.9
5	100	Topdress @ V3	Yes	179.5
			Pr>F	0.235

[A] Pre=preplant surface broadcast, Topdress @V3= surface broadcast.
[B] Instinct rate = 37 oz/ac, nitrapyrin active ingredient.

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Corn and Soybean Yield Responses to Tillage and Residue Management Treatments at the Southeast Research Farm (SERF) at Beresford, SD in 2015

Howard J. Woodard* and Brad Rops

INTRODUCTION

A long-term corn and soybean rotation was established in 2010 to determine the influence of tillage and residue management treatments on grain yields. The location of the corn and soybean plots alternated each year within the same site area in the northeastern quarter of the Southeast Research Farm. The main soil on the research site was determined to be an Egan/Trent soil with a silty clay loam textural class (22% sand, 31% silt, 47% clay) and with 3.9% organic matter.

The study was implemented with two levels of tillage (no-till and conventional-till), and two levels of corn residue management (corn residue-removed and residue-retained). After grain was harvested from the research site in the Fall of 2014, plots for the next growing season were prepared by removing corn residue from selected treatment plots with a commercial rake and baler owned by the research farm. About 80-90% of the corn residue was removed from the "residue removed" treatment plots in this process and the surface of the plot area was generally clean. (No soybean residue was removed from soybean plots). A chisel-plow operation was applied to the conventional-tilled treatment plots afterwards. In the Spring of 2015, a field cultivator operation prepared the seed bed in the conventional-tilled plots for both the corn and soybeans. Fertilizer N was applied as urea to the soil surface of all corn plots at a rate of 140 lbs N/a on April 22. Corn seed was planted in late April with 30" row spacing at a rate of 32,000 seeds/a. Soybean seed was planted in mid-May in 30" rows at a rate of 150,000 seeds/a. Fertilizer N was applied as a soil surface side-dress between the corn plots as 28-0-0 at the rate of 30 gal/a to provide about 90 lbs N /a. (No other fertilizer was applied any plots since the soil test P and K levels were medium-high and we needed to document the nutrient balances of the various treatment plots). Grain from both crops was harvested in October at physiological maturity and final grain yields were estimated on a per acre basis at 15% moisture for corn and 13.5% for soybeans.

RESULTS

The overall mean corn grain yield range in 2015 (189.4 - 193.3 bu/a) was slightly above the five-year grain yield average for the region (Table 1). The summer was characterized by warm weather throughout the growing season, but was not excessively hot. There was adequate rainfall in the first part of the growing season with reasonable shower activity during the grain filling period. Grain yield differences between tillage treatments and between residue management treatments was minor and not significant at the alpha = .05 level of significance. There was no advantage for the no-till treatment to increase grain yield compared to the conventional-till treatment in this climatic regime even when the residue was removed in the no-till treatment. The growing conditions

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were nearly ideal, so there was no distinct advantage of any of the treatment practices on grain yield.

Table 1. Corn grain yield response to tillage and residue management treatments at SERF, Beresford, SD, in 2015.

	Corn Residue Management		
Tillage	Removed (2013)	Retained	$LSD_{(.05)}$
	bu/a	bu/a	bu/a
No-Till	193.3	190.2	N.S.
Conventional	189.4	189.4	N.S.
$LSD_{(.05)}$	N.S.	N.S.	

N.S. indicated statistical non-significance at the alpha = .05 level.

The overall mean soybean grain yield range (55.6 – 61.9 bu/a) was near the five-year average for the region (Table 2). Neither the tillage treatment nor the residue management treatment (corn residue removed from the previous year) had any influence on final grain yield since the growing conditions were nearly ideal.

Table 2. Soybean grain yield response to tillage and residue management treatments at SERF, Beresford, SD, in 2015.

	Corn Residue Management		
Tillage	Removed (2014)	Retained	$LSD_{(.05)}$
	bu/a	bu/a	bu/a
No-Till	55.6	58.6	N.S.
Conventional	61.9	59.5	N.S.
$LSD_{(.05)}$	N.S.	N.S.	

N.S. indicated statistical non-significance at the alpha = .05 level.

SUMMARY

There was a no clear advantage of conventional-till to no-till, or either residue management treatment on corn and soybean yields during this cropping season. Growing conditions were nearly ideal, so there was no advantage of any of the tillage-residue management combinations on corn and soybean grain yield.

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Evaluating an integrated approach to manage Sudden Death Syndrome using host genetics and seed treatments in Beresford, SD, 2015.

F. Mathew*, B. Kontz, K. Kirby, and J. Kleinjan

A field trial was conducted at the South Dakota State University Southeast Research Station near Beresford, SD. Soybean seeds of different varieties (DuPont Pioneer), with and without resistance to Sudden Death Syndrome were planted on May 27, 2015 into a conventional-till field of silty clay loam soil previously cropped to corn.

Before planting, the following herbicides were applied on May 1, 2015; 32 oz/acre Roundup, 1.3 pt/acre Dual, 4 oz/acre Sencor, and 1 oz/acre Sharpen. The experimental design was a randomized complete block with four replicate blocks. The experimental plots were planted as four rows, spaced 30 in. apart and 20 ft long with a four-row SRES Precision Planter at a rate of 165,000 seeds/acre.

Stand counts were taken 14 days after planting (June 10) and 21 days after planting (June 18) as the total number of plants in the middle two rows of each plot. Plants in each plot were examined for symptoms of damping-off when stand counts were taken. Root rot severity and vigor was evaluated on June 18 using the following scale, where: 0 = 0%, 2 = trace to 4%, 7 = 5 to 10 %, 15 = 11 to 20%, 30 = 21 to 40%, 50 = 41 to 60%, 70 = 61- 80%, 85 = 81 to 90%, 93 = 91 to 95%, and 98 = 96 to 100%. Plant biomass and root weight were also evaluated on June 18 for the plants sampled from each of the plot. After planting, the following herbicides were applied on June 23, 2015; 12 oz/acre Flexstar, 0.3 oz/acre First Rate, and 8 oz/acre Select. The middle two rows of all plots were harvested on October 14, 2015. Data was analyzed using ARM 10 (Gylling Data Management, Brookings, SD).

Vigor was at 100% for all treatments, with no differences among treatments and was not included in the data analyses. Phytotoxocity was observed only on those treatments treated with seed treatment (ILeVo). Plant stands taken at 14 days after planting (DAP) were not significantly different ($p > 0.05$) among treatments. However, plant stands taken at 21 days after planting (DAP) were significantly different ($p < 0.05$) among treatments. Yield (bu/acre), test weight, and moisture content was not significantly different ($p > 0.05$) among treatments. No pre-emergence damping-off occurred in this study. Brown to reddish discoloration by root rot pathogens was visible on the cortical layer of the main root and hypocotyl; however, disease severity was not significant ($p > 0.05$) among treatments.

The weather conditions in May and June, in particular heavy rains and cooler temperatures, helped with the development of root rots in this trial. The check had higher disease severity than the treatments, although not significant. Monthly rainfall totals in May and June were 3.62 inches and 4.37 inches, respectively.

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Table 1. Analysis of variance (ANOVA) for management of soybean cyst nematode using seed treatments and host genetics (in collaboration with DuPont Pioneer and Bayer CropScience).

Soybean variety	Treatment	Stand count	Stand count	Phytotoxicity[a]	Vigor[a]	Root rot severity[a]	Yield	Moisture content	Test weight	SCN count
(DuPont Pioneer, Johnston, IA)		14-d	28-d				bu/A	(%)		(per 100 cc of soil)
SCN susceptible	Non-treated conrol	113822.3	116435.9	0	93	2	64.9	9.6	59.3	1062.5
SCN susceptible	ILeVO	118701.0	114345.0	7	93	2	66.4	9.5	60.2	1787.5
SCN resistant	Non-treated conrol	113386.7	116740.8	0	93	2	69.5	9.7	58.7	1700.0
SCN resistant	ILeVO	115216.2	117742.7	7	93	2	66.0	10.2	59.8	375.0
SCN + SDS susceptible	Non-treated conrol	108464.4	116871.5	0	93	2	62.9	9.5	59.8	3300.0
SCN + SDS susceptible	ILeVO	118396.1	110990.9	7	93	2	59.0	9.5	59.5	4175.0
SCN + SDS resistant	Non-treated conrol	116218.1	104761.8	0	93	2	64.6	9.4	59.1	812.5
SCN + SDS resistant	ILeVO	119572.2	125583.5	7	93	2	67.1	9.8	57.6	325.0
LSD (*P* = 0.05)		31.89	43.69	0	0	0	3.691	0.685	3.187	2404.92
Treatment F		0.651	0.922	0	0	0	6.79	1.283	0.585	3.174
Treatment Prob(F)		0.7083	0.5229	1	1	1	0.0021*	0.3358	0.7566	0.0382*

[a]Root rot severity, phytotoxicity, and vigor was evaluated on 18 June using the following scale, where: 0 = 0%, 2 = trace to 4%, 7 = 5 to 10 %, 15 = 11 to 20%, 30 = 21 to 40%, 50 = 41 to 60%, 70 = 61- 80%, 85 = 81 to 90%, 93 = 91 to 95%, and 98 = 96 to 100%.

Table 2. Analysis of variance (ANOVA) for management of Sudden Death Syndrome using seed treatments and host genetics (in collaboration with DuPont Pioneer and Bayer CropScience).

Soybean variety	Treatment	Stand count	Stand count	Phytotoxicity[a]	Vigor[a]	Root rot severity[a]	Yield	Moisture content	Test weight
(DuPont Pioneer, Johnston, IA)		14-d	28-d				bu/A	(%)	
SDS susceptible	Non-treated conrol	109989.0	124058.9	0	93	4.5	61.7	8.7	51.4
SDS susceptible	ILeVO	117394.2	112820.4	7	93	3.3	61.5	8.5	51.2
SDS resistant	Non-treated conrol	124058.9	132683.8	0	93	4.5	63.6	8.5	52.7
SDS resistant	ILeVO	126367.6	129939.5	7	93	2.0	62.6	8.5	52.5
SCN + SDS susceptible	Non-treated conrol	115129.1	118526.8	0	93	4.5	58.1	8.5	52.3
SCN + SDS susceptible	ILeVO	114606.4	123100.6	7	93	2.0	58.9	8.5	51.4
SCN + SDS resistant	Non-treated conrol	118265.4	137649.6	0	93	4.5	60.8	8.5	52.1
SCN + SDS resistant	ILeVO	122839.2	132770.9	7	93	2.8	62.7	8.6	51.2
LSD (*P* = 0.05)		31.89	43.69	0	0	3.66	5.5439	0.45	2.4132
Treatment F		0.651	0.922	0	0	0.924	1.105	0.347	0.589
Treatment Prob(F)		0.7083	0.5229	1	1	0.5219	0.4188	0.9161	0.7535

[a]Root rot severity, phytotoxicity, and vigor was evaluated on 18 June using the following scale, where: 0 = 0%, 2 = trace to 4%, 7 = 5 to 10 %, 15 = 11 to 20%, 30 = 21 to 40%, 50 = 41 to 60%, 70 = 61- 80%, 85 = 81 to 90%, 93 = 91 to 95%, and 98 = 96 to 100%.

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Evaluating an integrated approach to manage Soybean cyst nematode using host genetics and seed treatments in Beresford, SD, 2015

F. Mathew*, B. Kontz, K. Kirby, and J. Kleinjan

A field trial was conducted at the South Dakota State University Southeast Research Station near Beresford, SD. Soybean seeds of different varieties, (DuPont Pioneer) with and without resistance to Soybean Cyst Nematode (SCN), were planted on May 27, 2015, into a conventional-tilled field of silty clay loam soil previously cropped to corn. Before planting, the following herbicides were applied on May 1, 2015: 32 oz/acre Roundup, 1.3 pt/acre Dual, 4 oz/acre Sencor, and 1 oz/acre Sharpen.

The experimental design was a randomized complete block with four replicated blocks. The experimental plots were planted as four rows, spaced 30 in. apart and 20 ft long with a four-row SRES Precision Planter at a rate of 165,000 seed/acre.

Stand counts were taken 14 days after planting (June 10) and 21 days after planting (June 18) as the total number of plants in the middle two rows of each plot. Plants in each plot were examined for symptoms of damping-off when stand counts were taken. Root rot severity, phytotoxicity, and vigor were evaluated on June 18 using the following scale, where: 0 = 0%, 2 = trace to 4%, 7 = 5 to 10 %, 15 = 11 to 20%, 30 = 21 to 40%, 50 = 41 to 60%, 70 = 61- 80%, 85 = 81 to 90%, 93 = 91 to 95%, and 98 = 96 to 100%.

After planting, the following herbicides were applied on June 23, 2015; 12 oz/acre Flexstar, 0.3 oz/acre First rate, and 8 oz/acre Select. The middle two rows of all plots were harvested on October 14. Data was analyzed using ARM 10 (Gylling Data Management, Brookings, SD).

Vigor was at 100% for all treatments, with no differences among treatments and was not included in the data analyses. Phytotoxocity was observed only on those treatments treated with seed treatment (ILeVo, Bayer CropScience, Research Triangle Park, NC). Plant stands taken at 14 days after planting (DAP) and 21 days after planting (DAP) were not significantly different ($P > 0.05$) among treatments. Test weight and moisture content was not significantly different ($P > 0.05$) among treatments. No pre-emergence damping-off occurred in this study.

The weather conditions in May and June, in particular heavy rains and cooler temperatures, helped with the development of root rots in this trial. (Monthly rainfall totals in

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May and June were 3.62 inches and 4.37 inches respectively). Brown to reddish discoloration by root rot pathogens was visible on the cortical layer of the main root and hypocotyl; however, disease severity was not significant (*P* > 0.05) among treatments.

Yield (bu/acre) and SCN counts were significantly different (*P* < 0.05) among treatments. Based on the data analysis, if the SCN count (per 100 cc of soil) is low, use of nematicide seed treatments may be as effective as using soybean varieties with resistance to SCN. However, under high SCN numbers, it would be recommended to use soybean varieties with resistance to SCN (with seed treatment).

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Influence of Late Season Stratego Application on Soybean Yield in Eastern South Dakota in 2015.

Connie Strunk[*] and David Karki

INTRODUCTION

Fungicides can be effective in controlling fungal diseases in soybeans. However, response to fungicide application is most likely when there is significant disease pressure. There is a need to test different fungicides in order to recommend to producers the likelihood of obtaining a profitable return on fungicide investment in soybeans. The objective of this research in eastern South Dakota is to determine the efficacy of foliar fungicides (Stratego) in controlling soybean fungal diseases.

MATERIALS AND METHODS

Treatments listed in Table 1 are applied as below. Each location had untreated check plots (no fungicide applied) versus plots treated with fungicide (Stratego). Stratego's active ingredients are Propiconazole, 11.4% (CAS No. 60207-90-1) and Trifloxystrobin, 11.4% (CAS No. 141517-21-7). It is important to note - soybean disease pressure was very low to non-existent at each location.

Table 1. Materials and Method

Item	Description
Stratego application growth stage	R3
Locations	Crooks, Garretson 1 and 2, Arlington, South Shore
Stratego rate	4 oz/ac
Carrier volume	15 gpa water
Plot size	10 x 20 ft
Replications/location	4
Randomization	RCBD (randomized complete block design)
Statistics	ANOVA, Pr>F, treatment as independent variable
Harvest method	Small plot combine

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RESULTS AND DISCUSSION

No significant grain yield differences were found when fungicides were applied (Table 2). There was about a 1.5 bushels difference between the fungicide treated plots and untreated check plots which was not significantly different (Pr>F = 0.789).

Table 2. Influence of late season fungicide application on soybean yield at various locations in South Dakota during 2015.

	Location					
Treatment	**Crooks**	**Garretson 1**	**Garretson 2**	**Arlington**	**South Shore**	Grand Mean
	bu/ac					
Control	78.5	67.1	73.9	43.1	46.7	61.4
Stratego[A]	81.5	65.9	77.4	46.3	46.9	62.9
Pr>F	0.623	0.762	0.721	0.233	0.765	0.789
CV (%)	9.1	12.0	13.7	6.9	1.8	26.9
LSD(.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

[A] 4 oz/a applied at R3 growth stage.
NS = non-significant difference.

SUMMARY

Disease pressure was very low to non-existent at each location. Fungicide results indicated there were no significant grain yield differences when fungicides were applied.

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2015 CORN FOLIAR FUNGICIDE TRIALS

Yabwalo D.*, Geppert, R., and Byamukama, E.

INTRODUCTION

There are several foliar diseases that may attack corn throughout the growing season. These diseases have the potential to cause significant yield losses in any corn production area. Fungicides are sometimes used to control corn foliar diseases effectively. Some cultivars do have effective genetic resistance to some of the common foliar diseases. However, challenges still remain in the management of these diseases due to new pathogenic races that arise over time. It's been reported that in South Dakota, corn foliar diseases are more sporadic than in neighboring states. Environmental conditions, cultural practices, and choice of hybrids planted in an area contribute to occurrence and prevalence of corn diseases.

Gray leaf spot (*Cercospora zeae maydis*) has not been a major problem for most years in South Dakota and the 2015 growing season was not exceptional. However, gray leaf spot can occur on susceptible hybrids and it has occurred in South Dakota without causing economic injury. Common corn rust (*Puccinia sorghi*) is usually observed in most corn fields but rarely reaches economic thresholds. Although other foliar disease such as northern corn leaf blight (*Exserohilum turcicum*) and eyespot (*Aureobasidium zeae*) occur sporadically in South Dakota, effective management and control measures are important to keep the disease levels as low as possible thereby averting yield loss. Consequently, studies to generate information on the effectiveness of fungicides and their timing in the management of the most common diseases are necessary to stay equipped in case of incidences. The studies discussed herein, are aimed at testing the efficacy of several fungicide products at different corn growth stages to control fungal pathogens and protect yield.

MATERIALS AND METHODS

A corn cultivar, N29T-3111 was planted at the Southeast Research Farm (SERF), near Beresford, SD and DK3854 at the SDSU Experiment Farm at Volga, SD for both the Foliar Fungicide and the Uniform Foliar Fungicide studies at a rate of 35,000 plants/acre.

The experiments were planted in randomized complete blocks (RCBD) with four blocks or replicates of each treatment. Experimental plots were planted, rated, and harvested on the dates listed in Table 1. Fungal foliar disease assessments, % of green tissue left, lodging, stalk rot, and yield were done. Different foliar fungicide products were applied at various rates at V5, V6, V8, VT and R1 corn growth stages in both studies (Tables 2.1 and 2.2).

RESULTS AND DISCUSSION

Foliar Fungicide Study:

At the SERF location, significant differences were observed in all the disease

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ratings (Table 3). For example, gray leaf spot in the untreated control registered the highest disease rating which was significantly different from 92% of the treatments. Significant differences were also observed for common rust but none on eyespot. For grain yield, there were some significant differences that did not follow a particular pattern. However, most of the treatments had yields that were not significantly different from each other. Stratego YLD + 0.125% NIS produced the highest yield which was significantly different from the treatment combination with the lowest yield, Fortix + 0.25%NIS (Table 3).

At the Volga Research Farm, no significant differences among fungicides were observed for eyespot and top dieback. However, common rust reduction differed significantly among fungicides, although there were no significant differences between the untreated control and the rest of the treatments. A similar trend was observed for stalkrot and yield (Table 4).

Uniform Foliar Fungicide Study:

There was very low disease occurrence in corn at the SERF in the 2015 season. Therefore, there were no significant differences among treatments for diseases at this location. However, in terms of yield, most of the treatments had significantly higher yields than the control. For instance, Stratego YLD applied at V6, followed by a VT application had the highest yield and least amount of disease. Priaxor applied at VT followed by Headline AMP at VT was the second highest performing treatment for yield protection. Although some of the treatments were not significantly different from the control, they still had higher yields than the untreated control (Table 5).

The SDSU Research Farm at Volga had even less disease pressure. Significant differences were observed for the ratings observed at this location. For example, common rust and stalk rot diseases in the untreated control had the highest disease rating which was significantly different from most of the treatments (Table 6). In terms of yield, the only difference was between Priaxor at V6 and Approach applied at V6 and VT. Although there were no significant differences between the untreated check and the rest of the treatments, plots for the untreated check were among the lowest yielding (Table 6).

CONCLUSION

The 2015 corn growing season had very low fungal diseases pressure. While some fungicide treatments were associated with significantly higher yields than non-treated plots, yield difference may be due to other factors other disease control by fungicides.

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Table 1. Dates for planting, plot evaluations, and harvest at study locations.

Operation	Date of operation by location	
	SE Research Farm	**Volga Research Farm**
Planting	May 5, 2015	May 1, 2015
Disease Ratings- Foliar Fungicide Trial	August 25, 2015	September 4, 2015
Disease Ratings- Uniform Foliar Fungicide Trial	August 25, 2015	September 4, 2015
Lodging, Stalk Rot, Stand Counts	September 4, 2015	September 4, 2015
Harvest	October 27, 2015	October 27, 2015

Table 2.1 Fungicide or product name, application rate and growth stage at which a product was applied in the corn foliar fungicide trials for the year 2015.

Product No.	Product Name	Application Rate		Growth Stage
1	Untreated	N/A	N/A	N/A
2	Stratego YLD	2.000	fl oz/a	V5
	Induce NIS	0.125	% v/v	V5
3	Stratego YLD	4.000	fl oz/a	VT
	Induce NIS	0.125	% v/v	VT
4	Headline SC	6.000	fl oz/a	VT
	Induce NIS	0.125	% v/v	VT
5	Fortix	5.000	fl oz/a	V6
	Glyfos X-tra	32.000	fl oz/a	V6
	Induce NIS	0.250	% v/v	V6
6	Headline AMP	10.000	fl oz/a	V6
	Glyfos X-tra	32.000	fl oz/a	V6
	Induce NIS	0.250	% v/v	V6
7	Fortix	5.000	fl oz/a	V8
	Induce NIS	0.250	% v/v	V8
8	Headline AMP	10.000	fl oz/a	V8
	Induce NIS	0.250	% v/v	V8
9	Fortix	4.000	fl oz/a	VT
	Induce NIS	0.250	% v/v	VT
10	Fortix	5.000	fl oz/a	VT
	Induce NIS	0.250	% v/v	VT
11	Headline AMP	10.000	fl oz/a	VT
	Induce NIS	0.250	% v/v	VT
12	Glyfos X-tra	32.000	fl oz/a	V6
	Induce NIS	0.250	% v/v	V6
13	Headline SC	6.000	fl oz/a	V5
14	Priaxor	4.000	fl oz/a	V5
15	Stratego YLD	4.000	fl oz/a	V5
16	Quilt Xcel	10.500	fl oz/a	V5
17	Aproach	3.000	fl oz/a	V5
18	Fortix	5.000	fl oz/a	V5
19	Quilt Xcel	10.500	fl oz/a	V5
	Experimental A	4.100	fl oz/a	V5
	Induce NIS	0.250	% v/v	V5
20	Quilt Xcel	10.500	fl oz/a	R1
	Experimental A	4.100	fl oz/a	R1
	Induce NIS	0.250	% v/v	R1
21	Headline AMP	10.000	fl oz/a	R1
	Induce NIS	0.250	% v/v	R1
22	Priaxor D Component A 4.17 SC	4.000	fl oz/a	R1

Table 2.1 Continued

Product No.	Product Name	Application Rate		Growth Stage
	Priaxor D Component B 1.9 ME	4.000	fl oz/a	R1
	Induce NIS	0.250	% v/v	R1
23	AproachPrima 280 SC	3.400	fl oz/a	R1
	Induce NIS	0.250	% v/v	R1
24	Stratego YLD 4.18 SC	4.000	fl oz/a	R1
	Induce NIS	0.250	% v/v	R1

Table 2.2 Fungicide or product name, application rate and growth stage at which a product was applied in the corn uniform foliar fungicide trials for the year 2015.

Product No.	Product Name	Rate	Rate Unit	Growth Stage
1	Untreated	N/A	N/A	N/A
2	Priaxor	3.0	fl oz/a	V6
3	Stratego YLD	2.0	fl oz/a	V6
4	Aproach	3.0	fl oz/a	V6
5	Fortix	5.0	fl oz/a	V6
6	Headline AMP	10.0	fl oz/a	VT
7	Stratego YLD	4.0	fl oz/a	VT
8	Quilt Xcel	10.5	fl oz/a	VT
9	Aproach	6.0	fl oz/a	VT
10	Fortix	5.0	fl oz/a	VT
11	Aproach Prima	6.8	fl oz/a	VT
12	Priaxor	3.0	fl oz/a	V6
	Headline AMP	10.0	fl oz/a	VT
13	Stratego YLD	2.0	fl oz/a	V6
	Stratego YLD	4.0	fl oz/a	VT
14	Aproach	3.0	fl oz/a	V6
	Aproach	6.0	fl oz/a	VT
15	Fortix	5.0	fl oz/a	V6
	Fortix	5.0	fl oz/a	VT

Table 3. Corn foliar fungicide trial product application stage, disease rating and yield associated with various foliar treatments at South East Farm near Beresford, SD for the 2015 season.

Product Name	Growth Stage	Gray Leaf Spot Disease Rating (%)		Rust Disease Rating (%)		Eyespot Disease Rating (%)		Dieback % plants/plot		Stalk Rot % plants/plot		Yield (lb/A)	
Untreated		0.63	*a*	0.00	*b*	0.00	*a*	7.14	*bcdeg*	13.62	*bcde*	226.85	*abc*
Stratego YLD+0.125%NIS	V5	0.00	*c*	0.14	*b*	0.00	*a*	11.40	*abcde*	19.16	*bcd*	222.08	*abc*
Stratego YLD+0.125%NIS	VT	0.00	*c*	0.20	*b*	0.00	*a*	8.86	*abcdeg*	8.06	*cde*	241.00	*a*
Headline SC+0.125%NIS	VT	0.00	*c*	0.05	*b*	0.63	*a*	6.05	*cdefg*	5.96	*cde*	228.30	*ab*
Fortix+Glyfos X-tra+0.25%NIS	V6	0.00	*c*	0.00	*b*	0.00	*a*	16.15	*a*	2.18	*e*	150.82	*cd*
Headline AMP+Glyfos X-tra+.25%NIS	V6	0.00	*c*	0.15	*b*	0.00	*a*	15.68	*a*	9.33	*bcde*	162.82	*cd*
Fortix+.25%NIS	V8	0.00	*c*	0.00	*b*	0.00	*a*	4.75	*cefg*	9.29	*bcde*	223.93	*abc*
Headline AMP+0.25%NIS	V8	0.00	*c*	0.05	*b*	0.00	*a*	7.29	*bcdeg*	9.82	*bcde*	227.59	*ab*
Fortix+0.25%NIS	VT	0.00	*c*	0.10	*b*	0.00	*a*	13.74	*ab*	9.68	*bcde*	210.89	*c*
Fortix+0.25%NIS	VT	0.00	*c*	0.00	*b*	0.00	*a*	13.27	*abd*	12.24	*bcde*	235.97	*ab*
Headline AMP+0.25%NIS	VT	0.00	*c*	0.05	*b*	0.50	*a*	3.94	*cfg*	11.24	*bcde*	235.91	*ab*
Glyfos X-tra+0.25%NIS	V6	0.00	*c*	0.80	*a*	0.00	*a*	9.34	*abcde*	8.71	*cde*	171.54	*cd*
Headline SC	V5	0.00	*c*	0.10	*b*	0.00	*a*	13.96	*ab*	38.68	*a*	232.83	*ab*
Priaxor	V5	0.25	*bc*	0.25	*b*	0.00	*a*	3.78	*fg*	14.12	*bcde*	235.94	*ab*
Stratego YLD	V5	0.00	*c*	0.05	*b*	0.00	*a*	12.22	*abcde*	19.31	*bcd*	238.63	*a*
Quilt Xcel	V5	0.00	*c*	0.05	*b*	0.38	*a*	11.99	*abcde*	16.80	*bcde*	235.63	*ab*
Aproach	V5	0.00	*c*	0.25	*b*	0.00	*a*	9.15	*abcdeg*	12.95	*bcde*	222.11	*abc*
Fortix	V5	0.00	*c*	0.10	*b*	0.00	*a*	13.50	*abd*	13.58	*bcde*	224.02	*abc*
Quilt Xcel+Experimental A +0.25%NIS	V5	0.38	*ab*	1.00	*a*	0.00	*a*	8.07	*bcdeg*	18.25	*bcd*	168.20	*cd*
Quilt Xcel+Experimental A	R1	0.00	*c*	0.00	*b*	0.63	*a*	9.92	*abcde*	4.74	*ed*	217.08	*abc*
Headline AMP+0.25%NIS	R1	0.00	*c*	0.05	*b*	0.00	*a*	6.17	*cdefg*	7.61	*ecd*	218.74	*abc*
Priaxor D Component A 4.17 SC+Priaxor D Component B 1.9 ME+0.25%NIS	R1	0.00	*c*	0.00	*b*	0.00	*a*	3.01	*fg*	7.20	*ecd*	212.11	*bc*
AproachPrima 280 SC+0.25%NIS	R1	0.00	*c*	0.05	*b*	0.63	*a*	12.05	*abcde*	24.42	*ab*	230.01	*ab*
Stratego YLD 4.18 SC+0.25%NIS	R1	0.00	*c*	0.00	*b*	0.00	*a*	11.14	*abcde*	21.23	*bc*	226.67	*abc*
CV		**123**		**119.6**		**122.8**		**112.0**		**41.0**		**7.4**	

Means followed by the same letter are not significantly different (p=0.05).

Table 4. Corn Foliar Fungicide Trial's product application stage, disease rating and yield associated with various foliar treatments at Volga Farm near Brookings, SD for the 2015 season.

Product Name	**Growth Stage**	**Rust Disease Rating (%)**	**Eyespot Disease Rating (%)**	**Lodging % plants/plot**	**Dieback % plants/plot**	**Stalk Rot % plants/plot**	**Yield (lb/A)**
Untreated		3.50 *abc*	0.00 *b*	0.63 *a*	2.88 *a*	0.00 *b*	202.96 *abcd*
Stratego YLD+0.125%NIS	V5	3.50 *abc*	0.00 *b*	0.25 *a*	4.81 *a*	0.00 *b*	217.60 *ab*
Stratego YLD+0.125%NIS	VT	3.13 *bc*	0.00 *b*	47.43 *a*	2.63 *a*	5.84 *a*	167.00 *abdc*
Headline SC+0.125%NIS	VT	3.00 *bc*	0.00 *b*	0.00 *a*	0.96 *a*	0.00 *b*	199.62 *abcd*
Fortix+Glyfos X-tra+0.25%NIS	V6	3.00 *bc*	0.00 *b*	1.25 *a*	0.00 *a*	0.00 *b*	203.14 *abcd*
Headline AMP+Glyfos X-tra+.25%NIS	V6	3.38 *abc*	0.00 *b*	0.50 *a*	2.96 *a*	0.96 *b*	195.06 *abcd*
Fortix+.25%NIS	V8	3.13 *bc*	0.00 *b*	0.75 *a*	1.00 *a*	0.96 *b*	183.00 *abcd*
Headline AMP+0.25%NIS	V8	3.13 *bc*	0.00 *b*	0.38 *a*	1.92 *a*	6.05 *a*	160.19 *bcd*
Fortix+0.25%NIS	VT	3.88 *ab*	0.00 *b*	0.00 *a*	0.00 *a*	2.17 *ab*	210.48 *abc*
Fortix+0.25%NIS	VT	3.25 *abc*	0.00 *b*	0.00 *a*	2.08 *a*	0.00 *b*	204.52 *abcd*
Headline AMP+0.25%NIS	VT	3.88 *ab*	0.00 *b*	0.75 *a*	0.00 *a*	0.00 *b*	217.41 *ab*
Glyfos X-tra+0.25%NIS	V6	3.00 *bc*	0.00 *b*	0.00 *a*	5.33 *a*	0.00 *b*	196.64 *abcd*
Headline SC	V5	3.83 *ab*	0.00 *b*	0.33 *a*	2.67 *a*	0.00 *b*	201.52 *abcd*
Priaxor	V5	3.75 *ab*	0.00 *b*	0.50 *a*	1.00 *a*	0.00 *b*	200.05 *abcd*
Stratego YLD	V5	3.75 *ab*	0.00 *b*	0.75 *a*	2.81 *a*	1.85 *ab*	206.41 *abcd*
Quilt Xcel	V5	3.25 *abc*	0.00 *b*	0.13 *a*	1.97 *a*	0.96 *b*	218.74 *a*
Aproach	V5	3.50 *abc*	0.00 *b*	51.52 *a*	3.00 *a*	6.00 *a*	155.14 *dc*
Fortix	V5	3.00 *bc*	0.00 *b*	0.25 *a*	2.88 *a*	0.00 *b*	213.37 *ab*
Quilt Xcel+Experimental A+0.25%NIS	V5	4.00 *a*	0.00 *b*	0.00 *a*	0.00 *a*	0.00 *b*	203.99 *abcd*
Quilt Xcel+ Experimental A+0.25%NIS	R1	3.33 *abc*	0.67 *a*	1.00 *a*	3.85 *a*	0.00 *b*	223.69 *a*
Headline AMP+0.25%NIS	R1	3.75 *ab*	0.00 *b*	0.25 *a*	0.00 *a*	0.00 *b*	210.12 *abc*
Priaxor D Component A 4.17 SC+Priaxor D Component B 1.9 ME+0.25%NIS	R1	4.00 *a*	0.00 *b*	1.75 *a*	0.96 *a*	3.94 *ab*	201.97 *abcd*
AproachPrima 280 SC+0.25%NIS	R1	2.88 *c*	0.00 *b*	0.63 *a*	0.00 *a*	0.89 *b*	202.26 *abcd*
Stratego YLD 4.18 SC+0.25%NIS	R1	3.13 *bc*	0.00 *b*	55.30 *a*	2.67 *a*	3.25 *ab*	151.13 *d*
CV		**92.6**	**31.6**	**258.5**	**101.9**	**118.7**	**10.2**

Means followed by the same letter are not significantly different.

Table 5. Corn Uniform Foliar Fungicide Trial's product application stage, disease rating and yield associated with various foliar treatments at South East Farm near Beresford, SD for the 2015 season.

Product Name	**Growth Stage**	**Rust Disease Rating %**	**Northern Blight % plants/plot**	**Eyespot Disease Rating %**	**Lodging % plants/plot**	**Dieback % plants/plot**	**Stalk Rot % plants/plot**	**Yield (lb/ac)**
Untreated	N/A	0.06 *ab*	2.00 a	0.00 *b*	5.0 *b*	14.64 *ab*	12.74 *ab*	235.62 *c*
Priaxor	V6	0.19 *ab*	0.00 b	0.00 *b*	5.0 *b*	11.29 *ab*	21.14 *a*	258.83 *abc*
Stratego YLD	V6	0.00 *b*	0.38 ab	0.00 *b*	5.0 *b*	13.35 *ab*	8.40 *b*	277.50 *a*
Aproach	V6	0.75 *a*	0.88 ab	0.00 *b*	5.0 *b*	5.22 *b*	15.89 *ab*	254.59 *abc*
Fortix	V6	0.00 *b*	0.88 ab	0.00 *b*	5.0 *b*	17.06 *a*	15.84 *ab*	250.17 *abc*
Headline AMP	VT	0.63 *ab*	1.25 ab	0.00 *b*	5.0 *b*	11.70 *ab*	7.52 *b*	255.50 *abc*
Stratego YLD	VT	0.00 *b*	0.00 b	0.00 *b*	5.0 *b*	6.67 *b*	9.41 *b*	275.42 *ab*
Quilt Xcel	VT	0.00 *b*	0.00 b	0.00 *b*	5.0 *b*	11.23 *ab*	10.32 *ab*	270.91 *ab*
Aproach	VT	0.00 *b*	0.00 b	0.50 *ab*	5.0 *b*	11.30 *ab*	9.42 *b*	260.87 *abc*
Fortix	VT	0.00 *b*	0.00 b	1.00 *a*	5.5 *a*	13.00 *ab*	12.65 *ab*	243.91 *bc*
Aproach Prima	VT	0.00 *b*	0.00 b	0.25 *ab*	5.0 *b*	17.14 *a*	7.53 *b*	249.10 *abc*
Priaxor	V6	0.00 *b*	0.00 b	0.00 *b*	5.0 *b*	10.06 *ab*	9.48 *b*	276.67 *a*
Headline AMP	VT							
Stratego YLD	V6	0.00 *b*	0.00 b	0.00 *b*	5.0 *b*	11.96 *ab*	6.63 *b*	278.53 *a*
Stratego YLD	VT							
Aproach	V6	0.00 *b*	0.00 b	0.00 *b*	5.0 *b*	12.12 *ab*	5.26 *b*	262.25 *abc*
Aproach	VT							
Fortix	V6	0.19 *ab*	0.25 b	0.00 *b*	5.0 *b*	18.24 *a*	10.11 *ab*	253.95 *abc*
Fortix	VT							
CV		**159**	**38.1**	**12.0**	**25.7**	**248.8**	**288.8**	**7.85**

Means followed by the same letter are not significantly different (p=0.05).

Table 6. Corn Uniform Foliar Fungicide Trial's product application stage, disease rating and yield associated with various foliar treatments at Volga Farm, SD for the 2015 season.

Treatment name	**Growth Stage**	**Rust Disease Rating %**		**Lodging % plants/plot**		**Dieback % plants/plot**		**Stalk Rot % plants/plot**		**Yield (lb/ac)**	
Untreated		0.69	*a*	10.50	*ab*	1.79	*b*	4.91	*a*	197.54	*abc*
Priaxor	V6	0.00	*b*	0.00	*b*	1.89	*ab*	0.00	*b*	221.84	*a*
Stratego YLD	V6	0.00	*b*	8.75	*ab*	0.00	*b*	0.93	*b*	205.47	*abc*
Aproach	V6	0.00	*b*	0.00	*b*	4.35	*ab*	0.93	*b*	206.43	*abc*
Fortix	V6	0.00	*b*	0.25	*ab*	0.00	*b*	2.85	*ab*	209.48	*abc*
Headline AMP	VT	0.00	*b*	0.50	*ab*	0.00	*b*	0.00	*b*	214.47	*abc*
Stratego YLD	VT	0.44	*ab*	0.00	*b*	0.00	*b*	1.92	*ab*	220.10	*ab*
Quilt Xcel	VT	0.00	*b*	0.75	*ab*	2.85	*ab*	0.96	*b*	199.06	*abc*
Aproach	VT	0.06	*ab*	0.25	*ab*	0.00	*b*	0.00	*b*	208.88	*abc*
Fortix	VT	0.25	*ab*	0.00	*b*	0.00	*b*	0.00	*b*	211.75	*abc*
Aproach Prima	VT	0.00	*b*	7.25	*ab*	0.00	*b*	2.25	*ab*	209.28	*abc*
Priaxor	V6	0.00	*b*	0.25	*ab*	0.00	*b*	0.00	*b*	198.54	*abc*
Headline AMP	VT										
Stratego YLD	V6	0.00	*b*	1.00	*ab*	0.00	*b*	1.00	*b*	198.53	*abc*
Stratego YLD	VT										
Aproach	V6	0.19	*ab*	0.00	*b*	7.08	*a*	2.00	*ab*	192.96	*c*
Aproach	VT										
Fortix	V6	0.00	*b*	10.75	*a*	0.93	*b*	1.85	*ab*	195.46	*bc*
Fortix	VT										
CV		**159.1**		**110.21**		**112.1**		**75.3**		**8.3**	

Means followed by the same letter are not significantly different (p=0.05).

SOUTHEAST RESEARCH FARM ANNUAL REPORT
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Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

2015 SOYBEAN FOLIAR FUNGICIDE AND CYST NEMATODE TRIALS

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INTRODUCTION

Soybean foliar diseases are mainly caused by fungi, viruses, and bacteria. Some of the most common soybean foliar diseases include Cercospora blight and purple seed stain (*Cercospora kikuchii*), Frogeye leaf spot (*Cercospora sojina*), Downy mildew (*Peronospora manshurica*) and Brown spot (*Septoria glycines*). Fortunately, South Dakota has been fairly free of major foliar diseases that cause major economic yield losses in soybean.

However, brown spot is the most commonly observed disease of soybean and therefore, presumably the most important in South Dakota. The disease occurs in every field annually at varying severities. Wet, humid conditions and heavy crop canopies tend to favor all soybean foliar disease development. The brown spot pathogen, just like most soybean foliar pathogens, survives in crop residues and can be dispersed from the infected residues to soybean plants by splashing rain drops. The pathogen normally infects older leaves, but soybeans weakened by other diseases or environmental conditions become susceptible to this disease. Normally, brown spot does not cause significant yield losses unless premature defoliation occurs in the lower and mid canopy during critical reproductive stages. Most of the foliar diseases, including brown spot, can be effectively managed by implementing long term production practices such as selecting resistant/tolerant cultivars, effective weed and insect control, as well as crop rotation.

The soybean cyst nematode (SCN) (*Heterodera glycines*), a microscopic plant-parasitic roundworm, is the most damaging pest in soybeans in South Dakota and in the US. SCN can infect soybeans and cause yield loss without causing obvious above ground symptoms. By the time above-ground symptoms on plants are observed, it becomes more difficult to lower SCN population levels. Nematicide seed treatments can reduce SCN population while increasing soybean yield.

The 2015 soybean plant pathology studies in this report aimed at evaluating foliar fungicides and nematicide seed treatments in the management of foliar diseases and the soybean cyst nematode, respectively.

MATERIALS AND METHODS

The experiments were planted in randomized complete blocks (RCBD) with four blocks for each experiment. The plots were planted, rated, and harvested on the dates indicated in Table 1. Syngenta S17-B3 was planted at 150,000 seeds/acre at the Southeast Research Farm (SERF) near Beresford, SD and at the SDSU Experiment Farm at Volga for both foliar fungicide treatment trials I and II (Tables 2.1 and 2.2).

Plants were rated for fungal foliar diseases, protein, oil content, and yield. Multiple comparison of treatment means (LS-means) in this study were reported using the least significant difference (LSD) such that treatments followed by the same letter were not significantly different.

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In the SNC Study, S14-J7, a susceptible cultivar, and S17-B3, resistant to SCN, were used in a split-plot arrangement in RCBD at Hurley and Southeast Farm. Early plant population counts were done at V5, and late population counts were collected at full physiological maturity (R8). Also collected were yield, test weight, and protein and oil contents.

RESULTS AND DISCUSSION

Most of the common soybean diseases were not observed in the 2015 growing season. Southeast Farm was free of noticeable foliar diseases on the upper canopy. However, Brown spot and Cercospora were observed at Volga Research Farm and therefore ratings were taken.

Southeast Farm:

No foliar diseases were observed on the upper soybean canopy at Southeast Farm in both trials. Therefore, any yield variations are not attributable to disease incidence or severity (Tables 3 and 4).

Volga Farm:

Although some significant differences were observed in Cercospora severity in Trial I, the disease level was very low to attribute any differences in yield and quality to disease occurrence. The only significant difference was observed between Stratego YLD+0.125%NIS and Quilt Xcel+0.25%NIS. Stratego YLD+0.125%NIS was also significantly different from Aproach Prima+0.25%NIS and Quadris+0.25%NIS. In terms of brown spot severity, the untreated had the highest disease level which was significantly different from 75% of the treatments (Table 5). Although there were significant differences among treatments, none of them was large enough to be impactful on yield.

In foliar fungicide Trial II, there was low incidence on both Cercospora and white mold. No significant treatment differences were observed in Cercospora. Some significant treatment differences were observed in white mold; for example, Priaxor + AG14039 and Stratego YLD + MasterLock. However, the disease occurred at levels too low to attribute any differences to treatments (Table 6).

As indicated earlier, there were generally very low foliar disease occurrences in 2015, such that it is unwarranted to attribute any difference to treatment effects.

SCN Study:

At Hurley (Table 7), there were no significant differences for initial stand count (V5). Although there were some differences for stand counts at R8, none of the differences were due treatment effect. Yield and quality differences were not due to treatment effect. There were also no significant differences in Fall SCN counts among treatments. However, a significant negative correlation between yield and Fall SCN count was observed, $r = -0.28$, $p = 0.1$. No significant correlation was observed between yield and late stand count.

Similarly, there were no observed differences due to treatment for effects for both stand counts, yield, test weight, and spring SCN counts at Southeast Farm (Table 8). Although there were statistically significant treatment effects on fall SCN numbers, this may be attributed to high variability of SCN in the soil since even the non-treated plots had lower fall SCN counts than nematicide treated plots. The same can be said about effect of cultivar on fall SCN counts as the susceptible cultivar had lower fall SCN numbers than the resistant cultivar.

ACKNOWLEDGEMENT

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Table 1. Dates of planting, plot evaluations, and harvest at study locations.

Activity	**Date of activity by location**	
	SE Research Farm	**Volga Research Farm**
Planting	May 28, 2015	June 2, 2015
Final disease rating	September 14, 2015	September 16, 2015
Harvest	October 15, 2015	October 16, 2015

Table 2.1 Products, rates and growth stages of fungicides applied as foliar treatments in Foliar Fungicide Study I in 2015.

Treatment No.	**Treatment Name**	**Rate**	**Rate unit**	**Application stage**
1	Untreated			
2	Fortix	5	fl oz/a	R1
3	Fortix	5	fl oz/a	R3
4	Stratego YLD	4	fl oz/a	R3
5	Strategy YLD	4	fl oz/a	V5
	Induce NIS	0.125	% v/v	V5
6	Stratego YLD	2	fl oz/a	V5
	Induce NIS	0.125	% v/v	V5
	Stratego YLD	2	fl oz/a	R3
	Induce NIS	0.125	% v/v	R3
7	Stratego YLD	4	fl oz/a	R3
	Induce NIS	0.125	% v/v	R3
8	Priaxor	4	fl oz/a	R3
	Induce NIS	0.25	% v/v	R3
9	Quilt Xcel	10.5	fl oz/a	R3
	Induce NIS	0.25	% v/v	R3
10	Stratego YLD	4	fl oz/a	R3
	Induce NIS	0.25	% v/v	R3
11	Aproach Prima	6.8	fl oz/a	R3
	Induce NIS	0.25	% v/v	R3
12	Quadris Top	8	fl oz/a	R3
	Induce NIS	0.25	% v/v	R3
13	Fortix	5	fl oz/a	R3
	Induce NIS	0.25	% v/v	R3
14	Priaxor	4	fl oz/a	R3
	Fastac	3.8	fl oz/a	R3
	Induce NIS	0.25	% v/v	R3
15	Priaxor	4	fl oz/a	R3
	Induce NIS	0.25	% v/v	R3

Table 2.1 continued

Treatment No.	Treatment Name	Rate	Rate unit	Application stage
	Priaxor	4	fl oz/a	R5
	Domark	4	fl oz/a	R5
	Induce NIS	0.25	% v/v	R5
16	Priaxor	4	fl oz/a	R2
	Induce NIS	0.25	% v/v	R2
	Priaxor	4	fl oz/a	R4
	Induce NIS	0.25	% v/v	R4
17	Quadris	6	fl oz/a	R3
	Induce NIS	0.25	% v/v	R3

Table 2.2. Products, rates and growth stages of fungicides applied as foliar treatments in Foliar Fungicide Study II in 2015.

Treatment No.	Treatment Name	Rate	Rate unit	Application stage
1	Priaxor	4	fl oz/a	R3
2	Priaxor	4	fl oz/a	R3
	MasterLock	6.4	fl oz/a	R3
3	Priaxor	4	fl oz/a	R3
	AG 14012	6.4	fl oz/a	R3
4	Priaxor	4	fl oz/a	R3
	InterLock	4	fl oz/a	R3
5	Priaxor	4	fl oz/a	R3
	Superb HC	1	pt/a	R3
	InterLock	4	fl oz/a	R3
6	Priaxor	4	fl oz/a	R3
	AG14039	0.125	% v/v	R3
7	Priaxor	4	fl oz/a	R3
	AG14039	0.25	% v/v	R3
8	Priaxor	4	fl oz/a	R3
	AG14039	0.5	% v/v	R3
9	Priaxor	4	fl oz/a	R3
	AG14039	1	% v/v	R3
10	Stratego YLD	4	fl oz/a	R3
11	Stratego YLD	4	fl oz/a	R3
	MasterLock	6.4	fl oz/a	R3
12	Stratego YLD	4	fl oz/a	R3
	AG 14012	6.4	fl oz/a	R3
13	Stratego YLD	4	fl oz/a	R3
	InterLock	4	fl oz/a	R3
14	Stratego YLD	4	fl oz/a	R3
	Superb HC	1	pt/a	R3
	InterLock	4	fl oz/a	R3

Table 2.2. continued

Treatment No.	Treatment Name	Rate	Rate unit	Application stage
15	Stratego YLD	4	fl oz/a	R3
	AG14039	0.125	% v/v	R3
16	Stratego YLD	4	fl oz/a	R3
	AG14039	0.25	% v/v	R3
17	Stratego YLD	4	fl oz/a	R3
	AG14039	0.5	% v/v	R3
18	Stratego YLD	4	fl oz/a	R3
	AG14039	1	% v/v	R3

Table 3. 2015 Soybean Foliar Fungicide Study I: Yield associated with various foliar treatments at Southeast Research Farm near Beresford, SD.

ID No.	Treatment Name	Growth Stage	Yield (lb/A)	Test Weight (lb/bu)	Protein content (%)	Oil Content (%)
1	Untreated	N/A	75.23 ab	55.74 *ab*	34.53 *a*	20.15 *ab*
2	Fortix	R1	78.64 ab	55.49 *abc*	34.43 *a*	20.05 *ab*
3	Fortix	R3	75.70 ab	55.08 *bc*	34.55 *a*	19.93 *ab*
4	Stratego YLD	R3	74.77 ab	55.60 *abc*	34.55 *a*	20.15 *ab*
5	Strategy YLD	V5	79.95 ab	54.77 *c*	34.83 *a*	20.03 *ab*
	Induce NIS	V5				
6	Stratego YLD	V5	76.17 ab	55.18 *bc*	34.58 *a*	20.10 *ab*
	Induce NIS	V5				
7	Stratego YLD	R3				
	Induce NIS	R3				
8	Stratego YLD	R3	77.06 ab	55.25 *abc*	32.23 *b*	20.05 *ab*
	Induce NIS	R3				
9	Priaxor	R3	81.80 a	55.11 *bc*	34.58 *a*	19.98 *ab*
	Induce NIS	R3				
10	Quilt Xcel	R3	75.54 ab	55.65 *abc*	34.78 *a*	20.05 *ab*
	Induce NIS	R3				
11	Stratego YLD	R3	80.39 ab	56.18 *a*	35.10 *a*	19.88 *b*
	Induce NIS	R3				
12	Aproach Prima	R3	76.77 ab	55.29 *abc*	34.83 *a*	19.85 *b*
	Induce NIS	R3				
13	Quadris Top	R3	78.97 ab	55.28 *abc*	34.93 *a*	19.90 *b*
	Induce NIS	R3				
14	Fortix	R3	77.32 ab	55.20 *bc*	33.93 *b*	20.28 *a*
	Induce NIS	R3				
15	Priaxor	R3	81.06 a	55.72 *abc*	34.73 *a*	19.93 *ab*
	Fastac	R3				
	Induce NIS	R3				
16	Priaxor	R3	78.29 ab	55.32 *abc*	34.90 *a*	19.93 *ab*

Table 3. Continued

ID No.	Treatment Name	Growth Stage	Yield (lb/A)	Test Weight (lb/bu)	Protein content (%)	Oil Content (%)
	Induce NIS	R3				
	Priaxor	R5				
	Domark	R5				
	Induce NIS	R5				
17	Priaxor	R2	72.62 b	55.44 *abc*	34.70 *a*	20.10 *ab*
	Induce NIS	R2				
	Priaxor	R4				
	Induce NIS	R4				
	CV (%)		7.61	1.21	1.46	0.97

Means followed by the same letter are not significantly different (p=0.05).

Table 4. 2015 Soybean Foliar Fungicide Study II: Yield and quality characteristics from the foliar fungal trial at Southeast Research Farm near Beresford, SD.

ID No.	Treatment Name	Growth Stage	Yield (lb/A)		Test Weight (lb/bu)		Protein Content (%)		Oil Content (%)	
1	Priaxor	R3	82.65	*ab*	56.53	*a*	34.75	*cd*	19.88	*a*
2	Priaxor	R3	84.16	*a*	56.03	*ab*	35.00	*abcd*	19.70	*abcd*
	MasterLock	R3								
3	Priaxor	R3	76.39	*abcd*	56.14	*ab*	35.30	*ab*	19.63	*cd*
	AG 14012	R3								
4	Priaxor	R3	75.82	*abcd*	56.44	*a*	34.93	*abcd*	19.75	*abcd*
	InterLock	R3								
5	Priaxor	R3	80.26	*ab*	56.12	*ab*	35.33	*ab*	19.70	*abcd*
	Superb HC	R3								
	InterLock	R3								
6	Priaxor	R3	74.83	*abcd*	56.08	*ab*	34.85	*bcd*	19.73	*abcd*
	AG14039	R3								
7	Priaxor	R3	76.57	*abcd*	55.29	*b*	35.08	*abcd*	19.68	*abcd*
	AG14039	R3								
8	Priaxor	R3	78.07	*abcd*	56.16	*ab*	35.10	*abcd*	19.78	*abcd*
	AG14039	R3								
9	Priaxor	R3	79.46	*abcd*	56.23	*ab*	34.80	*cd*	19.65	*bcd*
	AG14039	R3								
10	Stratego YLD	R3	71.38	*cd*	56.40	*a*	35.15	*abcd*	19.83	*abc*
11	Stratego YLD	R3	73.00	*bcd*	55.61	*ab*	35.43	*a*	19.73	*abcd*
	MasterLock	R3								
12	Stratego YLD	R3	80.04	*abd*	55.68	*ab*	35.28	*ab*	19.75	*abcd*
	AG 14012	R3								
13	Stratego YLD	R3	69.19	*cd*	56.12	*ab*	35.15	*abcd*	19.80	*abcd*
	InterLock	R3								

Table 4. Continued

ID No.	Treatment Name	Growth Stage	Yield (lb/A)		Test Weight (lb/bu)		Protein Content (%)		Oil Content (%)	
14	Stratego YLD	R3	76.11	*abcd*	55.86	*ab*	35.35	*ab*	19.60	*d*
	Superb HC	R3								
	InterLock	R3								
15	Stratego YLD	R3	74.48	*abcd*	55.82	*ab*	35.10	*abcd*	19.75	*abcd*
	AG14039	R3								
16	Stratego YLD	R3	83.24	*ab*	56.59	*a*	35.15	*abcd*	19.75	*abcd*
	AG14039	R3								
17	Stratego YLD	R3	78.29	*abcd*	56.34	*ab*	35.13	*abcd*	19.85	*ab*
	AG14039	R3								
18	Stratego YLD	R3	74.47	*abcd*	56.64	*a*	35.23	abcd	19.65	*bcd*
	AG14039	R3								
	CV (%)		10.6		1.3		1.0		0.76	

Means followed by the same letter are not significantly different (p=0.05).

Table 5. 2015 Soybean Foliar Fungicide Study I: Disease rating and yield associated with various foliar treatments at Volga Research Farm, SD.

Treatment Name	Growth Stage	Cercospora	Brown spot	Test Weight (lb/bu)	Yield	Protein	Oil
Untreated	N/A	0.25 *ab*	2.50 *a*	56.37 *ab*	61.98 *de*	34.55 *bcd*	19.45 *abcd*
Fortix	R1	0.50 *ab*	1.75 *ab*	56.80 *ab*	62.44 *cde*	34.33 *cde*	19.55 *abc*
Fortix	R3	0.50 *ab*	1.75 *ab*	56.44 *ab*	64.93 *bcde*	33.80 *e*	19.70 *a*
Stratego YLD	R3	0.50 *ab*	0.50 *c*	56.96 *ab*	66.05 *abcde*	34.78 *abc*	19.33 *cde*
Stratego YLD	V5	0.00 *b*	2.50 *a*	55.95 *b*	61.62 *e*	34.73 *abc*	19.43 *bcd*
Induce NIS	V5						
Stratego YLD	V5	0.75 *ab*	0.00 *c*	56.41 *ab*	66.80 *abcde*	34.90 *abc*	19.23 *def*
Induce NIS	V5						
Stratego YLD	R3						
Induce NIS	R3						
Stratego YLD	R3	0.75 *ab*	0.00 *c*	57.26 *a*	66.97 *abcd*	34.33 *cde*	19.53 *abc*
Induce NIS	R3						
Priaxor	R3	0.25 *ab*	0.25 *c*	56.78 *ab*	66.62 *abcde*	34.40 *cde*	19.38 *bcde*
Induce NIS	R3						
Quilt Xcel	R3	1.00 *a*	0.50 *c*	56.59 *ab*	64.53 *bcde*	35.25 *a*	19.13 *ef*
Induce NIS	R3						
Stratego YLD	R3	0.25 *ab*	0.00 *c*	56.01 *ab*	66.84 *abcde*	34.27 *cde*	19.44 *abcd*
Induce NIS	R3						
Aproach Prima	R3	1.00 *a*	0.00 *c*	56.44 *ab*	66.75 *abcde*	35.10 *ab*	19.00 *f*
Induce NIS	R3						
Quadris Top	R3	0.50 *ab*	0.25 *c*	56.04 *ab*	67.27 *abc*	34.63 *abcd*	19.43 *bcd*
Induce NIS	R3						
Fortix	R3	0.50 *ab*	0.75 *bc*	56.34 *ab*	65.49 *bcde*	33.80 *e*	19.63 *ab*
Induce NIS	R3						
Priaxor	R3	0.75 *ab*	0.00 *c*	56.59 *ab*	68.18 *ab*	33.95 *de*	19.50 *abc*
Fastac	R3						
Induce NIS	R3						

Table 5. Continued

Treatment Name	Growth Stage	Cercospora	Brown spot	Test Weight (lb/bu)	Yield	Protein	Oil
Priaxor	R3	0.50 *ab*	0.00 *c*	57.06 *ab*	66.15 *abcde*	34.30 *cde*	19.43 *bcd*
Induce NIS	R3						
Priaxor	R5						
Domark	R5						
Induce NIS	R5						
Priaxor	R2	0.50 *ab*	0.00 *c*	56.59 *ab*	70.86 *a*	34.28 *cde*	19.43 *bcd*
Induce NIS	R2						
Priaxor	R4						
Induce NIS	R4						
Quadris	R3	1.00 *a*	0.25 *c*	56.80 *ab*	63.47 *bcde*	34.53 *bcd*	19.40 *bcd*
Induce NIS	R3						
CV (%)		5.21	15.79	1.53	5.44	1.26	0.99

Means followed by the same letter are not significantly different (p=0.05).

Table 6. 2015 Soybean Foliar Fungicide Study II: Disease rating, yield and quality associated with various foliar treatments at Volga Research Farm, SD.

ID No.	Treatment Name	Growth Stage	Cercospora (%)		White Mold (%)		Yield (lb/A)		Test Weight (lb/bu)		Protein Content (%)		Oil Content (%)	
1	Priaxor	R3	0.50	*a*	0.50	*ab*	67.62	*ab*	56.67	*ab*	34.15	*def*	19.60	*ab*
2	Priaxor	R3	0.00	*a*	0.50	*ab*	69.17	*a*	56.42	*ab*	34.13	*ef*	19.48	*bdc*
	MasterLock	R3												
3	Priaxor	R3	0.00	*a*	0.25	*b*	67.32	*ab*	56.46	*ab*	34.13	*ef*	19.45	*bcde*
	AG 14012	R3												
4	Priaxor	R3	0.00	*a*	0.25	*b*	66.93	*ab*	55.93	*b*	33.78	*f*	19.75	*a*
	InterLock	R3												
5	Priaxor	R3	0.25	*a*	0.25	*b*	66.83	*ab*	56.85	*ab*	34.45	*bcde*	19.38	*bcdef*
	Superb HC	R3												
	InterLock	R3												
6	Priaxor	R3	0.25	*a*	0.25	*b*	67.28	*ab*	56.56	*ab*	34.05	*ef*	19.58	*abc*
	AG14039	R3												
7	Priaxor	R3	0.00	*a*	1.25	*a*	66.81	*ab*	56.21	*ab*	34.38	*cdef*	19.40	*bcdef*
	AG14039	R3												
8	Priaxor	R3	0.00	*a*	0.50	*ab*	67.66	*ab*	56.04	*b*	34.38	*cdef*	19.45	*bcde*
	AG14039	R3												
9	Priaxor	R3	0.25	*a*	1.25	*a*	67.73	*ab*	56.63	*ab*	34.53	*bcde*	19.35	*cdefg*
	AG14039	R3												
10	Stratego YLD	R3	0.00	*a*	0.50	*ab*	65.93	*ab*	57.14	*a*	34.30	*cdef*	19.48	*bdc*
11	Stratego YLD	R3	0.25	*a*	0.25	*b*	67.96	*ab*	56.83	*ab*	34.83	*abc*	19.23	*efg*
	MasterLock	R3												
12	Stratego YLD	R3	0.50	*a*	1.25	*a*	67.13	*ab*	56.05	*b*	35.03	*ab*	19.13	*g*
	AG 14012	R3												
13	Stratego YLD	R3	0.75	*a*	1.00	*ab*	66.21	*ab*	56.37	*ab*	34.55	*bcde*	19.45	*bcde*
	InterLock	R3												

Table 6 Continued

ID No.	Treatment Name	Growth Stage	Cercospora (%)		White Mold (%)		Yield (lb/A)		Test Weight (lb/bu)		Protein Content (%)		Oil Content (%)	
14	Stratego YLD	R3	0.00	*a*	0.50	*ab*	65.80	*ab*	56.68	*ab*	35.35	*a*	19.20	*fg*
	Superb HC	R3												
	InterLock	R3												
15	Stratego YLD	R3	0.75	*a*	0.75	*ab*	66.44	*ab*	56.34	*ab*	34.63	*bcde*	19.40	*bcdef*
	AG14039	R3												
16	Stratego YLD	R3	0.50	*a*	0.75	*ab*	69.87	*a*	55.96	*b*	34.58	*bcde*	19.30	*defg*
	AG14039	R3												
17	Stratego YLD	R3	0.25	*a*	0.50	*ab*	68.55	*ab*	56.71	*ab*	34.83	*abc*	19.33	*defg*
	AG14039	R3												
18	Stratego YLD	R3	0.25	*a*	1.00	*ab*	64.31	*b*	57.12	*a*	34.75	*abcd*	19.33	*defg*
	CV (%)		19.52		14.83		3.95		1.22		1.23		0.86	

Means followed by the same letter are not significantly different (p=0.05).

Table 7. 2015 Soybean Cyst Nematode Study: Stand counts, yield and quality traits observed at Hurley, SD.

Cultivar	Trt No.	Treatment Name	Rate	Rate Unit	Early Stand Count (Plants/A	Late Stand Count (Plants/A)	Yield (lb/A)	Test Weight (lb/bu)	Protein Content (%)	Oil Content (%)	SCN Spring Count	SCN Fall Count
S14-J7 (Susceptible to SCN)	1	Untreated			89855 *a*	75969 *b*	55.06 *abcd*	55.50 *a*	32.25 *a*	20.18 *ab*	363 *a*	4638 *a*
	2	CruiserMaxx Vibrance	0.0945	mg A/Seed	82776 *a*	81142 *ab*	50.00 *d*	55.29 *a*	32.43 *a*	20.20 *ab*	338 *a*	2000 *a*
	3	Avicta Complete Beans 500	0.2419	mg A/Seed	82987 *a*	81948 *ab*	56.98 *a*	55.63 *a*	32.16 *a*	20.14 *b*	653 *a*	1940 *a*
	3	Vibrance	0.0038	mg A/Seed								
	4	Clarva Complete Beans (CruiserMaxx/Vibrance)	0.0945	mg A/Seed	87677 *a*	82504 *ab*	51.96 *bcd*	55.73 *a*	32.00 *ab*	20.30 *ab*	350 *a*	5088 *a*
	4	Clariva PN	2	FL OZ/Cwt								
	5	Evergol Energy	1	FL OZ/Cwt	86043 *a*	77058 *ab*	53.08 *abcd*	55.74 *a*	32.13 *a*	20.18 *ab*	725 *a*	2398 *a*
	5	Poncho/VoTivo	2	FL OZ/Cwt								
	5	Allegiance	0.75	FL OZ/Cwt								
	5	ILeVO	1.18	FL OZ/ 140000 Seeds								
S17-B3 (Resistan to SCN)	1	Untreated			81142 *a*	75696 *b*	54.72 *abcd*	55.66 *a*	31.70 *ab*	20.30 *ab*	738 *a*	3613 *a*
	2	CruiserMaxx Vibrance	0.0945	mg A/Seed	83593 *a*	83048 *ab*	56.39 *ab*	55.27 *a*	31.88 *ab*	20.43 *ab*	650 *a*	1860 *a*
	3	Avicta Complete Beans 500	0.2419	mg A/Seed	85692 *a*	84882 *a*	55.79 *abc*	54.89 *a*	32.36 *a*	20.57 *a*	528 *a*	2350 *a*
	3	Vibrance	0.0038	mg A/Seed								
	4	Clarva Complete Beans (CruiserMaxx/Vibrance)	0.0945	mg A/Seed	86315 *a*	81142 *ab*	53.12 *abcd*	55.56 *a*	32.00 *ab*	20.38 *ab*	363 *a*	3313 *a*

Table 7 continued

Cultivar	Trt No.	Treatment Name	Rate	Rate Unit	Early Stand Count (Plants/A	Late Stand Count (Plants/A)	Yield (lb/A)	Test Weight (lb/bu)	Protein Content (%)	Oil Content (%)	SCN Spring Count	SCN Fall Count
	4	Clariva PN	2	FL OZ/Cwt								
	5	Evergol Energy	1	FL OZ/Cwt	81687 *a*	76241 *b*	50.69 *cd*	55.64 *a*	30.95 *b*	20.10 *b*	613 *a*	4975 *a*
	5	Poncho/VoTivo	2	FL OZ/Cwt								
	5	Allegiance	0.75	FL OZ/Cwt								
	5	ILeVO	1.18	FL OZ/ 140000 Seeds								
		CV (%)			**7.5**	**7.3**	**9.1**	**10.9**	**3.2**	**1.4**	**59.0**	**100.2**

Means followed by the same letter are not significantly different (p=0.05).

Table 8. 2015 Soybean Cyst Nematode Study: Stand counts, yield and quality traits observed at Southeast Farm near Beresford, SD.

Cultivar	Trt. No.	Treatment Name	Rate	Rate Unit	Early Stand Count (Plants/A)	Late Stand Count (Plant/A)	Yield (lb/A)	Test Weight (lb/bu)	Protein Content (%)	Oil Content (%)	SCN Spring Count	SCN Fall Count
S14-J7 (Susceptible to SCN)	1	Untreated			77058 *ab*	74335 *b*	61.00 *de*	55.07 *ab*	32.73 e	20.43 *abc*	350 *ab*	2700 *c*
	2	CruiserMaxx Vibrance	0.0945	mg A/Seed	80598 *ab*	79508 *ab*	65.81 *bcde*	55.33 *ab*	33.03 cde	20.38 *abc*	238 *b*	6963 *bc*
	3	Avicta Complete Beans 500	0.2419	mg A/Seed	78692 *ab*	77602 *ab*	67.38 *abcd*	55.48 *ab*	32.98 de	20.48 *ab*	438 *ab*	3675 *c*
	3	Vibrance	0.0038	mg A/Seed								
	4	Clariva Complete Beans	0.0945	mg A/Seed	83321 *a*	81142 *ab*	63.68 *cde*	55.93 *a*	33.10 bcde	20.40 *abc*	313 *ab*	4988 *bc*
	4	Clariva PN	2	FL Oz/Cwt								
	5	CruiserMaxx Vibrance	0.0945	mg A/Seed	75697 *ab*	79780 *ab*	59.90 *e*	55.72 *ab*	32.98 de	20.60 *a*	288 *b*	9488 *bc*
	5	Clariva PN	2	FL Oz/Cwt								
	5	Mertect	0.03	mg A/Seed								
	6	Evergol Energy	1	FL Oz/Cwt	81959 *ab*	83865 *a*	65.78 *bcde*	55.50 *ab*	33.10 bcde	20.33 *abc*	475 *ab*	5663 *bc*
	6	Poncho/VoTivo	2	FL Oz/Cwt								
	6	Allegiance	0.75	FL Oz/Cwt								
	6	ILeVO	1.18	FL OZ/ 140000 seed								
S17-B3 (Resistant to SCN)	1	Untreated			83321 *a*	78691 *ab*	72.92 *ab*	56.16 *a*	33.43 abcd	20.28 *abc*	400 *ab*	4425 *bc*
	2	CruiserMaxx Vibrance	0.0945	mg A/Seed	79236 *ab*	78419 *ab*	69.38 *abc*	54.92 *ab*	33.15 bcde	20.33 *abc*	713 *a*	3088 *c*
	3	Avicta Complete Beans 500	0.2419	mg A/Seed	77058 *ab*	79508 *ab*	74.36 *a*	55.01 *ab*	33.63 ab	20.10 *c*	463 *ab*	17500 *a*
	3	Vibrance	0.0038	mg A/Seed								
	4	Clariva Complete Beans	0.0945	mg A/Seed	77603 *ab*	77330 *ab*	66.23 *bcde*	55.58 *ab*	33.55 abc	20.28 *abc*	463 *ab*	5000 *bc*
	4	Clariva PN	2	FL Oz/Cwt								
	5	CruiserMaxx Vibrance	0.0945	mg A/Seed	83048 *a*	77875 *ab*	66.11 *bcde*	56.03 *a*	33.53 abcd	20.33 *abc*	125 *b*	11475 *ab*
	5	Clariva PN	2	FL Oz/Cwt								

Table 8 Continued

Cultivar	Trt. No.	Treatment Name	Rate	Rate Unit	Early Stand Count (Plants/A)	Late Stand Count (Plant/A)	Yield (lb/A)	Test Weight (lb/bu)	Protein Content (%)	Oil Content (%)	SCN Spring Count	SCN Fall Count
	5	Mertect	0.03	mg A/Seed								
	6	Evergol Energy	1	FL Oz/Cwt	74335 *b*	79236 *ab*	72.04 *ab*	54.34 *b*	33.83 a	20.18 *bc*	188 *b*	4425 *bc*
	6	Poncho/VoTivo	2	FL Oz/Cwt								
	6	Allegiance	0.75	FL Oz/Cwt								
	6	ILeVO	1.18	FL OZ/ 140000 seed								
		CV (%)			**75.9**	**6.3**	**9.2**	**1.8**	**1.4**	**1.3**	**78**	**91.7**

Means followed by the same letter are not significantly different (p=0.05).

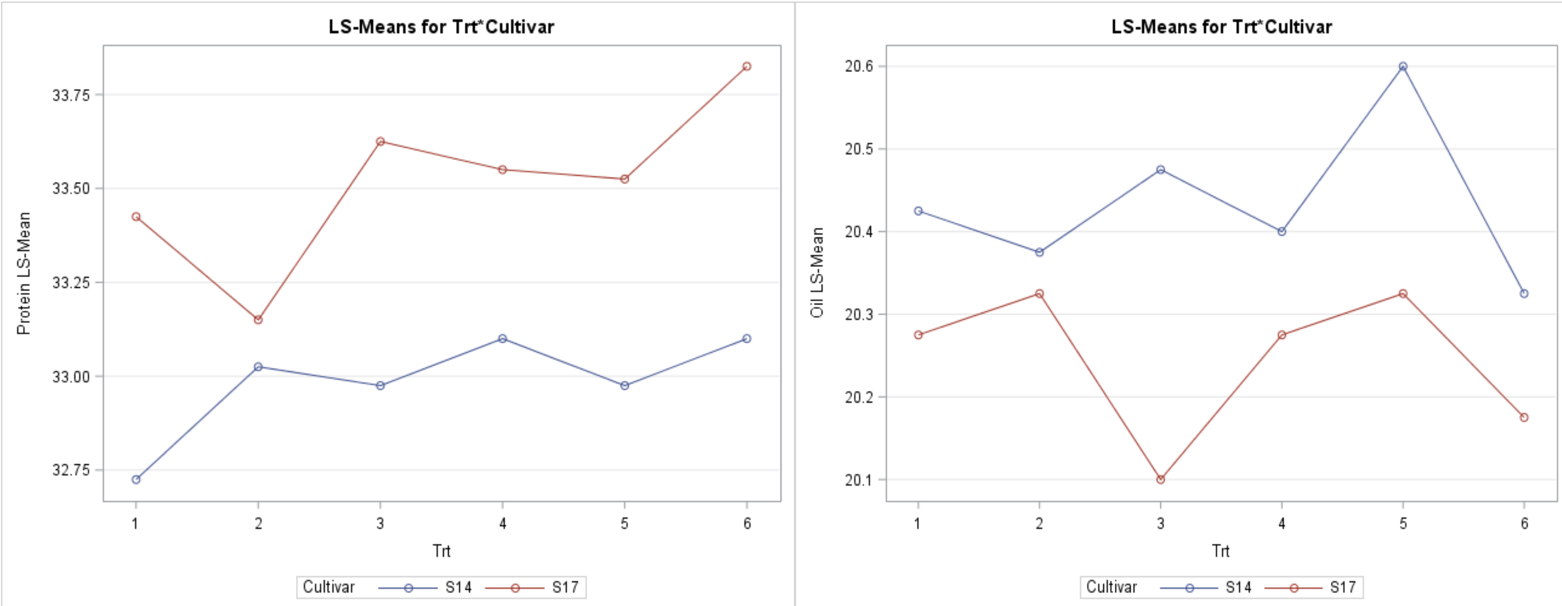

Figure 1. Soybean Cyst Nematode Study: Significant cultivar effects on protein and oil contents at Southeast Farm.

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Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

Abrasive Grit for Weed Control In Organic Soybeans

Michael Carlson*, Sharon Clay,
Frank Forcella, and Sam Wortman

Weed management in any cropping system is a major challenge and concern for producers. This challenge is amplified in organic systems where options are far fewer than in today's conventional systems. Natural amendments with herbicidal properties are limited. Tillage, while providing good weed control, may lead to problems with erosion or reduce organic matter. Flaming has cost and safety issues. In addition, flaming and tillage may only control weeds between and not within the crop row.

Spraying grit at high velocity (i.e. sandblasting) has been shown to kill broadleaf weeds and stunt grass weeds in corn. The objectives of this project are to determine: 1) if different grit type influence weed control; 2) the optimal timing for grit application to control weeds; 3) the injury (if any) sustained by soybean at different grit application timings; and 4) treatment effects on soybean yield.

A conventional soybean variety (Maturity group 2.1) was planted on June 9, 2015 at the SDSU Southeast Research Farm near Beresford. Plots were treated with four types of abrasive grits (walnut shell, soybean meal, and two types of grit manufactured from turkey litter (Sustane 8-2-4 and Sustane 4-2-2). These grits were applied twice using grit sprayer at a rate of 1200 lb/ac. The first application was June 26 (V1 stage of soybean), and the second application was July 10 (V3 stage of soybean) for in-row weed control.

The main weeds present at the first application were common lambsquarters, common waterhemp, and redroot pigweed, which ranged in size from the cotelydon to 3-leaf stage. The second application had the same broadleaf species present with yellow foxtail present at the 1- to 4-leaf stage. Between row weed control was accomplished using either flame weeding or inter-row cultivation just after the second grit application, or allowed to grow undisturbed. Weed density was evaluated prior to weed control operations. In-row and between-row weed biomass and density were evaluated twice, once in mid-July, soon after the final grit application, and once in mid-August when weed biomass was at its peak. Soybean were harvested to evaluate yield on October 20. Evaluations of the grit efficacy to weeds and effect on yield are on-going at this time.

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Auxin Herbicide Drift on Soybean

Sharon Clay*, Sen Subramanian, David Clay, Brian Van De Stroet, Graig Reicks, Stephanie Hansen, and Mason Thorstad

Auxin-mimic herbicide drift is a continuing concern for soybean producers. It has recently been shown that low levels of auxin in the root can impede soybean nodulation. This in turn may reduce plant N availability.

Auxin herbicides at drift levels (at levels 1/10 to 1/1000 of a typical application rate) were applied to soybean as a single or double application at various soybean growth stages (V3, V1+V3, V5, and V3+ V5). In addition, some treatments received a liquid foliar 28% N fertilizer that was applied either immediately after auxin application or about 10 d after the auxin herbicide application, to examine a rescue N treatment .

Soybean yield was determined by treatment after harvest. Seed yield by treatment will also be determined. At present, evaluations are on-going.

ACKNOWLEDGEMENT: The authors wish to acknowledge the SD Soybean Research and Promotion Council for their support of this work.

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An Intensive Management Trial to Evaluate Several Products on Soybean Yields

Graig Reicks*, David Clay,
Sharon Clay, and Michael Devens

INTRODUCTION

There are many products on the market that may increase soybean yields. A trial was initiated in 2013 that has continued through 2015 with plots near the eastern South Dakota locations of Beresford, Aurora, South Shore, Pierre, and Aberdeen that has involved testing some of these products, both alone and in various combinations.

METHODS

The previous crop was corn. The trial was a split-plot on a randomized complete block design, with four replications. Planting date was the main plot effect, while product or combination of products was the subplot (Table 1). Plot sizes were 10 ft wide by 30 ft long. An adapted soybean variety with a 2.9 maturity rating was planted on both May 13 and June 2 at approximately 160,000 seeds ac^{-1}.

Spraying was performed with a 4-nozzle CO_2 backpack sprayer at approximately 15 gal. per acre. A plot combine was used to harvest the middle two rows of each plot.

RESULTS

Yield information is being analyzed at this time. We are also looking for farmers willing to apply any of these products or others to their own fields. Using yield monitor data, we will then evaluate the effectiveness of the product(s) tested at different places in the field. Contact the corresponding author for more information.

ACKNOWLEDGEMENTS

This study was funded by the South Dakota Soybean Research and Promotion Council.

Table 1. Treatments in the high-input soybean trial near South Shore, SD in 2013

Input	Rate $Acre^{-1}$	Growth Stage	Treatment ID											
			1	2	3	4	5	6	7	8	9	10	11	12
Cobra®	12 oz	V4	x											
Urea®	75 lbs N	V4		x	x						x	x	x	
ESN® slow-release N fertilizer	75 lbs N	V4			x						x	x	x	
TaskForce® 2 foliar fertilizer	64 oz	V4				x							x	
Bio-Forge®antioxidant	16 oz	R3					x						x	
Ascend® plant growth regulator	6.4 oz	R3						x			x	x	x	
QuiltXcel$_{TM}$ fungicide (group 3 + 11)	21 oz	R3							x	x		x	x	
Domark® fungicide (group 3)	5 oz	R5								x		x	x	

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Interseeding Cover Crops into Soybeans

Graig Reicks*, Sharon Clay,
David Clay, and J. Chang

INTRODUCTION

Integrating cover crops into a South Dakota soybean production system after harvest poses many challenges due to cold dry autumn conditions that lead to poor or no seed germination and, if emerged, limited time for growth. Cover crops have been successfully established when interseeded into South Dakota corn from about V5 to V7 (Bich et al., 2014) without adversely impacting grain yields. However, due to rapid growth of corn, the interseeding opportunity is brief. Interseeding cover crops into wide row soybeans may have a broader range of planting dates due to the ability to run standard farm equipment through a soybean crop before canopy closure. However, if seeded too early, soybean may respond to the cover crop as a weed infestation and reduce yield, whereas if seeded too late, the cover crop may not establish well in a dense soybean canopy. This was the second year of a study that examined cool and warm season cover crop species seeded at different times [R1 (early flowering), R2, and R7 (leaf drop)]. At leaf drop two methods of seeding (broadcast vs. drill) were examined whereas at the earlier plantings, only a drill treatment was used.

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METHODS

The previous crop was corn with conventional tillage. The trial was a randomized complete block design with four replications. Each plot had 4 rows, each 2.5 ft. wide and 25 ft. long. A soybean variety with 2.2 maturity rating was planted at approximately 160,000 seeds ac-1 on June 10. Cover crops were interseeded on the following dates and growth stages: July 13 at R1 when the crop was 12 in. tall, August 7 at R3 when the crop was 35 in tall, and late-R6 on Sept. 13 just prior to leaf drop. A broadcast treatment was also performed on September 13 to examine the effectiveness of soybean leaf cover on germinating cover crop species. The cover crops treatments were either a type of cool season mix, cowpea (warm season), or both. One cool season mix contained forage radish (4.2 lbs ac-1) and crimson clover (14.7 lbs ac-1). The other contained annual rye (20 lbs ac-1) and dwarf essex canola (1.67 lbs ac-1). If seeded as either a cool season mix or cowpea alone, the mix was seeded in a single row half-way between two soybean rows with a hand push drill. In the treatment that received a cool season mix and cowpea, these two were seeded in separate rows, each 7.5” apart. Cover crop biomass sampling was performed on October 11, which was the day before soybean harvest. Cover crop sampling was performed again in November to determine the extent of cool season growth following soybean harvest.

RESULTS

Cover crop biomass yields in this report were from the October 11 sampling, as the November samples are still being analyzed. Therefore, the yield of cowpea, a warm season species, will be considered its final yield. Cowpea was the highest biomass yielding cover crop treatment, at 181.2 lbs ac-1 when seeded into R1 soybeans (Table 1). Despite the late frost, which occurred after soybean harvest, the cowpea also remained in the vegetative stages and did not set seed. It's also important to note that the fresh cowpea biomass did not affect soybean harvesting. Like cowpea, forage radish also yielded higher amounts of biomass when interseeded earlier in the growing season (Table 1). Broadcast treatments at R7 had minimal cover crop establishment and growth. This lack of establishment in broadcast treatments is similar to the data from *Bich et al. (2014)* for interseeding cover crops into corn.

When 2014 and 2015 soybean yield data were analyzed together, there was 7% yield increase when cover crops were interseeded at R1 (data not shown). This yield response however, was not significantly different when 2015 data was analyzed alone. Additional studies should be performed to determine the soybean growth stage where yields are negatively impacted by interseedeed cover crops. Earlier interseeding dates, provided they don't negatively impact yields, may promote increased cover crop production.

Table 1. Soybean yields and interseeded cover crop biomass production near Beresford, SD in 2015.

Species	Seeding Method	Timing	Soybean Yield	Cowpea (CP)	Forage Radish (RD)	Crimson Clover (CC)	Annual Rye (RY)	Dwarf Essex (DE)	Total Biomass
			bu ac^{-1}	----------------------------lbs biomass ac-1------------------------------					
RD+CC	Drilled	R1	†60.1		41.4 a	7.0 b			48.4 cd
RY+DE	Drilled	R1	59.9				‡	0.3 bc	0.3 e
CP	Drilled	R1	59.5	181.2 a					181.2 a
CP+RD+CC	Drilled	R1	61.9	69.9 b	38.2 a	6.3 bc			114.4 b
CP+RY+DE	Drilled	R1	60.1	9.4 cd			2.7 ab	0.5 abc	12.6 e
RD+CC	Drilled	R2	56.7		1.0 b	0.2 d			1.2 e
RY+DE	Drilled	R2	55.6				0.2 b	‡	0.2 e
CP	Drilled	R2	57.1	56.7 b					56.7 c
CP+RD+CC	Drilled	R2	59.7	47.2 bc	1.4 b	0.6 d			49.2 cd
CP+RY+DE	Drilled	R2	58.1	11.4 d			5.8 ab	0.1 c	17.3 de
CP+RD+CC	Drilled	R7	59.8	11.1 d	26.4 ab	26.6 a			64.1 bc
CP+RD+CC	Broadcast	R7	58.8	10.3 d	4.5 b	0.9 cd			15.7 de
CP+RY+DE	Drilled	R7	60.7	10.1 d			6.9 a	3.2 ab	19.9 de
CP+RY+DE	Broadcast	R7	57.4	0.4 d			3.2 ab	3.5 a	7.1 e
None			58.0						

† Values followed by the same letter within the same column are significant at the 0.05 probability level.
‡No measureable cover crop growth.

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Long-term Rotation Project Report:

Long-term Tillage and Crop Rotation Impacts on Soil Properties. (Field 302 Rotation & Tillage)

Project personnel: Sandeep Kumar (PI)*, Abdullah Alhameid (PhD graduate student), Peter Sexton, Mostafa Ibrahim, Rajesh Chintala, Douglas Malo, and Thomas E. Schumacher, Shannon Osborne, Amadou Maiga.

PROJECT METHODS

The experimental site is located at the Southeast Research Farm of South Dakota State University located near Beresford, South Dakota. The experiment was initiated in 1990 to assess the impact of different tillage systems and crop rotations on the long term production and economics of cropping systems. The experimental site has 80 plots distributed randomly in a complete block design. Each plot has a width of 20 m and a length of 100 m. The experimental plots were designed to be large so that field operations could be carried out using commercial sized farm equipment. The experiment had three different tillage systems which were no till (NT), conventional till (CT), and ridge till (RT). Ridge till system had only a two year crop rotation of corn (*Zea mays* L.) – soybean (*Glycine max*. L.).

In the fall of every year, after harvest, residues of corn, soybean, and wheat were disked and chiseled in all of the conventionally tilled plots. The RT plots were excluded from this study because it had only one rotation system. Both NT and CT had three rotation systems, which were a two year rotation of corn-soybean, a three year rotation of corn-soybean-wheat (*Triticum aestivum* L.), and a four year rotation of corn-soybean-wheat-oat (*Avena sativa*).

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Task 1. *Measurement of Soil Organic Matter (SOM) and nutrients.* Soil samples were collected every fall after harvesting the crops. Samples from each plot were collected from 1991 to 2004. Three cores of soil samples from each plot were collected at a depth of 0-15 cm using a 3.5-cm diameter and 50-cm-tall hand probe (Inc. JMC Soil Samplers) and mixed together to make a composite sample. Composited soil samples were labeled, sealed in plastic zip-lock bags, and transported to the laboratory. Every year, after bringing the soil samples to the laboratory, all of them were air dried, ground, and sieved to pass a 2-mm sieve. All of the analyses were carried out using the soil fine fraction (< 2 mm in diameter). Soil organic matter (SOM) was measured using the loss on ignition (LOI) method (Mikha et al., 2006). Briefly, 10 g of each soil sample was weighed in an aluminum crucible, transferred to a muffle at a temperature of 450-500 ^{o}C for 4 h, and then the loss of weight was determined. P was extracted using a 0.5 *M* $NaHCO_3$ solution and then the extraction was measured calorimetrically (Olsen, 1954). Nitrate was determined using a nitrate-specific ion electrode. Available K was extracted by 1 M NH_4OAc at pH 7.0, and it was determined using an atomic absorption (AA) (Warncke and Brown, 1998)

Task 2. *Measuring Soil Quality Parameters*. The impact of long-term soil management and crop rotation systems on selected soil properties. (TN, TC, SIC, pH, EC, C fractions, Soil aggregate, soil penetration resistance, bulk density). (Chapter #1 of PhD dissertation, Alhameid)

Task 3. *Measuring Hydrological Properties*. Influence of long-term soil management and crop rotation systems on hydrological and physical properties. (Water infiltration, field capacity, soil penetration resistance, soil textural analysis, bulk density, soil water retention, and pore size distribution). (Chapter #2 of PhD dissertation, Alhameid).

Task 4. *Measurements of Soil Microbiological Parameters.* The impact of crop rotations systems and tillage managements on soil microbial community. (Chapter #3 of PhD dissertation, Alhameid).

Task 5. *Response of Diversified Cropping Systems to Soil Quality Parameters.* This will address the general premise of the crop rotations, intensification impacts on soil physical and biological functions, and how conservation systems minimize such effects. Intensified agroecosystems (long-term diverse crop rotations, cover crops and their impacts on soil organic carbon and health indicators). Study will assess the impacts of crop rotation on soil organic carbon and C fractions rotation impacts on selected soil quality parameters. (Dr. Maiga)

Project deliverables/products.

- Published paper:
    - Ibrahim MA, Alhameid AH, Kumar S, Chintala R, Sexton P, et al. (2015) *Long-Term Tillage and Crop Rotation Impacts on a Northern Great Plains mollisol.* Adv Crop Sci Tech 3: 178. doi:10.4172/2329-8863.1000178. (Task 1)

- Oral presentation at ASA conference by graduate student (Abdullah Alhameid).
    - Abdullah H. Alhameid, Mostafa Ibarhim, Saroop Sandhu, Ekrem Ozlu, Sandeep Kumar, S.L. *Osborne*, Sexton P, Thomas E. Schumacher, S. Ali *Long-term tillage and diverse crop rotation systems impacts on organic carbon and selected soil properties.* Oral Presentation at the ASA-CSSA-SSSA. International Annual Meeting at Minneapolis, MN. November 15-18, 2015. (Task 2)

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Manure Management Project Report

Manure management on soil properties, crop yield and greenhouse gas emissions under long-term a corn-soybean rotation in South Dakota. (Manure plots)

Project personnel: Sandeep Kumar (PI)*, Ekrem Ozlu (MS graduate student), Peter Sexton, Erin Cortus, and Nigel Hoilett.

PROJECT METHODS

These plots were established as a corn-soybean rotation on an Egan soil (deep, well-drained) in 2003 at the SDSU Southeast Research Farm located near Beresford, SD.

These conventionally-tilled plots had beef feedlot manure applied. Treatments included: (i) recommended fertilizer (recommended fertilizer rate determined from soil test and yield goal), (ii) manure-P (P manure rate based on P recommendation from soil test or on P removal from crop, whichever is greater), (iii) manure-N (N manure rate is based on N requirement for corn and soybean minus soil test nitrate-N and legume credit), (iv) manure-2N, (v) fertilizer (high; high fertilizer rate to determine maximum yield from fertilizer), and (vi) control.

The soil test P from the P manure treatment was used to calculate the manure needed for that treatment. If the soil test P is high enough where no P recommendation would be made, the average crop P removal was used to calculate manure P rate. Similarly, the soil test nitrate-N from the N manure treatment was used to calculate the manure needed for that treatment. Both the P and nitrate-N soil tests were used from the fertilizer treatment to make the P and N recommendations for the fertilizer treatment. The manure was incorporated with a disc in one to three days after application.

Treatments were randomized complete block design with four replications. A study was previously conducted on these manure plots by **Dr. Ron Gelderman**, Professor at SDSU, and results reported that the manure application to corn-soybean plots improved the soil organic matter, and the bioavailability of nutrients from either manure or fertilizer increased the crop yields, compared to the control treatment.

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Task 1. *Soil health assessment and Crop Yield performance.* To assess the manure management impacts on soil physical health and crop yield. (Chapter#1 of MS thesis, Ozlu).

Task 2. *Soil Physical and Hydrological Properties and Soil Carbon.* To assess the manure management impacts on soil physical and hydrological properties and soil organic carbon. (Chapter#2 of MS thesis, Ozlu).

Task 3. *Soil Microbial Activities and Greenhouse Gas Emissions.* To assess the manure management impacts on soil microbial properties and greenhouse gas emissions. (Chapter#3 of MS thesis, Ozlu).

Project deliverables/products

- Oral presentation at ASA conference by graduate student (Ekrem Ozlu).
  - Ekrem Ozlu, Sandeep Kumar, Sara Berg , A. Bly, Peter Sexton, Ron Gelderman

Impact of manure application on soil health and crop yield under corn-soybean rotation in South Dakota, Conference: ASA-CSSA-SSSA. International Annual Meeting, November 15-18, 2015. Minneapolis, MN.

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NRCS-CIG Project Report

Demonstrating the Short-Term Impacts of Grazing Cover Crops on Soil Health

Project personnel: Sandeep Kumar (PI)*, Colin Tobin (MS graduate student), Peter Sexton, Anthony Bly, Shaukat Ali, Douglas Malo, and Bruce Bleakley

PROJECT METHODS

Selected farms will be used for demonstrating the impacts of cover crops and grazing on soil health and crop productivity.

The Southeast Research Farm, near Beresford, South Dakota, has been selected as one location for the proposed project. The proposed demonstration at the Southeast Farm will include 32 plots with 4 treatments (three cover crop mixtures and one control), 2 blocks (grazing and non-grazing) with 4 replications. Each field is of 9 m (30 feet) by 36.6 m (120 feet) long. Another producer's (**Mr. John Shubeck**) location will have 3 fields that include one cover crop mixture (brassica/legume blend), grazing and no cover crop and grazing. *Note*: *To make it simple and as per producer's consent, only 3 fields (30 feet by 120 feet) plots will be selected on Mr. Shubeck's farm that will include grazing and cover crops, and no grazing*.

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Task 1. *Measurements of soil physical properties*. Soil compaction was measured using soil bulk density and soil penetration resistance tests. The intact core samples were collected from every farm in 4 replicates and bulk density will be calculated using the core method (Grossman and Reinsch, 2002). *Soil penetration resistance* measurements will be taken using the Eijkelkamp-type hand penetrometer. Soil samples will be collected to measure other basic soil properties that include: textural analysis (*only at the start of the experiment*), pH, electrical conductivity (EC), aggregate stability, and moisture content. Soil samples will be air-dried for 3-4 days before soil analysis, and then ground by hand to pass a 2.0 mm sieve. Soil texture will be analyzed using the pipette method and, bulk density will be analyzed using the core method (Grossman and Reinsch, 2002). In addition, *Daily weather data* will also be collected from nearby weather station that includes solar radiation, maximum and minimum air temperature, and precipitation.

Task 2. *Measurements of soil hydrological properties*. Soil water infiltration will be measured using the ponded and cornell infiltrometer methods. *Water infiltration* from all the plots will be measured with a double-ring infiltrometer using a constant-head method (Reynolds et al., 2002) with 25-cm inner diameter and 30-cm in length. Plant residues will not be removed while inserting the ring. At the time of infiltration measurements, gravimetric soil water content at depths of 0-10, 10-20, and 20-30 cm will also be taken in the area surrounding the ring from all the fields and adjusted to volumetric water content using the bulk density values. The steady state infiltration (infiltrability) of the soils will also be determined using a Cornell Sprinkle Infiltrometer, a miniature rainfall simulator (Ogden et al., 1997). The cylindrical base of the Cornell Sprinkler will be driven into the soil such that the runoff water outlet coincided with the soil surface. One liter plastic beakers will be placed in auger bores for runoff water collection. Steady state infiltration rate will be determined using this method. An interval of 3 minutes was used during measurements and water level was read directly off a scale attached to the water reservoir. This method is very easy and cheap, and producers can handle it very easily with little training. Both methods are cheap and will be demonstrated to the producers.

Task 3. *Measurement of soil C and N fractions, and stocks*. Plant residues remaining after growing cover crops and livestock grazing on mixed cover crops will add C and N to the soil.

Task 4. *Stakeholders' Participation and Field Demonstrations*. We expect to contact 100-150 or more landowners/ producers, and stakeholders residing close to the farm sites to create awareness among the producers about soil health improvement using grazing management and the proposed plans to promote the integrated crop-livestock systems.

Project deliverables/products.

- Poster presented at ASA conference by graduate student (Colin Tobin).
    - Tobin, C., S. Kumar, E. Grings, D.D. Malo, P. Sexton, S. Ali. 2015. Impacts of Integrated Crop-Livestock System on Soil Health Parameters. Poster Presentation at the ASA-CSSA-SSSA. International Annual Meeting at Minneapolis, MN. November 15-18, 2015.
- Data shared in the workshop.

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Drainage Management Strategies for Managing Water and Nutrients in South Dakota

Laurent Ahiablame*, Peter Sexton, Christopher Hay, Todd Trooien, Erin Cortus, and Dennis Todey

INTRODUCTION

Subsurface drainage installation has increased dramatically in eastern South Dakota in the last several years driven by increases in precipitation and commodity and land prices. This research will evaluate the economic, water quality, and hydrologic impacts of drainage in South Dakota.

We have separated the research into four components-a core component and three associated components. The core component is a monitoring network to study strategies to best manage water and nutrients on tiled and non-tiled fields at plot and field scales. This basic instrumentation setup will feed into the other three research components addressing drainage design criteria and economics, water quality and nutrient management, and hydrologic impacts of drainage (Fig. 1). This report provides a brief discussion of drainage research conducted at the SDSU Southeast Research Farm.

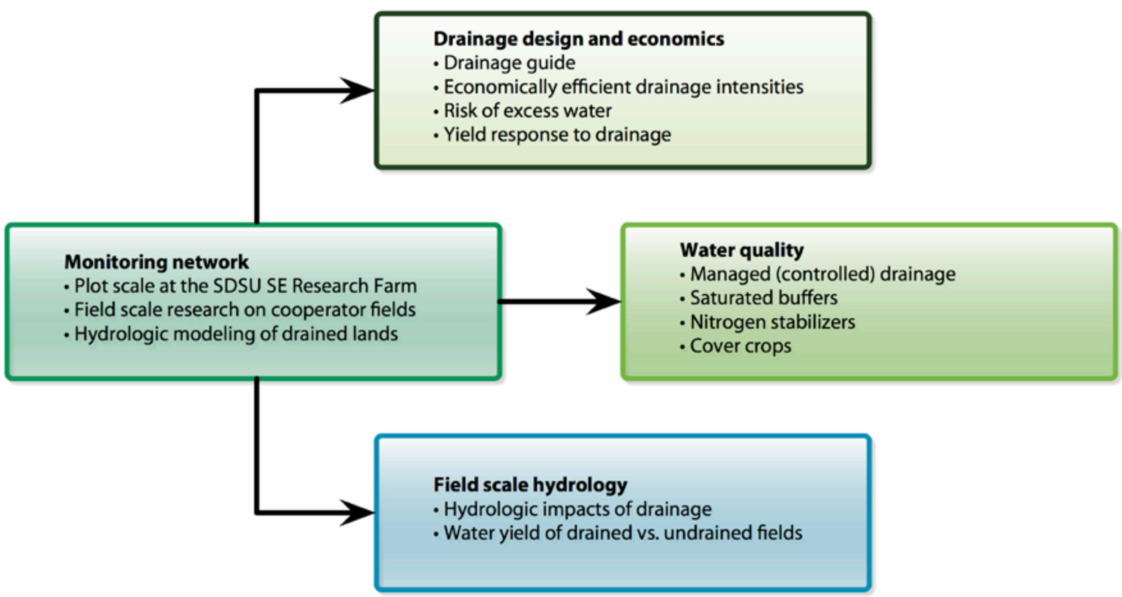

Figure 1. Diagram of research project components

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OBJECTIVES

Proposed Objectives

The proposed research seeks to:

1. Develop guidance on drainage intensity and drain spacing for representative soils and climatic conditions in South Dakota to maximize economic benefits and minimize negative environmental impacts
2. Evaluate the impact of nitrogen stabilizers on nitrate losses from drained areas
3. Compare the water yield among conventionally drained, managed drained, and undrained fields
4. Demonstrate and evaluate the use of managed (controlled) drainage and saturated buffers for reducing nitrate losses from tile drained fields
5. Evaluate potential cover crop strategies to manage wet areas and to tie up nutrients and reduce drainage outflow

Notes on Completion of Proposed Objectives

Work is mostly complete for objective 1. Model runs based on data from the Southeast Research Farm and other drainage sites have been completed to develop design drainage rates. These will be combined with the economic analysis to complete the development of guidance on drainage intensity for South Dakota. Work continues on the other objectives as the additional growing seasons of field research continue.

METHODS

Two sets of subdrainage plots were installed at the SDSU Southeast Research Farm. The first set of plots (North plots) were installed during the week of May 6–10, 2013. The drain lines were installed in six plots of approximately 1-acre size across two fields that have been in a long-term corn-soybean rotation (Fig. 2). The drain lines were installed at a 4-ft. depth with 80-ft. spacings. For the soils in the plots, this results in an estimated drainage coefficient (design capacity of the drainage system) of ½ inch per day at 4-ft deep or ⅜ inches per day when operated at a 3-ft. outlet depth. Three of the plots are operated as drained to a 3-ft. depth, and the other three plots have the outlets closed and are operated as undrained.

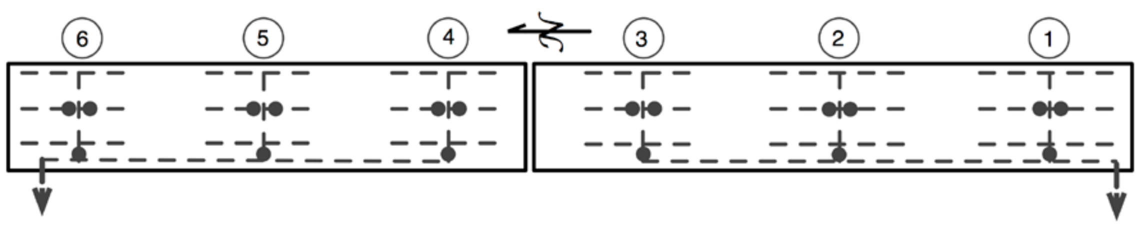

Fig. 2. North subsurface drainage plots at the Southeast Research Farm. Dashed lines are the tile lines, and dots are the control structures. Plots 2, 3, and 6 are drained to a 3-ft. depth, and plots 1, 4, and 5 have the outlets closed and are managed as undrained. Within each of these plots, half of the plot will receive conventional urea nitrogen applications and the other half will receive applications of nitrogen with a nitrogen stabilizer (nitropyrin).

The study is set up in a split-plot design with drainage as the whole-plot treatment and nitrogen as the split-plot treatment. The tile plot area was seeded to soybeans in the spring of 2013 after disking operations to smooth out the fields following the drainage installation. The drained plots were planted on June 3rd, 2013. Because of wet conditions, planting was delayed on the undrained plots until June 18th and 20th. With the beginning of a new study, however, there was some initial confusion over study goals that resulted in one of the drained plots being planted later than it could have been. Corn was planted in 2014 followed by soybeans in 2015 on these plots.

Soil moisture, water level, and precipitation monitoring instrumentation were installed in the summer of 2013. Stevens Hydra Probe II sensors for continuous measurement of soil water content, soil temperature, and electrical conductivity were installed on the control (conventional nitrogen) side of each whole-plot at depths of 6″, 18″, 30″, and 42″. Decagon CTD sensors were installed in each of the control structures for continuous measurement of water level (for calculating drain discharge), water temperature, and electrical conductivity. Monitoring wells were installed in each whole-plot, midway between two tile lines, for monitoring shallow groundwater levels. Additionally, two tipping bucket gages were installed for measuring precipitation. Other climatological measurements will come from the existing weather station at the research farm. Table 1 summarizes the datasets being collected from the six research plots to date.

The second set of subdrainage plots (9.3-acre) were installed during the week of September 23, 2013 and named the South plots. The plots consist of a 4-acre plot for conventional drainage and a 5.3-acre plot for drainage water management (DWM) (Fig. 3). The tiles were installed at 4-ft deep with 40-ft spacing. Oats were planted on these plots in 2015 and corn will be planted in 2016 to match the North plots (Fig. 2). The data collected on North plots are also being collected for these plots, except crop yield data will be collected from 2016 harvest.

The conventional drainage plot operated with an estimated drainage coefficient (design capacity of the drainage system) of ⅜ inches per day. The outlet of the DWM plot is controlled with a riser board which is removed, raised or lowered, as needed, according to growing and non-growing seasons. Specifically;

1. The boards will be removed in early April for corn and mid-April for soybeans. The boards should be removed approximately 3 weeks prior to planting, depending on existing and forecast conditions.
2. After planting:
   - Corn: Boards will be replaced to 18 inches below the soil surface at the control structure. When corn reaches the 4-leaf stage, the outlet elevation should be lowered to 24 inches below the soil surface. When corn reaches the 10-leaf stage, the outlet elevation will be lowered to 30 inches below the surface and left there for the remainder of the growing season.
   - Soybean: Boards will be replaced to 24 inches below the soil surface at the control structure until the beans reach 8 inches tall and then the boards will be lowered to 30 inches below the surface and left there for the remainder of the growing season.
3. If needed, boards will be removed 10 days before harvest.
4. Boards will be replaced within one week after harvest to 6 inches below the soil surface.

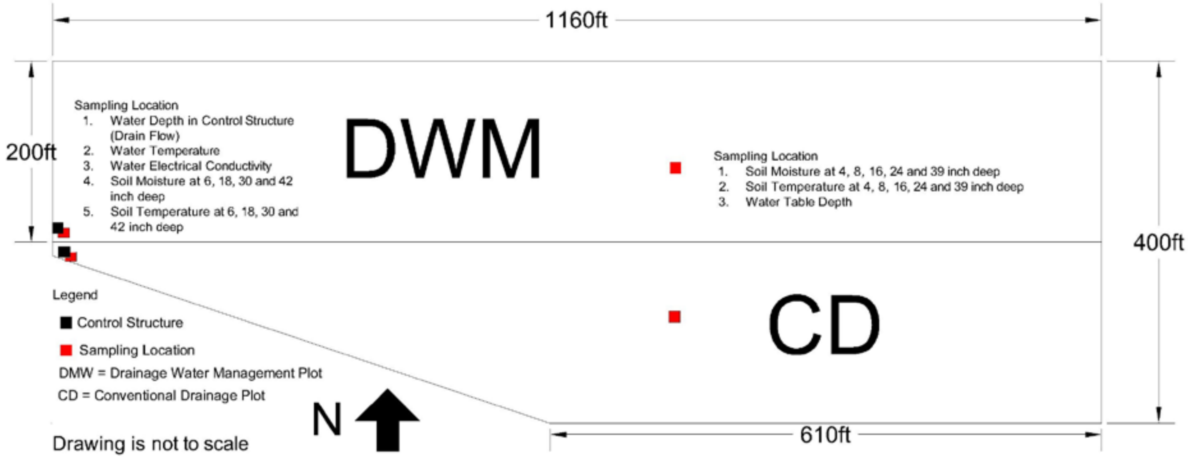

Fig. 2. Layout of Drainage Water Management Plots (i.e. South Plots) at SDSU SERF near Beresford, SD

The data have not yet been statistically analyzed to determine the effects of drainage on soil water characteristics and crop yields. The information presented in this report is strictly a summary of field data collected.

Table 1. List of data being collected from research plots at SDSU Southeast Research Farm near Beresford, South Dakota.

No.	Data Type	Frequency	Equipment	Description	Start Date	End Date	Unit of Measmt	Remark
1	Drain Flow	15 min	Decagon CTD	Water Depth in Control Structure	9/11/2013	Present	mm	Removed during winter
2	Temperature	15 min	Decagon CTD	Water Temperature	9/11/2013	Present	°C	Removed during winter
3	Electrical Conductivity	15 min	Decagon CTD	Water Electrical Conductivity	9/11/2013	Present	dS/m	Removed during winter
4	Soil Moisture	15 min	Stevens Hydra Probe II	Soil Moisture Depth - 6 inch	9/11/2013	Present	m^3/m^3	Continuous
5	Soil Moisture	15 min	Stevens Hydra Probe II	Soil Moisture Depth - 18 inch	9/11/2013	Present	m^3/m^3	Continuous
6	Soil Moisture	15 min	Stevens Hydra Probe II	Soil Moisture Depth - 30 inch	9/11/2013	Present	m^3/m^3	Continuous
7	Soil Moisture	15 min	Stevens Hydra Probe II	Soil Moisture Depth - 42 inch	9/11/2013	Present	m^3/m^3	Continuous
8	Soil Moisture	15 min	Decagon 5TM	Soil Moisture Depth - 54 inch	4/30/2015	Present	Ea	Continuous
9	Soil Temperature	15 min	Stevens Hydra Probe II	Soil Temperature Depth - 6 inch	9/11/2013	Present	°C	Continuous
10	Soil Temperature	15 min	Stevens Hydra Probe II	Soil Temperature Depth - 18 inch	9/11/2013	Present	°C	Continuous
11	Soil Temperature	15 min	Stevens Hydra Probe II	Soil Temperature Depth - 30 inch	9/11/2013	Present	°C	Continuous
12	Soil Temperature	15 min	Stevens Hydra Probe II	Soil Temperature Depth - 42 inch	9/11/2013	Present	°C	Continuous
13	Soil Temperature	15 min	Decagon 5TM	Soil Temperature Depth - 54 inch	4/30/2015	Present	°C	Continuous
14	Soil Electrical Conductivity	15 min	Stevens Hydra Probe II	Soil Electrical Conductivity Depth - 6 inch	9/11/2013	Present	S/m	Continuous
15	Soil Electrical Conductivity	15 min	Stevens Hydra Probe II	Soil Electrical Conductivity Depth - 18 inch	9/11/2013	Present	S/m	Continuous
16	Soil Electrical Conductivity	15 min	Stevens Hydra Probe II	Soil Electrical Conductivity Depth - 30 inch	9/11/2013	Present	S/m	Continuous
17	Soil Electrical Conductivity	15 min	Stevens Hydra Probe II	Soil Electrical Conductivity Depth - 42 inch	9/11/2013	Present	S/m	Continuous
18	Soil Moisture	15 min	UMS T4 Tensiometer	Tensiometer, Depth - 54 inch	4/30/2015	Present	KPa	Wet End
19	Soil Moisture	15 min	UMS T4 Tensiometer	Tensiometer, Depth - 78 inch	4/30/2015	Present	KPa	Wet End
20	Soil Moisture	15 min	Camp Sci 229	Soil Matric Potential, Depth - 54 inch	4/30/2015	Present	Degree Celcius	Dry End

21	Soil Moisture	15 min	Camp Sci 229	Soil Matric Potential, Depth - 78 inch	4/30/2015	Present	Degree Celcius	Dry End
22	Water Table Depth	15 min	Hobo Water Level Logger	Water Depth - Observation Well	8/21/2014	Present	m wrt sensor depth	Removed during winter
23	Water Table Depth	15 min	Hobo Water Level Logger	Water Depth - Deep Well	8/21/2014	Present	m wrt sensor depth	Removed during winter
24	Soil Penetration Resistance	Weekly	Cone Penetrometer	Cone Penetration	4/9/2014	7/11/2014	KPa	Growing Season
					3/31/2015	10/6/2015	KPa	Growing Season
25	Leaf Area Index	Weekly	Ceptometer	Leaf Area Index	7/9/2014	10/2/2014	unitless	Growing Season
					6/23/2015	9/1/2015	unitless	Growing Season
26	Nutrient Analysis	Random	Grab Sampling Method	Nitrate-Nitrate Analysis	6/10/2014	7/22/2014	mg/L	When there is flow
					5/13/2015	7/7/2015	mg/L	When there is flow
27	Precipitation	15 min	Tipping Buck Rain Gauge	Precipitation	9/11/2013	Present	mm	Continuous
28	Infiltration	Monthly	4 inch Infiltration Ring	Sorptivity	5/8/2014	8/21/2014	ml/min	Growing Season
					3/31/2015	7/14/2015	ml/min	
29	Bulk Density	Year 1, 3, 5 and 10	AMS bulk density kit	Bulk Density			gm/cm^3	Within 1 month of planting
30	Grain Yield	Yearly	Kincaid Plot Combine	Plot area 15' x approximately 185'	5/1/2013	Present	bu/acre	Annually
31	100 Seed Weight	Yearly	Hand Count / Gram Scale	Hand Count	5/1/2013	Present	grams	Annually
32	Stand Count	Yearly	Hand Count	Hand Count	5/1/2013	Present	plants	Annually
33	Soil Sampling & Analysis (Nitrate-N, Olsen P, K, pH, Zn, S and EC (1:1 saturated paste))	Yearly	Tractor Probe	Analysis by SDSU Soils Lab	5/1/2013	Present	ppm	Annually
34	Corn Biomass Nutrient Analysis	Year 2	ICP tissue analysis	6' Samples; Dried, Weighed; Subsample Analyzed	11/7/2014	11/7/2014	lbs./ac	After Harvest

RESULTS AND DISCUSSION

Wetness had no impact on planting in spring 2015, even though there were many drain flow events from mid-May till mid-October. In 2014, there was no drainage in the early spring, and the water table remained below the tile outlet elevation until a series of heavy rainfall events in mid-June that resulted in drainage in the drained plots and an elevated water table in the undrained plots.

Overall mean yields from the drained plots and undrained plots were similar (Tables 2 and 3). Yields were also similar between the control and N-Serve (nitrapyrin) treatments. However, there were slightly greater average yields in drained plots, which are 52 and 57 bu./ac. for soybean and 211 bu./ac. for corn compared to the average yields in undrained plots. A thorough statistical analysis of the yield results will be conducted very soon. Analysis of drainflow, water level, water quality, soil moisture, leaf area index, sorptivity, and soil penetration resistance will also be statistically analyzed.

The benefits of tile drainage are reflected in yield data for both crops, although there is no statistical significant difference in crop yields and related crop measurements (Tables 2 and 3). When SuperU was considered there was a statistical significant difference between drained and undrained plots in Seed 100 Wt. and moisture (Table 3). Stand count and 100-Seed were not completed in 2013.

Table 2. Mean corn yield under drained and undrained and control and N-Serve nitrogen treatments at the SDSU Southeast Research Farm North Plots in 2014

Tile	N Treatment	Yield	Moisture	Test Wt.	Seed 100 Wt.	Stand Count at Harvest
		(bu/ac)	(%)	(lb/bu)	(g)	(plants/ac)
Undrained	Control	208.0	16.1	58.9	33.4	31702
Undrained	NServe	206.7	16.4	58.0	33.4	33154
Drained	Control	209.0	15.9	58.5	33.4	32912
Drained	NServe	214.1	16.2	58.6	33.1	31702
mean		209.5	16.2	58.5	33.3	32368
CV (%)		2.6	1.0	1.2	1.0	5.9
Tile p-value		NS	NS	NS	NS	NS
N Source p-value		NS	0.017	NS	0.074	NS

NS = not statistically significant at 5% significance level.

Table 3. Mean soybean yield under drained and undrained treatments at the SDSU Southeast Research Farm North Plots in 2015

Tile	100-Seed Wt.	Test Wt.	Grain Yield	Stand Count at Harvest
	(g)	(lb/bu)	(bu/ac)	(plants/ac)
Drained	17.5	59.8	57.2	126,808
Undrained	16.2	59.4	53.9	130,680
Mean	*16.8*	*59.8*	*55.5*	*128,744*
CV (%)	*4.0*	*1.0*	*6.5*	*4.6*
p-value	*0.134*	*0.530*	*0.377*	*0.506*

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SDSU Oat Breeding

Melanie Caffe-Treml* and Nick Hall

In 2015, South Dakota oat production, at 12.6 million bushels, was up 36% from last year (NASS). Oat is used for forage, feed, food, and cover crop. It is a low input crop which can provide benefits when included in rotations with corn and soybean by breaking weed and pest cycles. The goal of the oat breeding program is to develop new oat varieties to increase the profitability of oat producers. More specifically, the objective is to develop and release new varieties that exhibit improved yield and yield stability, high test weight, lodging resistance, disease resistance, and that are suited to the various end-uses of the crop. The Southeast Farm is one of the three main locations used by the breeding program to evaluate the performance of the breeding material. Accurate evaluation requires assessing performance over multiple locations and over several years. Southeast Farm is therefore a key location for the oat breeding program.

Approximately 1000 plots were grown at the Southeast Farm in 2015. Material evaluated included early generation populations, breeding lines from the Preliminary and Advanced Yield Trials, as well as several collaborative nurseries such as the Uniform Early Oat (UEO), and the Uniform Midseason Oat (UMO) Performance Nurseries. Data collected included heading date, crown and stem rust severity, height, lodging, yield, test weight, and seed quality characteristics. Data collected at the Southeast Farm were compiled with those collected at other testing locations and were used to select and keep only the most promising breeding lines. Participation in collaborative nurseries such as the UEO and UMO provides the opportunity to test our most promising experimental lines in a more diverse set of environments and to ensure that yield performance is stable.

One breeding line, SD110466, will be increased for potential release in the fall of 2016. Line SD110466 is a white-hulled early maturing oat resistant to crown rust races currently present in South Dakota. It exhibits excellent test weight. The targeted region of production would be the eastern part of the state where crown rust is prevalent. When evaluated in the 2015 South Dakota Oat Variety Trial, SD110466 had an average yield of 139 bu/acre at east river locations (trial average: 131 bu/acre), and 68 bu/acre at west river locations (trial average: 81 bu/acre). It ranked fifth for average yield at east river locations behind Deon, Hayden, Natty, and Goliath. It ranked first for test weight. Performance of SD110466 in the UEO at South Dakota locations is reported in Table 1. Line SD110466 is resistant to smut but moderately susceptible to BYDV. The line will be evaluated again in the 2016 South Dakota CPT Oat Variety Trial.

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Table 1. Performance of South Dakota breeding lines in the 2015 Uniform Early Performance Nursery at South Dakota Locations§.

ID	YIELD (Bu/Acre)	TEST WEIGHT (Bu/lbs.)	HEADING (days)	HEIGHT (inches)	LODGING (%)	CROWN RUST (%)
WIX10055-8	189.7	31.8	169.5	41.5	42.5	0.8
SD120296	186.9	36.0	162.5	37.2	35.0	3.2
SD120069	184.8	35.5	160.8	35.5	80.0	0.0
SD120638	182.5	38.0	159.5	35.7	70.0	9.5
MN11140	176.5	34.7	164.2	40.0	65.0	2.3
SD120289	176.3	37.5	158.7	34.2	68.8	3.3
WIX9562-5	175.7	33.5	163.3	38.5	48.8	3.3
WIX9645-1	174.0	35.3	165.5	38.7	43.5	2.5
MN11115	170.3	35.3	164.0	37.2	51.3	1.7
MN11139	168.1	33.3	163.3	39.5	61.3	2.5
IL08-2010	166.7	36.0	161.7	36.7	78.8	6.7
IL09-5745	163.0	35.3	161.5	34.7	75.0	16.3
WIX10088-6	162.0	33.9	166.7	37.0	57.5	10.0
SD110466	154.6	38.7	160.3	37.5	53.8	3.3
NATTY	149.8	35.9	162.7	42.5	70.0	21.7
SD120129	148.3	38.9	158.0	33.0	40.0	3.3
SD120524	147.5	36.9	161.0	35.7	56.3	29.2
IL11-2353	147.2	36.9	159.8	35.5	30.0	3.7
WIX10097-2	143.8	38.6	160.3	35.8	70.0	3.7
IL11-5748	140.7	34.4	163.5	37.7	50.0	28.3
KAME	137.2	31.7	162.3	36.3	48.8	38.3
CLINTFORD	135.3	35.0	161.5	36.3	75.0	22.5
DON	128.8	33.9	161.2	34.5	72.5	39.2
OTEE	111.4	35.1	162.2	34.7	72.5	40.0
nreps	2	2	2	2	2	2
nlocs	3	3	3	3	2	3
Mean	159.2	35.5	162.3	36.9	59.0	12.3
LSD	24.4	1.6	1.1	2.3		
CV	7.6	2.2	0.3	3.1		

§: Average over three locations (Volga, Southshore and Southeast Farm).

A separate experiment consisted in the evaluation of winter oat survival in South Dakota. The majority of US oat grain is produced in the northern part of the US from spring-sown oat. Winter oat is grown in the south-eastern part of the US primarily for forage production. Winter oat could be an attractive crop to farmers in the northern part of the Great Plains; however, winter oat is less tolerant to low temperature than other winter cereals such as rye, wheat, and barley. In the 2014-2015 growing season, fifty winter oat experimental lines and released cultivars were evaluated for winter survival at Southeast Farm. Breeding programs in the southern oat producing regions of the United States submitted their most winter hardy lines for evaluation in South Dakota. The experiment was planted at two planting dates (early and mid- to late September) and two planting depths. None of the winter oat lines survived the winter. Although this suggests that the winter oat lines evaluated do not have the winter hardiness required to be grown in South Dakota, the winter was characterized by several episode of snow melting followed by extremely low temperatures which is known to be unfavorable to winter survival. A small experiment was planted again in 2015 to further evaluate the winter survival potential of winter oat in South Dakota. The experiment was planted at the end of August. A temperature sensor was placed in the soil to monitor the temperature at crown level.

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Efficacy of soybean meal in reducing the effects of a PRRSv challenge in weaned piglets

M. R. Fiene*, R. C. Thaler

The objective of our trial was to determine the efficacy of dietary soybean meal (SBM) in reducing the effect of a porcine reproductive and respiratory syndrome virus (PRRSv) challenge in nursery pigs as measured by immune response and growth performance. The two dietary treatments differed by method of supplying amino acids: either by SBM or synthetic amino acids (SAA) with SBM. Seventy-two mixed sex, weanling pigs (21 d of age, 10.83 ± 0.82 kg) were allotted by weight and sex to one of 18 pens in a completely random design. There were 4 pigs/pen and 9 observations/treatment. All pigs were fed the same industry-standard diet for 14 days, and then were fed one of two experimental diets for 10 days. All pigs were then inoculated both intramuscularly and intranasally with 1 mL each of live PRRS virus MN-184 (1X 10^6 fluorescent focus units (FFU)/mL dose) at 38 d of age (0 d post-inoculation, DPI). Blood was collected on 0, 3, 7, 14, and 28 DPI for determination of serum PRRSv load and cytokine concentrations. Pig BW and pen feed intake were recorded on blood collection days for the first 28 days and then bi-weekly until the termination of the trial at 125 kg BW. Pigs in the AA group tended to have lower TNF-α (Tumor Necrosis Factor-α) and IL-8 (InterLuekin-8) concentrations (P=0.100 and P=0.100) respectively on 0 DPI. At 3 DPI, pigs fed SBM vs. SAA had higher ADG (.613 vs. .299 kgs) (P=0.005) and G:F (.603 vs. .336) (P=0.0007). On 3 DPI, pigs fed the AA treatment tended to have lower IL-8 concentrations (117 vs 145 pg/mL) (P=0.08). Serum concentrations of INF-γ (Interferon Gamma) tended to be lower for the AA group at 7 DPI. At 14 DPI, serum concentrations of IL-4 (Interleukin-4) (P=0.025) were higher in pigs fed the SBM treatment. Pigs fed the AA diets had higher INF-γ concentrations on 14 DPI (P=0.034) and it tended to be higher (P=0.080) at 28 DPI. Results observed for growth performance and blood parameters were not consistent between treatments throughout the trial. While initial growth responses were improved by SBM diets, an overall increase in immune response was observed from pigs fed the AA based diets. Therefore, additional work needs to be done in clarifying the role of amino acid source in piglet growth and immune status.

KEY WORDS: Pigs, Soybean Meal, PRRSv

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2015 Crop Performance Testing Results for SERF: Corn, Soybean, Winter Wheat, and Oats.

Jonathan Kleinjan*, Kevin Kirby, and Shawn Hawks

INTRODUCTION

The results of the SDSU Crop Performance Testing (CPT) program are released each year due in part to sponsorship by the SDSU extension service and the South Dakota Agricultural Experiment Station. Corn, soybean, winter wheat, and oat variety trials are conducted annually at the Southeast Research Farm location near Beresford, SD. The winter wheat breeding project manages the winter wheat variety trial at this location and the oat breeding project manages the oat variety trial. CPT personnel manage the corn and soybean trials. For more information about the CPT program, please visit their Facebook page: https://www.facebook.com/SDSUExtCropTesting

METHODS

Corn and soybean trials were planted in 30- inch rows with a SRES precision four-row planter. Four-row plots were planted to a length of 20 ft and the center two rows were harvested for grain yield. Small grain variety trials were drilled using John Deere no-till openers set on 8-inch spacing. At harvest, plots were 5 ft wide and 13 ft in length. Additional information about trial management can be found with the trial results.

RESULTS AND DISCUSSION

Results for the corn and soybean trials are included in the following pages and can also be found, along with the small grains trial results, on the igrow website: http://igrow.org/agronomy/profit- tips/variety-trial-results/

The five-year average corn yields for this location are 215 and 216 bu/acre, respectively for the early (≤107 day RM) and late (≥108 day RM) maturity tests. Yields in 2015 were well above average with early and late test averages of 231 and 235 bu/acre, respectively. Soybeans also performed better than the five-year average of 66 bu/acre (Group II), with 2015 yields of 71 bu/acre.

Winter wheat yields were higher in 2015 (89 bu/acre) than the 3-year average of (65 bu/acre). Oat yields were also higher (142 bu/acre) than the 3-year average of 106 bu/acre. Winter wheat varieties recommended for the 2016 season, based on 3-year averages, include Ideal, Lyman, Redfield, Freeman, WB-Grainfield, WB- Matlock, Overland, and SY Wolf. Recommended oat varieties for 2016 are Deon, Hayden, Jury, Newburg, and Souris.

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2015 South Dakota Corn Hybrid Trial Results Beresford

Jonathan Kleinjan | SDSU Crop Performance Testing Director
Kevin Kirby | Agricultural Research Manager
Shawn Hawks | Agricultural Research Manager

Location:	6 miles west and 3 miles south of Beresford (57432) in Clay county, SD (GPS: N 43°02.783' W 096°54.125')
Cooperator:	SDSU Southeast Research Farm - Peter Sexton, manager
Soil Type:	Egan-Clarno-Trent silty complex, 0-2% slope, non-irrigated
Fertilizer:	132-78-90 preplant; 30-10-10 starter
Yield Goal:	200 bu/acre
Previous crop:	Soybeans
Tillage:	Conventional
Row spacing:	30 inches
Seeding Rate:	31,400/acre
Herbicide:	Pre: Roundup (glyphosate) +Dual (metolachlor) +Metribuzin (metribuzin) + Sharpen (saflufenacil) Post: Atrazine (atrazine) + Callisto (mesotrione)
Date seeded:	5/12/2015
Date harvested:	10/29/2015

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2015 South Dakota Corn Hybrid Trial Results Beresford

Table 1. Glyphosate-resistant corn hybrid variety performance results (average of 4 replications) - **Early Season Trial (107 day maturity or less)** at Beresford, SD.

Variety Information			Agronomic Performance				
Brand	Hybrid	Maturity Rating	Yield Bu/A (15.5%)	Moisture %	Test Wt. (lbs/bu)	Lodging* %	Final Stand (plants/A)
Nutech/G2 Genetics	5Z-906	106	**254.8**	17.2	61.8	2.7	28000
Channel	207-27STXRIB	107	**254.2**	17.1	60.2	0.7	29800
Rea Hybrids	6A071-RIB	107	**245.0**	15.8	61.0	1.5	29200
Great Lakes Hybrids	5688STXRIB	106	**244.7**	16.7	60.9	3.8	29200
Great Lakes Hybrids	5755STXRIB	107	**244.6**	16.7	61.4	0.0	29000
Titan Pro	TP 56-06 3110	106	**244.0**	17.2	61.0	3.0	29100
Pioneer	P0589AM	105	**242.2**	15.5	60.7	0.4	29200
Renk Seed	RK712SSTX	106	**242.0**	16.0	61.9	2.7	28200
Nutech/G2 Genetics	5Z-504	104	239.9	16.0	61.4	5.2	27100
Renk Seed	RK776SSTX	107	239.6	17.8	62.0	2.3	28200
Pioneer	P0760AMXT	107	238.0	16.6	62.8	1.2	28200
Titan Pro	TP 39-05 SS	105	235.9	15.8	61.4	2.7	27800
Wensman	W91073STXRIB	107	232.6	16.7	60.8	2.4	27200
Nutech/G2 Genetics	5X-905	105	232.1	15.7	60.0	1.5	29300
Rea Hybrids	6A032-RIB	103	231.5	16.0	61.0	4.0	27700
Channel	205-19STXRIB	105	228.3	15.2	59.9	4.4	27400
Wensman	W9325STXRIB	102	226.5	14.8	60.6	1.5	29500
Rea Hybrids	6A050-RIB	105	225.9	15.7	60.7	0.4	27800
Wensman	W91051STXRIB	105	225.9	16.3	62.6	0.4	28400
Masters Choice	MCT 5661	103	225.0	16.2	59.1	2.1	25600
Masters Choice	MCT 527GT	105	224.8	15.9	60.2	5.9	27700
Check	Check	99	224.6	15.2	61.8	3.8	29000
Rea Hybrids	6A062-RIB	106	223.2	15.7	59.7	6.1	28500
Channel	206-55STXRIB	106	221.9	15.5	61.2	2.0	27400
Thunder Seed	4600 RR	100	219.8	14.6	59.9	7.2	28900
Masters Choice	MCT 5371	103	219.6	15.7	59.1	2.1	26500
Great Lakes Hybrids	5283STXRIB	102	218.3	15.5	61.4	0.8	26900
Nutech/G2 Genetics	5X-806	106	217.4	16.0	61.0	0.0	28900
Great Lakes Hybrids	5470STXRIB	104	215.4	15.9	61.9	2.0	27200
Thunder Seed	6600 VT2RIB	100	212.4	14.4	59.8	0.0	25900
Thunder Seed	7603 GENSSRIB	103	207.6	15.0	60.3	0.4	26700
		Trial Average	230.6	15.9	60.9	2.4	28100
		LSD (0.05)†	13.2	0.5	1.0	2.4	1000
		C.V.‡	4.1	2.1	1.2	-	2.7

* Lodging percentage - stalks broken below the ear as a percentage of the final stand.

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

2015 South Dakota Corn Hybrid Trial Results Beresford

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Table 2. Glyphosate-resistant corn hybrid variety performance results (average of 4 replications) - Late **Season Trial (108 day maturity or more)** at Beresford, SD.

Variety Information			Agronomic Performance				
Brand	Hybrid	Maturity Rating	Yield Bu/A (15.5%)	Moisture %	Test Wt. (lbs/bu)	Lodging* %	Final Stand (plants/A)
Rea Hybrids	7B090-RIB	109	**257.6**	17.3	61.5	3.0	29000
Nutech/G2 Genetics	5F-709	109	**254.2**	17.6	61.4	1.1	29600
Wensman	W91112STX	111	**245.8**	16.5	60.9	2.4	27900
Nutech/G2 Genetics	5F-510	110	**245.5**	18.3	62.0	1.5	28400
Pioneer	P1197AM	111	244.5	18.5	59.4	0.4	26600
Wensman	W91095STXRIB	109	244.4	16.5	62.5	1.2	28000
Titan Pro	TP 55-11 2P	111	242.2	18.5	60.3	0.4	28300
Channel	209-46STXRIB	109	239.6	17.0	61.4	0.0	28200
Nutech/G2 Genetics	5Z-308	108	239.3	17.3	67.3	0.8	27900
Channel	209-53STXRIB	109	237.6	18.0	61.2	1.9	28600
Channel	211-35STXRIB	111	237.1	19.1	63.1	1.2	27300
Great Lakes Hybrids	6399STXRIB	113	237.0	18.5	63.0	3.1	28400
Renk Seed	RK871VT2P	111	234.3	18.9	61.3	3.6	27000
Renk Seed	RK791SSTX	108	230.7	16.4	62.5	0.4	27200
Rea Hybrids	7A111-RIB	111	229.9	16.6	61.6	5.8	28100
Great Lakes Hybrids	6185STXRIB	111	228.7	17.3	61.7	2.0	27800
Great Lakes Hybrids	6068STXRIB	110	226.8	17.1	60.7	2.7	28100
Channel	213-28STXRIB	113	226.5	18.3	60.7	1.6	26700
Check	Check	99	223.4	15.3	61.3	3.4	29300
Great Lakes Hybrids	6462STXRIB	114	216.3	20.1	62.1	0.8	26500
Titan Pro	TP 59-08 SS	108	214.3	17.6	60.1	2.9	26600
Rea Hybrids	7A082-RIB	108	212.6	17.7	61.3	1.3	24300
		Trial Average	234.9	17.6	61.7	1.9	27700
		LSD (0.05)†	12.7	0.5	3.4	2.6	1100
		C.V.‡	3.8	2.2	3.9	-	2.8

* Lodging percentage - stalks broken below the ear as a percentage of the final stand.

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

2015 South Dakota Soybean Variety Trial Results - Beresford

Jonathan Kleinjan | SDSU Crop Performance Testing Director
Kevin Kirby | Agricultural Research Manager
Shawn Hawks | Agricultural Research Manager

Location:	6 miles west and 3 miles south of Beresford (57432) in Clay county, SD (GPS: N 43°02.776' W 096°54.068')
Cooperator:	SDSU Southeast Research Farm - Peter Sexton, manager
Soil Type:	Egan-Clarno-Trent silty clay loam, 0-2% slope, non-irrigated
Fertilizer:	0-78-90 preplant incorporated
Previous crop:	Corn
Tillage:	Conventional
Row spacing:	30 inches
Seeding Rate:	165,000/acre
Herbicide:	Pre: Roundup Power Max (glyphosate) + Dual (metolachlor) + Metribuzen (metribuzen) + Sharpen (saflufenacil) Post: Roundup Power Max (glyphosate) + Select Max (clethodim)
Insecticide:	None
Date seeded:	5/19/2015
Date harvested:	10/13/2015

Table 1. Glyphosate-resistant soybean variety performance results (average of 4 replications) - Maturity Group 1 at Beresford, SD).					
Variety Information			Agronomic Performance		
Brand	Variety	Maturity Rating	**Yield (bu/ac@13%)**	Moisture %	Lodging Score (1-5)*
Thunder Seed	3619N R2Y	1.9	**76.7**	8.3	2.5
Channel	1808R2	1.8	73.7	8.3	2.8
Rend Seed	RS195NR2	1.9	73.4	8.2	1.5
Thunder Seed	3614N R2Y	1.4	72.9	8.2	2.8
Credenz	CZ 1787 RY	1.7	71.6	8.1	2.8
Check	Check	1.4	70.0	8.3	3.0
Thunder Seed	3511N R2Y	1.1	69.9	8.4	4.0
Thunder Seed	3617 R2Y	1.7	68.6	8.2	1.8
Thunder Seed	3114 R2Y	1.4	68.6	8.0	3.0
Sodak Genetics	SD2172R2Y	1.7	68.1	7.9	3.3
Sodak Genetics	SD2101R2Y	1.0	64.7	8.3	1.8
Sodak Genetics	SD2173R2Y	1.7	63.5	8.2	2.0
		Trial Average	70.1	8.2	2.6
		LSD (0.05)†	2.7	0.2	0.7
		C.V.‡	2.7	1.6	-

* Lodging Score (1 = no lodging to 5 = flat on the ground)

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another. Yield values statistically similar to the overall trial winner are shown in **boldface**.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

Table 2a. Glyphosate-resistant soybean variety performance results (average of 4 replications) - Maturity Group 2 at Beresford, SD).

Variety Information			Agronomic Performance		
Brand	Variety	Maturity Rating	**Yield (bu/ac@13%)**	Moisture %	Lodging Score (1-5)*
Dairyland Seed	DSR-2616/R2Y	2.6	**75.9**	8.0	2.3
Channel	2108R2	2.1	**75.1**	8.0	3.5
Pioneer	P31T11R	3.1	**74.7**	8.3	2.5
Channel	2808R2	2.8	**74.2**	8.3	2.3
Nutech/G2 Genetics	7273	2.7	**74.0**	8.2	2.0
Pioneer	P28T08R	2.8	**73.9**	7.6	2.0
Rea Hybrids	R2016	2.0	**73.8**	8.1	3.8
Stine	24RE03	2.4	**73.6**	8.3	3.0
Titan Pro	22M12	2.2	**73.4**	7.9	2.8
Nutech/G2 Genetics	7250	2.5	**73.4**	8.1	2.5
Prairie Brand	PB-2188R2	2.1	**72.8**	8.0	3.3
Great Lakes Hybrids	2551NR2	2.5	**72.6**	8.1	2.8
Rea Hybrids	R2115	2.1	**72.5**	8.2	3.8
Rea Hybrids	R2815	2.8	72.4	8.6	2.8
Dairyland Seed	DSR-2110/R2Y	2.1	72.1	8.2	3.3
Wensman	W3200NR2	2.0	71.8	8.1	2.3
Rea Hybrids	R2615	2.6	71.8	8.0	2.8
Channel	2908R2	2.9	71.7	8.3	3.8
Prairie Brand	PB-2600R2	2.6	71.7	8.0	2.0
Prairie Brand	PB-2556R2	2.5	71.4	8.1	3.0
Great Lakes Hybrids	2469R2	2.4	71.3	8.0	3.3
Credenz	CZ 2474 RY	2.4	71.2	8.3	2.8
Prairie Brand	PB-2876R2	2.8	70.9	8.3	2.3
Stine	24RH62	2.4	70.9	8.3	2.3
Rea Hybrids	R2316	2.3	70.9	8.0	2.8
Wensman	W3201NR2	2.0	70.8	8.1	3.0
Wensman	W3226NR2	2.2	70.7	8.0	3.3
Prairie Brand	PB-2419RR2	2.3	70.7	8.1	2.8
Prairie Brand	X15263R2	2.6	70.3	8.1	3.0
Channel	2607R2	2.6	70.3	7.9	3.0
		Trial Average	70.5	8.1	2.9
		LSD (0.05)†	3.4	0.3	0.7
		C.V.‡	3.5	2.7	-

* Lodging Score (1 = no lodging to 5 = flat on the ground)

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another. Yield values statistically similar to the overall trial winner are shown in **boldface**.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

Table 2b. Glyphosate-resistant soybean variety performance results, continued (average of 4 replications) - Maturity Group 2 at Beresford, SD).

Variety Information			Agronomic Performance		
Brand	Variety	Maturity Rating	**Yield (bu/ac@13%)**	Moisture %	Lodging Score (1-5)*
Channel	2408R2	2.1	70.2	8.1	2.8
Credenz	CZ 2788 RY	2.7	70.2	8.6	2.3
Renk Seed	RS246NR2	2.4	70.1	8.2	2.5
Prairie Brand	PB-2156R2	2.1	69.9	7.9	3.8
Channel	2609R2	2.6	69.7	8.1	4.0
Wensman	W3254NR2	2.5	69.7	8.1	2.5
Stine	29RE22	2.9	69.6	8.4	2.3
Check	Check	1.4	69.4	7.8	4.0
Prairie Brand	PB-2024R2	2.1	69.3	8.1	2.5
Titan Pro	TP-23R04	2.3	69.0	7.9	3.0
Titan Pro	TP-21R55	2.1	69.0	8.0	3.5
Channel	2009R2	2.0	68.9	8.0	3.8
Prairie Brand	PB-2296R2	2.2	68.5	8.1	3.3
Prairie Brand	PB-2486R2	2.4	68.1	8.2	2.3
Channel	2309R2	2.3	68.0	8.0	3.0
Dairyland Seed	DSR-2330/R2Y	2.3	68.0	8.1	2.5
Wensman	W3275NR2	2.7	68.0	8.4	3.8
Wensman	W3228NR2	2.2	67.8	7.7	3.0
Renk Seed	RS213NR2	2.1	67.7	8.1	3.0
Great Lakes Hybrids	2789R2	2.7	67.5	8.1	3.8
Renk Seed	RS216NR2	2.1	66.9	7.8	4.3
Nutech/G2 Genetics	7240	2.4	66.5	8.3	2.3
Stine	28RF02	2.8	66.2	7.9	2.0
Pioneer	P24T93R	2.4	64.4	8.0	2.0
Great Lakes Hybrids	2959NR2	2.9	62.4	8.0	2.0
		Trial Average	70.5	8.1	2.9
		LSD (0.05)†	3.4	0.3	0.7
		C.V.‡	3.5	2.7	-

* Lodging Score (1 = no lodging to 5 = flat on the ground)

† Yield or moisture value required (≥LSD) to determine if varieties are significantly different from one another. Yield values statistically similar to the overall trial winner are shown in **boldface**.

‡ C.V. is a measure of variability or experimental error, 15% or less is acceptable.

2015 South Dakota Winter Wheat Variety Trial Results

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Jonathan Kleinjan | Crop Performance Testing Director, Brookings
Chris Graham | SDSU Extension Agronomist, Rapid City
Bruce Swan | Ag Research Manager, Rapid City
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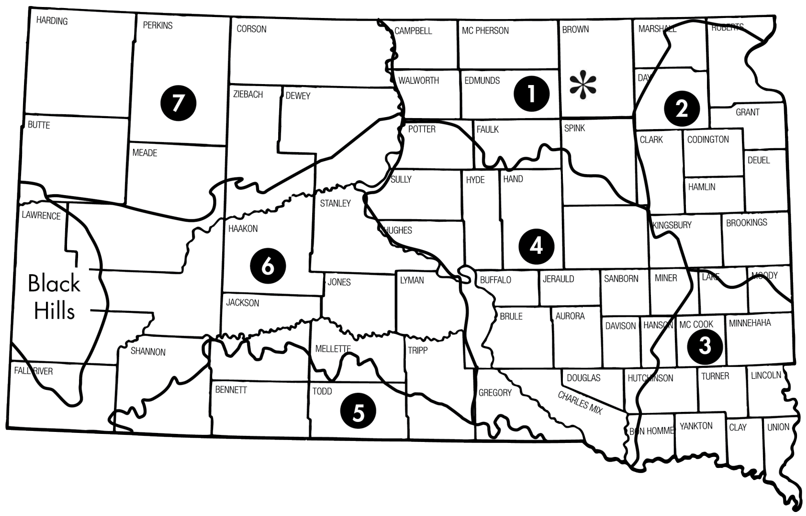
Steve Kalsbeck | Winter Wheat Breeding Project Research Associate, Brookings



Recommended Winter Wheat Varieties for Fall 2015 by Crop Zone†

Zone - 1[pc]	Zone - 2[pc]	Zone - 3	Zone - 4[pc]	Zone - 5	Zone - 6	Zone - 7[pc]
Ideal‡	Ideal‡	Ideal‡	Ideal‡	Ideal‡	Ideal‡	Ideal‡
Lyman	Lyman	Lyman	Lyman	Redfield	Lyman	Lyman
Redfield	Expedition	Redfield	Redfield	Freeman‡	Redfield	Redfield
Freeman‡	Freeman‡	Freeman‡	Freeman‡	Millenium‡	Freeman‡	Freeman‡
WB-Matlock‡	Overland	WB-Grainfield	WB-Grainfield	LCS Mint	LCS Mint	WB-Grainfield
Overland	SY Wolf‡	WB-Matlock‡	Millenium‡	Overland	SY Wolf‡	Millenium‡
SY Wolf‡		Overland	Overland	SY Wolf‡		LCS Mint
		SY Wolf‡	SY Wolf‡			Overland
						SY Wolf‡

Promising

Zone - 1[pc]	Zone - 2[pc]	Zone - 3	Zone - 4[pc]	Zone - 5	Zone - 6	Zone - 7[pc]
	WB-Matlock‡	Decade		Denali	Decade	
		Denali			Denali	

* Multi-year averages are not available for this zone, however it is suggested to select a variety that appears frequently in the recommended list across all zones for the state or neighboring zones.

† Crop Zones for small grains are base on soil & climate information.

[pc] plant in protective cover to improve winter survival in Crop Zones 1, 2, 4, & 7 and in other zones when planting varieties with (Fair) or lower winterhardiness ratings

‡ Variety is susceptible or moderately susceptible to Fusarium Head Blight (Scab).

SDSU Extension

2015 South Dakota Winter Wheat Variety Trial Results

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Table 1a. 2015 East River Winter Wheat Performance - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture).

Variety	Crop Zone - 1			Crop Zone - 2					
	Selby			Brookings			Brookings w/Fung.#		
	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein
Alice (White)	82	59.4	13.4	38	55.9	12.3	46	60.9	11.2
Antero (White)†	77	56.7	13.7	**44**	56.4	11.2	**60**	61.8	10.1
Brawl CL Plus	74	58.9	**14.7**	26	54.3	**13.3**	37	60.4	**12.4**
Byrd	64	56.8	13.5	32	55.1	11.5	46	60.4	10.7
LCS Compass†	79	**61.0**	14.4	38	58.1	12.0	49	**62.5**	11.5
Decade	65	54.4	**15.3**	39	55.2	11.3	50	60.5	11.0
Denali	71	57.3	12.8	41	55.8	11.0	**59**	**62.0**	9.7
AC Emerson†	80	**60.4**	**14.6**	**50**	**59.8**	11.6	47	61.7	11.7
Expedition	82	59.1	12.7	36	58.0	11.4	42	61.3	11.5
Freeman	**87**	56.7	13.4	**47**	57.0	10.6	48	59.9	10.5
WB-Grainfield	86	58.9	14.3	37	55.8	11.8	50	61.0	11.0
Ideal	83	59.2	13.2	43	57.6	11.3	51	61.4	10.3
LCH13NEDH-7-45†	**87**	58.0	14.1	42	54.9	10.8	**54**	60.8	10.5
Lyman	**89**	**61.5**	**14.5**	**47**	**59.9**	11.9	**53**	**62.4**	11.5
WB-Matlock	**89**	**60.9**	13.3	39	57.5	12.1	**59**	61.6	11.2
Millennium	86	**60.1**	13.9	40	58.5	11.1	50	61.2	10.4
LCS Mint	67	58.6	13.5	40	56.9	10.7	**53**	**62.9**	11.0
SY Monument†	77	56.3	13.8	38	53.9	12.1	**58**	59.9	10.4
NE10589†	75	57.0	13.4	38	55.0	11.6	52	60.9	10.8
Overland	**89**	**60.0**	13.4	**45**	58.4	11.1	**55**	61.4	10.2
Redfield	**87**	59.0	13.9	40	56.4	11.5	**57**	61.8	10.8
T158	78	57.9	13.9	29	54.1	11.9	45	60.7	11.3
WB4059CLP†	-	-	**-**	23	51.3	**13.6**	28	58.6	**13.0**
WB4614†	59	54.6	**15.2**	28	52.6	12.4	**56**	60.4	11.0
Wesley	75	56.3	**15.0**	40	55.7	12.4	47	59.2	12.0
SY Wolf	80	58.4	**14.5**	**47**	58.4	11.1	**53**	61.3	10.6
Trial Average	80	58.4	14.0	38	56.4	11.6	49	60.9	11.1
LSD(0.05)‡	9	1.6	0.8	7	0.9	0.7	8	1.0	0.9
TPG value§	86	59.9	14.5	43	59.0	12.9	52	61.9	12.1
CV(%)¶	8.1	2.0	4.2	12.7	1.2	4.3	11.6	1.2	5.4

Foliar fungicide applied at flowering.

† New entry in 2015, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § minimum value required to be in the top performance group (TPG) of varieties **(in boldface)**, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

2015 South Dakota
Winter Wheat Variety Trial Results

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Table 1b. 2015 East River Winter Wheat Performance, continued - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture).

Variety	Crop Zone - 3			Crop Zone - 4			Crop Zones 1,2,3, & 4			
	Beresford			Onida			East River Average*			
	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	TPG%	Test Wt.	Protein
Alice (White)	82	58.9	**13.0**	57	57.1	**13.3**	61	0	58.4	12.7
Antero (White)†	86	**60.1**	**12.5**	**70**	59.0	12.4	**67**	40	58.8	12.0
Brawl CL Plus	91	**60.9**	**13.0**	57	58.3	**13.4**	57	0	58.6	**13.3**
Byrd	89	**60.5**	12.0	56	57.4	11.8	57	0	58.0	11.9
LCS Compass†	**102**	**59.5**	11.5	50	**59.2**	12.8	64	20	60.1	12.4
Decade	88	**59.8**	**12.6**	55	54.7	12.9	59	0	57.0	12.6
Denali	**99**	59.4	12.1	55	57.7	12.3	65	20	58.5	11.6
AC Emerson†	88	59.2	**12.5**	63	57.9	**13.5**	**66**	20	59.8	12.8
Expedition	**99**	**61.2**	**12.2**	50	57.5	12.4	61	20	59.4	12.0
Freeman	90	59.2	12.1	58	55.3	12.6	**66**	40	57.7	11.9
WB-Grainfield	86	**61.3**	**12.8**	65	57.4	13.1	65	0	58.9	12.6
Ideal	91	58.8	**12.3**	55	55.8	12.4	64	0	58.5	11.9
LCH13NEDH-7-45†	87	58.0	**12.6**	**71**	56.7	12.7	**68**	60	57.7	12.1
Lyman	85	**60.4**	**12.4**	66	**60.0**	12.6	**68**	60	**60.8**	12.6
WB-Matlock	80	59.3	**12.8**	55	58.6	**13.6**	64	20	59.5	12.6
Millenium	88	59.2	11.9	61	58.8	12.5	65	0	59.4	12.0
LCS Mint	88	**60.9**	**12.3**	60	58.8	12.0	61	20	59.6	11.9
SY Monument†	92	**60.4**	12.1	66	55.1	13.0	**66**	20	57.1	12.2
NE10589†	89	**59.7**	**12.6**	62	57.5	12.7	62	0	58.3	12.3
Overland	82	**59.7**	**12.2**	64	58.4	12.2	**67**	60	59.5	11.8
Redfield	89	58.8	**12.4**	63	57.6	**13.5**	**67**	40	58.7	12.4
T158	**99**	**60.6**	11.5	57	57.8	12.4	62	20	58.2	12.2
WB4059CLP†	85	**59.8**	**12.7**	32	52.2	**13.7**	46	0	57.3	**13.3**
WB4614†	86	**60.0**	**12.6**	54	56.1	**13.9**	56	20	56.7	13.0
Wesley	86	**59.7**	11.8	47	53.6	**13.8**	59	0	56.9	13.0
SY Wolf	89	**60.2**	**12.5**	**69**	58.8	**13.6**	**68**	40	59.4	12.5
Trial Average	89	59.8	12.4	60	57.5	12.9	62	-	58.5	12.4
LSD(0.05)‡	9	1.8	0.8	6	1.0	0.6	4	-	0.6	0.4
TPG value§	93	59.5	12.2	67	59.0	13.3	66	-	60.2	12.9
CV(%)¶	8.8	2.7	5.6	6.9	1.2	3.3	9.6	-	1.7	4.5

† New entry in 2015, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § minimum value required to be in the top performance group (TPG) of varieties **(in boldface)**, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

* Locations at Pierre, Platte, and South Shore were abandoned due to winterkill.

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2015 South Dakota Winter Wheat Variety Trial Results

Table 2a. 2015 West River Winter Wheat Performance - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture).

Variety	Crop Zone - 5			Crop Zone - 6								
	Martin			Hayes			Kennebec			Sturgis		
	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein
Alice (White)	43	49.7	12.3	78	56.0	12.9	52	50.0	12.4	69	**58.6**	11.0
Antero (White)†	48	48.6	11.7	68	**57.9**	11.7	49	48.4	12.5	**85**	**57.9**	9.6
Brawl CL Plus	43	48.2	**13.0**	67	56.1	**13.2**	40	45.2	**13.2**	63	57.6	**11.6**
Byrd	46	52.0	11.0	69	56.3	12.0	39	45.3	12.3	68	**57.9**	9.7
LCS Compass†	51	**52.9**	12.0	70	57.1	12.7	40	47.8	12.7	60	57.6	**11.5**
Decade	37	46.0	12.0	**84**	**57.7**	12.9	40	41.8	**12.8**	71	55.5	10.6
Denali	**59**	**53.0**	11.5	81	57.1	12.4	44	47.3	12.2	75	57.6	9.6
AC Emerson†	45	50.2	12.3	66	54.5	**13.5**	54	**50.6**	**13.2**	69	56.2	**11.7**
Expedition	50	**53.6**	11.4	71	55.8	**13.1**	49	48.1	12.1	63	56.5	10.6
Freeman	**56**	**52.8**	10.9	78	55.0	12.5	50	45.8	12.3	80	**58.2**	10.2
WB-Grainfield	48	49.1	11.9	79	56.7	12.8	63	**52.6**	12.5	**82**	**58.9**	10.6
Ideal	51	51.2	11.5	78	56.8	12.8	43	45.0	12.7	72	56.4	10.0
LCH13NEDH-7-45†	44	48.5	11.6	**94**	56.6	12.0	61	49.1	12.2	76	**57.9**	10.0
Lyman	45	**54.0**	**12.9**	69	55.9	**13.1**	55	49.6	12.1	63	**58.4**	**11.7**
WB-Matlock	36	47.9	**12.5**	73	55.4	**13.0**	45	46.3	**12.8**	61	56.6	11.0
Millennium	47	**53.8**	11.3	72	**57.6**	12.8	57	50.2	11.7	68	**58.1**	**11.3**
LCS Mint	46	49.4	11.5	79	55.7	12.6	52	49.2	12.4	**87**	57.5	10.2
SY Monument†	45	47.7	12.0	**84**	56.5	**13.0**	58	**51.1**	**12.8**	**82**	57.1	10.7
NE10589†	50	50.7	11.5	**92**	55.9	12.0	63	**50.8**	11.9	73	**58.1**	10.9
Overland	47	52.2	11.6	73	**57.6**	12.7	54	49.2	11.8	72	**58.1**	10.6
Redfield	45	48.3	12.2	80	**57.5**	12.7	58	**50.5**	12.6	74	57.8	10.8
T158	44	49.9	12.3	73	55.9	12.5	46	49.2	12.7	70	57.7	**11.3**
WB4059CLP†	33	43.6	12.4	65	53.3	**13.6**	12	36.1	12.5	57	53.3	**11.7**
WB4614†	44	48.2	12.0	71	55.7	**13.3**	49	46.8	**13.5**	**86**	57.1	10.0
Wesley	43	51.3	12.5	74	54.6	12.8	44	44.5	12.3	68	55.8	**11.4**
SY Wolf	**56**	51.6	12.1	80	56.6	12.4	**75**	**50.8**	**13.0**	76	57.5	10.8
Trial Average	48	50.7	11.9	75	56.0	12.8	53	48.5	12.5	73	57.4	10.7
LSD(0.05)‡	6	2.1	0.5	11	1.6	0.6	11	2.7	0.7	6	1.5	0.5
TPG value§	55	52.5	12.5	83	56.3	13.0	67	50.3	12.8	80	57.9	11.2
CV(%)¶	11.8	4.3	3.1	13.7	2.9	3.9	14.7	4.0	4.1	6.2	1.9	3.6

† New entry in 2015, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § minimum value required to be in the top performance group (TPG) of varieties **(in boldface)**, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

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2015 South Dakota Winter Wheat Variety Trial Results

Table 2b. 2015 West River Winter Wheat Performance, continued - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture).

Variety	Crop Zone - 6								
	Wall			Winner			Winner w/Fung.#		
	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein	Yield	Test Wt.	Protein
Alice (White)	61	**58.6**	10.7	56	59.0	13.4	55	59.8	13.5
Antero (White)†	81	**58.5**	9.3	**79**	**61.8**	11.5	**83**	**62.6**	11.0
Brawl CL Plus	65	57.2	**11.7**	57	**60.9**	13.5	58	60.9	13.5
Byrd	74	**58.6**	9.8	60	**60.7**	12.2	**81**	**62.8**	11.0
LCS Compass†	62	**58.8**	10.6	52	**60.6**	13.1	59	61.7	12.7
Decade	76	55.9	10.1	53	58.2	13.2	63	58.5	12.9
Denali	**90**	**59.3**	9.6	52	57.8	12.1	64	60.2	12.1
AC Emerson†	67	55.3	**11.1**	35	55.5	**15.0**	39	57.7	**15.5**
Expedition	74	**59.3**	10.2	51	59.4	13.6	62	60.6	13.0
Freeman	66	56.5	10.1	62	57.9	12.6	70	59.9	11.8
WB-Grainfield	74	**59.2**	10.3	47	59.4	**14.5**	70	61.8	11.5
Ideal	77	55.5	9.5	64	**59.9**	12.7	70	60.9	12.2
LCH13NEDH-7-45†	72	57.1	9.7	65	**59.7**	13.4	74	61.4	12.0
Lyman	64	57.6	**11.3**	63	**61.3**	14.0	69	**62.5**	13.2
WB-Matlock	61	57.0	10.7	47	58.6	13.6	59	60.1	13.1
Millennium	63	57.8	10.5	64	**60.1**	13.3	62	60.9	12.9
LCS Mint	77	**58.6**	9.3	62	**61.2**	12.5	62	**62.4**	11.9
SY Monument†	**87**	56.8	10.3	67	59.5	13.3	63	60.2	11.8
NE10589†	63	**58.1**	10.1	63	**60.9**	12.2	71	61.0	11.7
Overland	68	**58.4**	10.4	60	59.7	13.1	70	60.6	12.5
Redfield	**83**	**58.9**	10.0	58	**60.2**	13.8	66	60.5	12.4
T158	67	56.2	10.5	60	**61.3**	12.3	65	61.1	12.0
WB4059CLP†	55	55.0	10.6	26	53.8	**14.1**	41	57.3	14.1
WB4614†	81	57.6	10.5	50	57.1	13.8	66	59.4	12.7
Wesley	66	**58.2**	10.2	49	56.4	**14.2**	53	57.6	13.8
SY Wolf	67	55.4	10.2	**71**	**61.1**	13.4	64	61.5	12.4
Trial Average	71	57.5	10.3	58	59.4	13.3	63	60.5	12.6
LSD(0.05)‡	7	1.4	0.8	9	2.1	1.0	6	0.8	0.6
TPG value§	83	57.9	10.9	70	59.7	14.0	76	62.0	14.9
CV(%)¶	10.4	2.5	5.2	9.7	2.2	4.7	6.0	0.7	3.1

Foliar fungicide applied at flowering.

† New entry in 2015, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § minimum value required to be in the top performance group (TPG) of varieties **(in boldface)**, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

2015 South Dakota Winter Wheat Variety Trial Results

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Table 2c. 2015 West River Winter Wheat Performance, continued - Yield (13% moisture), Test Weight (harvest moisture), and Protein (13% moisture).

Variety	Crop Zone - 7						Crop Zones - 5, 6 & 7			
	Bison			McLaughlin			West River Average			
	Yield	Test wt	Protein	Yield	Test wt	Protein	Yield	TPG%	Test Wt.	Protein
Alice (White)	44	52.6	12.7	37	49.9	**13.8**	55	0	54.9	12.5
Antero (White)†	51	53.5	11.1	41	47.7	12.8	**65**	33	55.0	11.2
Brawl CL Plus	**55**	**54.1**	12.5	31	46.3	**13.8**	53	11	54.2	**12.9**
Byrd	**59**	**54.7**	10.9	28	49.3	13.1	58	22	55.4	11.3
LCS Compass†	41	**54.3**	12.3	41	**54.3**	**13.9**	53	0	56.2	12.4
Decade	**52**	50.7	12.3	35	49.5	**13.7**	57	11	52.3	12.3
Denali	**62**	51.6	11.6	36	48.7	13.2	**63**	33	54.7	11.6
AC Emerson†	50	**54.5**	**13.8**	**53**	**57.3**	**13.5**	53	11	54.7	**13.3**
Expedition	49	53.0	11.7	36	46.8	**13.4**	56	0	54.9	12.1
Freeman	**55**	51.5	11.9	43	51.9	13.3	**62**	22	54.6	11.7
WB-Grainfield	**57**	**54.7**	11.8	46	**53.2**	**13.4**	**63**	22	56.1	12.1
Ideal	**54**	53.2	11.9	39	50.2	12.5	61	11	54.2	11.7
LCH13NEDH-7-45†	41	52.6	12.6	**52**	**53.4**	13.0	**64**	22	55.2	11.8
Lyman	49	**56.4**	12.7	48	**53.8**	**13.6**	58	0	**56.8**	12.7
WB-Matlock	28	51.3	**13.1**	42	**53.3**	**13.9**	50	0	54.1	12.7
Millennium	40	**54.7**	12.5	48	**57.0**	12.8	58	0	56.6	12.1
LCS Mint	49	52.2	12.5	41	51.1	13.1	**62**	11	55.3	11.8
SY Monument†	**54**	51.1	12.3	**49**	48.8	13.2	**65**	56	54.3	12.1
NE10589†	47	52.5	12.2	41	52.7	**13.8**	**63**	11	55.8	11.8
Overland	**53**	53.8	12.3	43	**53.1**	12.9	60	11	55.6	12.0
Redfield	50	52.2	12.4	38	50.8	**13.6**	61	11	54.9	12.3
T158	**59**	53.6	11.6	45	47.9	13.1	59	11	54.8	12.0
WB4059CLP†	39	46.0	**12.9**	28	45.7	**14.0**	40	0	49.3	**12.9**
WB4614†	46	51.0	12.5	30	47.2	**13.7**	58	11	53.3	12.4
Wesley	**61**	49.3	12.4	34	48.4	**13.6**	55	11	52.9	12.6
SY Wolf	**53**	50.0	12.6	**55**	51.2	13.1	**66**	56	55.1	12.2
Trial Average	49	53.0	12.3	42	51.0	13.4	59	-	54.6	12.2
LSD(0.05)‡	10	2.4	1.0	8	4.1	0.6	4	-	0.9	0.4
TPG value§	52	54.0	12.8	49	53.0	13.4	62	-	57.0	12.9
CV(%)¶	20.3	3.2	5.3	13.7	5.9	3.0	12.1	-	3.3	4.1

† New entry in 2015, not previously tested.

‡ Yield, test weight, or protein value required (≥LSD) to determine if varieties are statistically different than one another, § minimum value required to be in the top performance group (TPG) of varieties **(in boldface)**, ¶ Coefficient of Variation (C.V.) is a measure of the variability of the experimental error, 15% or less is acceptable.

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2015 South Dakota Winter Wheat Variety Trial Results

Table 3. 2013-2015 (2 and 3-year averages) East River Yield (bu/ac @ 13% moisture) Performance - sorted by overall 3-year yield.

Variety	Crop Zone - 2				Crop Zone - 3		Crop Zone - 4		Crop Zones 2 ,3, & 4	
	Brookings		Brookings w/Fung.#		Beresford		Onida	Pierre	East River Average	
	2 year	3 year	2 year	3 year	2 year	3 year	2 year	2 year*	2 year	3 year
SY Wolf	**57**	**60**	**62**	65	**76**	**72**	**86**	**66**	**72**	**69**
Lyman	**72**	**68**	**54**	61	60	**68**	**81**	65	**70**	**69**
Ideal	50	54	60	63	**79**	**73**	80	**71**	**71**	**68**
Overland	**52**	**57**	**62**	**66**	**72**	**69**	76	63	**69**	**67**
Freeman	**56**	**57**	60	64	**76**	**68**	77	63	**70**	**66**
WB-Matlock	47	52	**66**	**70**	**73**	65	71	65	**68**	**66**
Redfield	47	52	59	64	**74**	67	80	62	**69**	**65**
WB-Grainfield	50	54	57	61	**72**	65	80	63	**68**	65
Millennium	45	50	56	61	71	67	75	64	66	64
Expedition	43	49	50	58	**74**	**69**	68	53	63	60
LCS Mint	51	50	59	60	68	61	77	58	66	60
Alice (White)	42	50	54	60	61	57	69	58	62	60
Wesley	50	51	54	56	68	63	70	57	65	59
T158	39	42	51	57	67	63	72	60	62	58
Denali	45	-	59	-	**76**	-	71	-	**67**	-
Decade	**73**	-	47	-	52	-	76	-	65	
Byrd	69	-	41	-	51	-	70	-	63	-
Brawl CL Plus	35	-	44	-	69	-	64	-	59	-
AC Emerson†	-	-	-	-	-	-	-	-	-	-
Antero (White)†	-	-	-	-	-	-	-	-	-	-
LCH13NEDH-7-45†	-	-	-	-	-	-	-	-	-	-
LCS Compass†	-	-	-	-	-	-	-	-	-	-
NE10589†	-	-	-	-	-	-	-	-	-	-
SY Monument†	-	-	-	-	-	-	-	-	-	-
WB4059CLP†	-	-	-	-	-	-	-	-	-	-
WB4614†	-	-	-	-	-	-	-	-	-	-
Trial Average	46	53	55	62	70	65	74	59	65	63
LSD(0.05)‡	5	4	5	4	7	5	5	5	5	4
TPG value§	52	57	61	66	72	68	81	66	67	65

Foliar fungicide applied at flowering.

* Pierre 2-year data is from 2013 and 2014.

† New entry in 2015, not previously tested.

‡ Yield value required (≥LSD) to determine if varieties are statistically different than one another, § minimum value required to be in the top performance group (TPG) of varieties **(in boldface)**.

2015 South Dakota Winter Wheat Variety Trial Results

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Table 4a. 2013-2015 (2 and 3-year averages) West River Yield (bu/ac @ 13% moisture) Performance - sorted by overall 3-year yield.

Variety	Crop Zone - 5		Crop Zone - 6						Crop Zones 5, 6, & 7	
	Martin		Kennebec	Hayes	Sturgis		Wall		West River Average	
	2 year	3 year	2 year	2 year*	2 year	3 year	2 year	3 year	2 year	3 year
SY Wolf	**51**	**50**	**84**	**62**	**65**	**60**	60	**63**	**66**	**61**
Ideal	**52**	**48**	74	58	64	**63**	**71**	**66**	**65**	**60**
Lyman	47	45	72	55	57	58	60	61	**61**	**58**
LCS Mint	**51**	**50**	71	**60**	**71**	**66**	63	61	**62**	**57**
Freeman	**55**	**49**	72	**61**	64	59	61	61	**62**	**57**
Overland	**52**	**49**	73	55	59	59	56	57	**61**	**57**
Redfield	**51**	**48**	72	**59**	61	59	**69**	**67**	**62**	**57**
Millennium	**53**	**50**	74	56	58	55	57	59	**60**	**57**
WB-Grainfield	45	43	73	**61**	64	59	62	**63**	**60**	56
Wesley	47	46	67	56	57	54	58	57	58	54
T158	42	44	65	56	58	55	53	56	56	52
Expedition	46	45	68	55	56	52	57	57	56	52
Alice (White)	43	43	66	57	56	53	52	55	55	51
WB-Matlock	43	41	68	54	56	51	54	53	55	50
Denali	**56**	-	70	-	**66**	-	**72**	-	**63**	-
Decade	45	-	69	-	61	-	**70**	-	**62**	-
Byrd	44	-	65	-	58	-	59	-	57	-
Brawl CL Plus	39	-	53	-	55	-	54	-	51	-
AC Emerson†	-	-	-	-	-	-	-	-	-	-
Antero (White)†	-	-	-	-	-	-	-	-	-	-
LCH13NEDH-7-45†	-	-	-	-	-	-	-	-	-	-
LCS Compass†	-	-	-	-	-	-	-	-	-	-
NE10589†	-	-	-	-	-	-	-	-	-	-
SY Monument†	-	-	-	-	-	-	-	-	-	-
WB4059CLP†	-	-	-	-	-	-	-	-	-	-
WB4614†	-	-	-	-	-	-	-	-	-	-
Trial Average	48	46	71	57	61	58	61	60	58	56
LSD(0.05)‡	7	3	8	6	6	6	6	5	7	4
TPG value§	49	47	76	59	65	60	66	62	59	57

* Hayes 2-year data is from 2013 and 2015.

† New entry in 2015, not previously tested.

‡ Yield value required (≥LSD) to determine if varieties are statistically different than one another, § minimum value required to be in the top performance group (TPG) of varieties **(in boldface)**.

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2015 South Dakota Winter Wheat Variety Trial Results

Table 4b. 2013-2015 (2 and 3-year averages) West River Yield (bu/ac @ 13% moisture) Performance, continued - sorted by overall 3 year yield.

Variety	Crop Zone - 6				Crop Zone - 7				Crop Zones 5, 6, & 7	
	Winner		Winner w/Fung.#		Bison		McLaughlin		West River Average	
	2 year	3 year	2 year	3 year	2 year	3 year	2 year	3 year	2 year	3 year
SY Wolf	**75**	**69**	**71**	**66**	**48**	**51**	**56**	**52**	**66**	**61**
Ideal	**71**	**66**	**73**	**67**	**46**	**49**	**50**	**49**	**65**	**60**
Lyman	68	**67**	**70**	**67**	**45**	**49**	**52**	**50**	**61**	**58**
LCS Mint	69	62	**68**	60	42	**47**	42	43	**62**	**57**
Freeman	68	63	**69**	**64**	**45**	**47**	45	43	**62**	**57**
Overland	68	64	**69**	**66**	**45**	**49**	48	46	**61**	**57**
Redfield	64	60	**68**	61	42	**46**	44	45	**62**	**57**
Millennium	66	63	64	**63**	38	44	**50**	**48**	**60**	**57**
WB-Grainfield	63	58	67	**63**	42	**47**	44	42	**60**	56
Wesley	61	58	64	60	**48**	**49**	38	40	58	54
T158	61	55	62	58	44	**47**	44	41	56	52
Expedition	60	57	62	58	41	43	41	39	56	52
Alice (White)	59	54	56	52	37	41	45	41	55	51
WB-Matlock	56	54	61	58	32	37	48	43	55	50
Denali	61	-	66	-	**50**	-	40	-	**63**	-
Decade	66	-	**69**	-	**45**	-	41	-	**62**	-
Byrd	63	-	**72**	-	44	-	33	-	57	-
Brawl CL Plus	58	-	56	-	43	-	33	-	51	-
AC Emerson†	-	-	-	-	-	-	-	-	-	-
Antero (White)†	-	-	-	-	-	-	-	-	-	-
LCH13NEDH-7-45†	-	-	-	-	-	-	-	-	-	-
LCS Compass†	-	-	-	-	-	-	-	-	-	-
NE10589†	-	-	-	-	-	-	-	-	-	-
SY Monument†	-	-	-	-	-	-	-	-	-	-
WB4059CLP†	-	-	-	-	-	-	-	-	-	-
WB4614†	-	-	-	-	-	-	-	-	-	-
Trial Average	66	62	66	62	42	45	45	45	58	56
LSD(0.05)‡	5	4	5	4	5	6	6	4	7	4
TPG value§	70	65	68	63	45	45	50	48	59	57

Foliar fungicide applied at flowering.

† New entry in 2015, not previously tested.

‡ Yield value required (≥LSD) to determine if varieties are statistically different than one another, § minimum value required to be in the top performance group (TPG) of varieties **(in boldface)**.

2015 South Dakota Winter Wheat Variety Trial Results

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Table 5. List of winter wheat varieties being tested in 2015 along with origin, agronomic, and grain quality characteristics.

Variety	Testing and Origin		Agronomic Characteristics				Grain Quality		
	Years Tested in SD Trials	Origin†-Year	Rel.‡ Hdg days	Rel.‡ Hght inches	Lodging Res.§	Winter Hardi-ness§	2015 Test Wt.	2015 Protein %	Baking Quality#
Alice (White)	5+	SD-06	0	-2	G	G	Good	Good	E
Antero (White)	new	PG-12	0	2	F-G	G	Good	Low	*(G)¶*
Brawl CL Plus	2	PG-11	0	-1	G	F	Adequate	High	*(E)*
Byrd	2	PG-11	1	-1	P	*(G)*	Good	Low	*(E)*
LCS Compass	new	LCS-15	-1	1	F	G	High	Good	*(E)*
Decade	2	MT/ND-10	2	1	G	G	Low	Good	*(A)*
Denali	2	PG-11	2	-3	G	G	Good	Low	*(A)*
AC Emerson	new	MS-15	4	-1	G	G	Adequate	High	*(G)*
Expedition	5+	SD-02	0	0	F-G	G	Good	Adequate	G
Freeman	3	NE-13	2	-2	F	F	Adequate	Low	A-G
WB-Grainfield	3	WB-12	1	2	F	F	Good	Good	G
Ideal	5+	SD-11	4	1	F-G	G-E	Adequate	Low	A
LCH13NEDH-7-45	new	LCS-exp	1	0	F-G	G-E	Adequate	Adequate	-
Lyman	5+	SD-08	1	0	F-G	G-E	High	Good	A
WB-Matlock	5+	WB-10	2	1	F-G	G	Adequate	Good	G
Millennium	5+	NE-00	1	2	F-G	G	Good	Adequate	A
LCS Mint	3	LCS-12	1	0	F	G	Good	Low	*(G)*
SY-Monument†	new	AP-14	1	2	F-G	G-E	Adequate	Adequate	*(G)*
NE10589†	new	NE-exp	1	3	G	G	Good	Adequate	*(G)*
Overland	5+	NE-06	3	2	F-G	G-E	Good	Adequate	F
Redfield	5+	SD-13	3	-3	G	G	Good	Good	G
T158	3	LCS-09	1	-3	G	G	Adequate	Adequate	G
WB4059CLP	new	WB-13	1	-2	G	G	Low	High	*(G)*
WB4614	new	WB-14	4	4	F	G	Low	Good	-
Wesley no PVP	5+	NE-99	2	-1	G	G	Low	Good	G
SY-Wolf	5+	AP-11	0	1	G	G	Good	Good	A

† AP, AgriPro; LCS, Limagrain Cereal Seeds; MS, Meridian Seeds; MT, Montana; NE, Nebraska; ND, North Dakota; PG, PlainsGold; SD, South Dakota; WB, WestBred; and – (Year of Release).

‡ Difference in days to heading compared to **Expedition** (2015 maturity notes from the Brookings location). Height compared to Expedition (33 inches) at the Beresford location.

§ Lodging resistance and winter hardiness: E, excellent; G, good; F, fair; P, poor.

Baking Quality: E, excellent; G, good; A, acceptable; F, fair.

¶ Estimated ratings *(X)*, based on information provided by entity that submitted the variety.

2015 South Dakota Winter Wheat Variety Trial Results

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Table 6. Winter wheat variety disease ratings.

Variety	Disease Ratings‡					
	2015 Stripe Rust	Stem Rust	2015 Leaf Rust	2015 Leaf Spot	WSMV	FHB
Alice (White)	MS	MR	MS	MS-S	MS	S
Antero (White)†	*(R)¶*	*(MR)*	*(S)*	MS-S	*(MS)*	-
Brawl CL Plus	*(MS)*	*(R)*	*(R)*	S	*(MS)*	-
Byrd	MR	*(MS)*	*(MS)*	S	*(MS)*	-
LCS Compass†	MR MS	*(R)*	MS-MR	S	*(S)*	*(R)*
Decade	MS	*(R)*	MR	*(MR)*	-	-
Denali	S	*(MS)*	MS-S	S	*(MS)*	-
AC Emerson†	*(R)*	*(R)*	MS	S	-	*(R)*
Expedition	MS	R	MS-S	MS-S	S	MR
Freeman	MR	MR	MS-S	S	S	MS
WB-Grainfield	MR	MR	MR	S	MR	MR
Ideal	S	MR	MR-MS	S	S	MS
LCH13NEDH-7-45†	MR	-	MR	MS	*(S)*	-
Lyman	MR	R	MR ?	S	S	MR
WB-Matlock	MS	*(MR)*	MS	MS-S	*(S)*	*(S)*
Millennium	MR	MR	MR-MS	MS-S	S	S
LCS Mint	MR	MS	MS-S	S	MR	-
SY-Monument†	MR	*(R)*	MR	S	*(R)*	-
NE10589†	MR	*(MR)*	MS-S	S	-	-
Overland	MR	MR	MR	S	MS	MR
Redfield	MR	MR	MS-MR	MS-S	S	MR
T158	MR	MS	MR	S	MS	S
WB4059CLP†	S	-	S	MR-MS	-	*(S)*
WB4614†	MR	-	MS	MS-S	*(S)*	-
Wesley[no PVP]	MR	R	MS	S	S	S
SY-Wolf	MR MS	MR	MR	MS	MR	S

† new entry in 2015

‡ Disease ratings: R, resistant; MR, moderately resistant; MS, moderately susceptible; S, susceptible.

¶ Estimated rankings based on information provided by the entity that submitted the variety.

2015 South Dakota Oat Variety Trial Results

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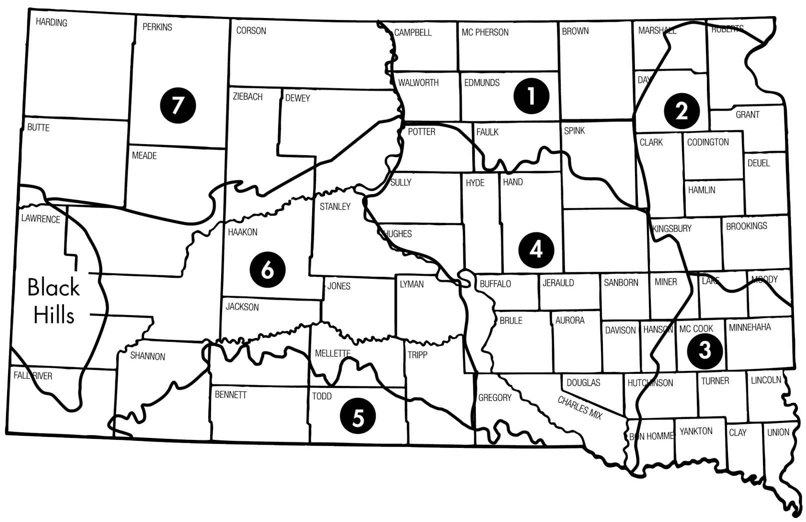
Jonathan Kleinjan | Crop Performance Testing Director, Brookings
Chris Graham | SDSU Extension Agronomist, Rapid City
Bruce Swan | Ag Research Manager, Rapid City
Kevin Kirby | Ag Research Manager, Brookings
Shawn Hawks | Ag Research Manager, Brookings

Crop Zones for Small Grains in South Dakota



Recommended/Promising Oat Varieties for Spring 2015 by Crop Zone†

Zone - 1	Zone - 2	Zone - 3	Zone - 4	Zone - 5	Zone - 6	Zone - 7
Deon	Deon	Deon	Hayden	Not Evaluated‡	Hayden	Goliath
Hayden	Goliath	Hayden	Horsepower		Jury	Hayden
Horsepower	Horsepower	Jury	Natty		Shelby427	Jury
Newburg	Natty	Newburg	Newburg		Souris	Newburg
Souris	Stallion	Souris	Rockford		Stallion	Rockford
						Souris

† Crop Zones for small grains are base on soil & climate information
‡ Varieties are not evaluated in this zone, however it is suggested to select a variety that appears frequently in the recommended list across all zones for the state or neighboring zones.

SDSU Extension

Trial Highlights

Oat variety selection is a significant and important management decision for producers. During the 2015 crop year in eastern SD, the difference between the high and low yielding oat varieties was 52 bu/acre (Table 1a). Assuming an average cash price of $2.00, the difference in revenue per acre attributed to variety selection could be as much as $104/acre.

The 2015 average yield statewide in oat variety trials was 10 bu/ac higher than in 2014, at 106 bu/ac (Tables 1a, 1b, & 2). Lowest and highest yielding locations were at Bison (77 bu/ac) and Selby (141 bu/ac), respectively. South Dakota generally experienced a dry early spring until mid-May, followed by fairly normal precipitation and temperatures for the remainder of the growing season. Due to weather variation from season to season, producers need to select complementary varieties with a range of maturities each year. To maximize the utility of the crop performance testing trials, we encourage producers to identify varieties with a proven record of performance of over a 3-yr period (Tables 3 & 4) and, more specifically, those recommended varieties on page 1. Experimental lines are tested and occasionally later released as varieties (Table 4), i.e **Hayden** (2014 release). Also, producers should utilize the oat variety characteristics or qualities in Table 4 to select for factors that provide good protection against yield-limiting factors in their production system, i.e. lodging, test weight, or diseases.

Practices and Methods

East River: Four replications of each variety are planted at each location. Locations are seeded at 28 pure live seeds (PLS)/ft^2 or about 1.2 million seeds/ac by a drill with 7.5-inch row spacing. Plots are 5-ft wide and 13-ft long at harvest. Plots were fertilized appropriately to achieve a 150 bu/ac yield goal. The previous crop at South Shore was spring wheat and all other locations were soybeans. No-till planting was performed at the Aberdeen and Miller locations while conventional-tillage was used at the Beresford, Brookings, Selby, and South Shore locations. The Miller location was lost to hail just prior to harvest. The planting dates for Aberdeen, Beresford, Volga, Miller, Selby, and South Shore were Apr. 1, Mar. 31, Apr. 13, Mar. 23, May 1, and Apr. 10, respectively.

West River: In 2015, the oats testing location at Wall was moved to Winner and the Okaton location was moved to Draper. Four replications of each variety are planted at each location. Locations are no-till seeded at 28 pure live seeds (PLS)/ft^2 or about 1.2 million seeds/ac by a drill with 10-inch row spacing. Plots are 5-ft wide and 25-ft long at harvest. Plots at Winner are planted in a similar manner to the East River locations. Plots were fertilized appropriately to achieve a 90 bu/ac yield goal. The previous crops at Bison, Draper, and Winner were winter wheat, winter wheat, and forage sorghum, respectively. The planting dates for Bison, Draper, and Winner were Apr. 15, Apr.1, and Mar. 30, respectively.

Acknowledgments

The efforts of the following SDSU staff are gratefully appreciated: Oat Breeding Project – M. Caffe-Treml and N. Hall, Foundation Seed Stocks – J. Ingemansen, Brookings Agronomy Farm – D. Doyle, Southeast Research Farm (Beresford) – P. Sexton and staff, and the Northeast Research Farm (South Shore) – A. Heuer. The cooperation and resources of these cooperators are appreciated: G. & R. Locken (Aberdeen), D. Shea (Bison), B. Jorgenson (Winner), P. Patterson (Draper), P. Fulton (Miller), and T. Fieldler (Selby).

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2015 South Dakota Oat Variety Trial Results

Table 1a. 2015 East River Oat Perfomance - Average yield (14% moisture) and test weight, sorted by overall average yield.

Variety	Crop Zone 1				Crop Zone 3		Crop Zones 1, 2, & 3¶		
	Aberdeen		Selby#		Beresford		East River Average		
	Yield	Test Wt.	Yield	Test Wt.	Yield	Test Wt.	Yield	Top 1/3 %	Test Wt.
Deon	156	33.8	165	36.4	185	35.2	168	100	35.0
Stallion	147	34.9	163	36.6	174	37.0	151	100	34.8
Hayden	147	34.7	168	38.6	171	34.8	150	83	35.2
Natty	135	35.5	142	37.0	168	34.7	149	67	35.7
Goliath	147	35.1	171	38.0	157	33.1	145	67	34.1
Newburg	147	33.4	163	34.6	151	30.4	139	33	31.9
GMI 423	150	32.9	116	32.1	153	25.0	131	33	29.0
Shelby427	135	34.3	120	37.2	151	36.6	131	17	36.0
Jury	145	33.7	153	36.9	145	31.7	129	0	32.8
Colt	118	33.5	162	38.0	142	35.5	129	0	35.1
Jerry	117	33.9	158	37.0	135	34.9	128	0	34.2
Souris	134	34.3	173	36.9	110	28.4	122	17	31.5
Horsepower	150	33.3	144	37.1	108	28.8	121	17	30.8
Rockford	142	35.0	142	37.5	119	30.1	116	0	32.4
*Buff**	83	37.9	90	43.9	123	39.9	95	0	40.9
*Streaker**	106	42.7	90	44.8	90	41.7	89	0	42.5
Trial Average	135	34.7	141	37.5	142	33.6	131	-	34.4
LSD(0.05)†	12	1.4	13	1.0	21	2.0	18	-	1.8
C.V.§	5.4	2.4	6.6	1.9	10.7	4.0	7.4	-	2.8

fungicide applied to protect the flag leaf.

¶ The Miller location was destroyed by hail. There was no test in Crop Zone 4 in 2015.

‡ Shading denotes varieties placing in the top 1/3 for yield at each location (Note: results for some experimental lines tested are not included in this publication).

† Yield or test weight value required to determine if varieties are significantly different from one another with 95% confidence.

§ C.V. (Coefficient of Variation) is a measure of variability or experimental error, >15% is acceptable.

* Hulless varieties

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2015 South Dakota Oat Variety Trial Results

Table 1b. 2015 East River Oat Perfomance, continued - Average yield (14% moisture) and test weight, sorted by overall average yield.

Variety	Crop Zone 2						Crop Zones 1, 2, & 3¶		
	South Shore		Volga		Volga w/fung.#		East River Average		
	Yield	Test Wt.	Yield	Test Wt.	Yield	Test Wt.	Yield	Top 1/3 %	Test Wt.
Deon	166‡	35.2	166	34.5	169	34.8	168	100	35.0
Stallion	142	35.3	124	32.1	154	33.0	151	100	34.8
Hayden	137	35.7	117	32.8	160	34.7	150	83	35.2
Natty	141	36.9	135	34.3	174	35.5	149	67	35.7
Goliath	124	34.2	124	31.0	150	33.0	145	67	34.1
Newburg	112	32.5	102	28.8	157	31.8	139	33	31.9
GMI 423	123	28.5	104	26.7	142	28.8	131	33	29.0
Shelby427	133	36.5	106	35.6	142	35.7	131	17	36.0
Jury	111	33.3	91	28.8	132	32.2	129	0	32.8
Colt	117	35.3	95	33.0	138	35.0	129	0	35.1
Jerry	119	34.8	91	31.0	150	33.5	128	0	34.2
Souris	87	29.3	81	27.1	147	32.9	122	17	31.5
Horsepower	100	28.3	89	26.3	139	31.4	121	17	30.8
Rockford	88	30.2	82	28.0	124	33.5	116	0	32.4
*Buff**	83	39.9	78	40.2	114	43.7	95	0	40.9
*Streaker**	75	41.2	75	42.1	99	42.5	89	0	42.5
Trial Average	118	34.1	106	32.0	144	34.4	131	-	34.4
LSD(0.05)†	11	1.2	9	1.3	12	1.2	18	-	1.8
C.V.§	6.8	2.5	6.0	2.8	6.1	2.5	7.4	-	2.8

fungicide applied to protect the flag leaf.

¶ The Miller location was destroyed by hail. There was no test in Crop Zone 4 in 2015.

‡ Shading denotes varieties placing in the top 1/3 for yield at each location (Note: results for some experimental lines tested are not included in this publication).

† Yield or test weight value required to determine if varieties are significantly different from one another with 95% confidence.

§ C.V. (Coefficient of Variation) is a measure of variability or experimental error, >15% is acceptable.

* Hulless varieties

Table 2. 2015 West River Oat Perfomance - Average yield (14% moisture) and test weight, sorted by overall average yield.							
Variety	Crop Zone 6		Crop Zone - 7		Crop Zones 6 & 7¶		
	Winner		Bison		West River Average		
	Yield	Test Wt.	Yield	Test Wt.	Yield	Top 1/3 %	Test Wt.
GMI 423	100‡	34.4	94	32.9	97	100	33.6
Hayden	91	39.5	97	37.3	94	100	38.4
Rockford	91	39.3	93	37.5	92	100	38.4
Jury	98	38.8	84	36.3	91	50	37.5
Horsepower	82	38.9	95	36.8	88	50	37.8
Souris	90	38.3	86	35.4	88	50	36.9
Deon	86	38.2	87	36.1	87	0	37.1
Newburg	69	37.2	96	35.7	82	50	36.5
Goliath	75	39.8	89	37.3	82	0	38.5
Jerry	77	39.2	76	35.3	77	0	37.3
Shelby427	89	39.3	58	35.6	73	0	37.5
Stallion	77	39.5	68	35.7	73	0	37.6
Colt	84	39.6	61	36.0	72	0	37.8
Natty	78	39.7	61	36.0	69	0	37.8
*Buff**	75	43.9	38	37.8	57	0	40.9
*Streaker**	68	45.2	33	41.2	51	0	43.2
Trial Average	84	39.3	77	36.4	81	-	37.9
LSD(0.05)†	18	0.9	23	1.4	14	-	0.8
C.V.§	14.9	1.7	18.2	2.8	16.3	-	2.2

¶ The Draper location was destroyed by hail.

‡ Shading denotes varieties placing in the top 1/3 for yield at each location (Note: results for some experimental lines tested are not included in this publication).

† Yield or test weight value required to determine if varieties are significantly different from one another with 95% confidence.

§ C.V. (Coefficient of Variation) is a measure of variability or experimental error, >15% is acceptable.

* Hulless varieties

2015 South Dakota Oat Variety Trial Results

Table 3. 2013-2015 (3-Yr Average) East River Oat Variety Performance - sorted by overall yield (bu/ac @ 14% M).							
	East River (Crop Zones 1-4)						
	Crop Zone-1		Crop Zone-2		Crop Zone-3	Crop Zone-4	3-Yr East River Averaage
Variety	Aberdeen	Selby	South Shore	Volga	Beresford	Miller§	
Deon	160‡	161	148	157	117	140	146
Hayden	148	167	144	119	125	153	143
Natty	139	149	142	125	116	144	137
Newburg	151	167	116	107	117	150	133
Stallion	151	145	123	127	121	143	133
Goliath	150	149	122	126	113	135	131
Jury	151	154	123	108	117	137	129
Horsepower	150	158	132	94	97	147	128
Souris	133	169	114	90	95	141	125
Shelby427	139	130	125	98	105	125	120
Rockford	141	152	107	85	98	145	119
Colt	120	142	110	98	107	117	116
Jerry	119	140	106	83	96	127	113
*Buff**	93	97	99	76	82	100	92
*Streaker**	110	109	82	71	77	99	90
Trial Average	137	146	120	104	106	135	123
LSD(0.05)†	12	7	8	6	9	9	16

§ Miller data is a 2 year average from 2013-2014.

‡ Shading denotes varieties placing in the top 1/3 for yield at each location.

† Yield or test weight value required to determine if varieties are significantly different from one another with 95% confidence.

* Hulless varieties.

Table 4. 2013-2015 (3-Yr Average) West River Oat Variety Performance - sorted by overall yield (bu/ac @ 14% M).

Variety	West River (Crop Zones 6 & 7)			
	Crop Zone-6		Crop Zone-7	3-Yr West River Average
	Wall	Okaton§	Bison§	
Jury	104‡	76	89	92
Hayden	101	81	87	90
Souris	104	81	84	90
Rockford	97	74	83	86
Newburg	97	79	83	85
Deon	96	77	79	84
Stallion	107	76	73	84
Goliath	90	80	83	83
Horsepower	95	73	79	82
Natty	96	72	75	80
Shelby427	101	72	62	79
Jerry	91	74	70	78
Colt	85	71	74	77
*Streaker**	92	59	51	65
*Buff**	79	59	44	62
Trial Average	97	74	74	81
LSD(0.05)†	15	8	16	10

§ Bison and Okaton data are 2 year averages from 2013-2014.

‡ Shading denotes varieties placing in the top 1/3 for yield at each location.

† Yield value required to determine if varieties are significantly different from one another with 95% confidence.

* Hulless varieties.

Table 5. Oat variety origin, characteristics, grain quality, and disease ratings.

	Testing and Origin		Agronomic Characteristics			Grain Quality¶			Disease Ratings#			
Variety[PVP*]	Years Tested in SD	Origin†-Year	Rel.‡ Hdg. *days*	Rel.‡ Height *inches*	2015 Lodging Score §	Grain Color	Test Wt.	2015 Protein	Smut	Stem Rust	Crown Rust	BYDV or Red Leaf
Colt[PVP]	5+	SD-05	**0**	**0**	3.8	White	Good	13.6	R	MS	S	MS
Deon[Pdg]	5+	MN-13	9	6	3.3	Yellow	Good	14.0	R	MR	R	MR
GMI 423	1	GM-15	10	6	3.9	White	Low	12.8	*(R)††*	*(MS)*	*(MS)*	*(MR)*
Goliath[Pdg]	5+	SD-12	9	11	4.2	White	Good	13.4	R	R	MS	MR
Hayden[Pdg]	3	SD-14	7	6	4.0	White	Good	12.8	R	MS	MS	R
Horsepower[Pdg]	5+	SD-11	4	0	4.0	White	Low	12.3	MR	R	S	MR
Jerry[PVP]	5+	ND-94	4	5	4.0	White	Good	13.8	MS	MS	S	MS
Jury[Pdg]	4	ND-12	8	9	4.1	White	Adequate	12.7	-	R	S	*(MR)*
Natty[Pdg]	3	SD-14	2	8	3.9	White	Good	13.9	R	MS	MS	MR
Newburg[PVP]	5+	ND-11	6	9	4.0	White	Adequate	12.6	S	R	S	MR
Rockford[PVP]	5+	ND-09	9	6	3.8	White	Adequate	13.2	MR-MS	S	S	MR
Shelby427[PVP]	5+	SD-09	2	3	3.9	White	Good	13.2	MR	MS	S	S
Souris[PVP]	5+	ND-06	8	4	4.0	White	Low	12.8	MR	MS	S	MS
Stallion[PVP]	5+	SD-06	7	8	4.1	White	Good	14.3	S	S	MR	MR
Buff	5+	SD-02	4	2	3.3	Hulless	Very High	14.2	R	S	MS	MR
Streaker[PVP]	5+	SD-09	3	4	4.4	Hulless	Very High	15.8	R	MR	MS	R

* Plant variety protection (PVP) status or PVP status that is pending (Pdg).

† GM - General Mills, MN - Minnesota, ND - North Dakota, SD - South Dakota; - (Year of Release)

‡ Days to heading as compared to **Colt**. Height compared to **Colt (37 inches)** at 2014 East River locations.

§ Lodging score: Rating scale 1-5 (1=Standing perfectly to 5=Completely flat) based on 2015 East River locations.

¶ Based on 2015 East River test weight and protein.

Disease ratings: R - resistant, MR - moderately resistant, MS - moderately susceptible, S - susceptible, VS - very susceptible

†† Ratings *(X)* based on information supplied by the entity submitting the variety.

SOUTHEAST RESEARCH FARM ANNUAL REPORT
South Dakota State University
2015 Progress Report
Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

WEED CONTROL DEMONSTRATIONS and EVALUATION TESTS for 2015

Southeast South Dakota Research Station

Paul O. Johnson*, Ext. Weed Science Coordinator;
David Vos, SDSU Ag Research Manager,
and Jill Alms, SDSU Ag Research Manager

INTRODUCTION:

Experiment stations have an important role in the WEED (Weed Evaluation and Extension Demonstration) Project. Plots provide weed control data for the area served by the Southeast South Dakota Research Station. The station is the major site for corn and soybean weed control studies. Tests at the station focus on common waterhemp, velvetleaf, common lambsquarters, common cocklebur, and foxtail.

2015 TESTS:

Several studies were established to evaluate new weed control technologies. The demonstration plots centered around programs that would answer questions on the glyphosate resistance issue around the state, especially as it relates to soybean and corn waterhemp management. A dry spring followed by timely rains resulted in several weed flushes until the crops canopied.

NOTE:

Data reported in this publication are results from field tests that include product uses, experimental products or experimental rates, combinations or other unlabeled uses for herbicide products. Trade names of products used are listed; there frequently are other brand products available in the market. Users are responsible for applying herbicide according to label directions. Refer to the appropriate weed control fact sheet available from regional extension offices or iGrow.org for herbicide recommendations.

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Studies listed below are summarized in the following tables. Information for each study is included as part of the summary.

1. Corn Herbicide Demonstration
2. Preemergence Herbicides in Corn
3. Post Broadleaf Options in Corn
4. Early Postemergence Weed Control Programs in Corn
5. DiFlexx & Laudis Combinations for Weed Control in Corn
6. Preemergence Weed Control Comparisons in Corn
7. Solstice Tank-Mixes in Corn
8. Anthem Tank-Mix Comparisons in Corn
9. Impact Programs
10. Callisto Additives in Corn
11. Soybean Herbicide Demonstration
12. Liberty Link Soybean Demonstration
13. Cheetah Max Efficacy in LL Soybeans
14. Broadaxe XC Comparisons in Soybeans
15. Panther Combinations for Weed Control in Soybeans
16. Enlist Soybean Programs
17. Soybean Programs with Authority Products
18. AMS Water Conditioners with Glyphosate
19. Foxtail Barley Control in Spring Wheat
20. Huskie for Broadleaf Weed Control in Sorghum

ACKNOWLEDGEMENTS:

We greatly appreciate the cooperation and assistance provided by the station personnel.

Due to the distance from the SDSU campus, assistance with field preparation and daily oversight of the fields is critical to the success of the weed control research. Field equipment and management of the plot areas are important contributions to the project. Regional Extension field specialists and program technicians provide assistance with tours and utilize the data in direct producer programs, publications and news releases. In addition to the Southeast Farm Report, research results will be published in the annual Weed Control Field Test Data Book, SDSU Pest Management Guides and Weed Control Fact Sheets updated annually for major South Dakota commodities, and on the internet at www.iGrow.org.

Program input and partial support for field programs is also acknowledged.

South Dakota Soybean Research and Promotion Council

South Dakota Oilseed Initiative

South Dakota Wheat Commission

Crop Protection Industries

2015
CORN HERBICIDE DEMONSTRATION
Southeast Research Farm

Treatment	Rate/A	Vele 5/28/15		Vele 6/9/15		Cowh 6/9/15		Cowh 6/24/15		Vele 6/24/15		Cowh 7/23/15		Vele 7/23/15		Yield bu/A 10/14/15	
Check	---	0	d	0	c	0	d	0	d	0	d	0	c	0	c	152	b
Pre & Post																	
Surestart II & Durango DMA + AMS	2 pt & 32 oz + 2.5%	81	ab	82	a	96	b	98	a	98	a	99	a	99	a	224	a
Harness & Roundup Powermax + Atrazine + AMS	1.75 pt & 22 oz + 1 pt + 2.5 lb	71	b	61	b	97	ab	99	a	96	abc	99	a	98	a	218	a
Anthem + Atrazine & Roundup Powermax + AMS	8 oz + 1 pt & 22 oz + 1.7 lb	88	a	85	a	97	ab	99	a	98	a	99	a	98	a	216	a
Harness & Impact + RU Powermax + Atrazine + MSO + AMS	1.75 pt & 0.75 oz + 32 oz + 1 pt + 0.5% + 2.5%	--		50	b	99	a	99	a	99	a	99	a	99	a	220	a
Dual II Mag & Halex GT + NIS + AMS	1 pt & 3.6 pt + 0.25% +1.7 lb	0	d	14	c	91	c	99	a	99	a	99	a	99	a	221	a
Bicep Lite II Mag & Callisto + Touchdown Total + NIS + AMS	1 qt & 3 oz + 22 oz + 0.25% + 1.7 lb	26	c	13	c	96	b	99	a	99	a	99	a	99	a	217	a
Breakfree NXT & Realm Q + Atrazine + Abundit Extra + AMS	1.75 pt & 4 oz + 1 pt + 32 oz + 1.7 lb	66	b	56	b	99	a	99	a	99	a	99	a	99	a	219	a
Pre & Lpost																	
Acuron & Halex GT + NIS + AMS	3 qt & 3.6 pt + 0.25% + 1.7 lb	99	a	99	a	99	a	99	a	99	a	99	a	99	a	221	a
Zidua + Verdict & Roundup Powermax + Status + NIS + AMS	2 oz + 10 oz & 22 oz + 5 oz + 0.25% + 2.5 lb	99	a	97	a	99	a	99	a	99	a	99	a	99	a	221	a
Verdict & Status + Roundup Powermax + NIS + AMS	15 oz & 5 oz + 22 oz + 0.25% + 2.5 lb	99	a	95	a	99	a	99	a	98	a	99	a	99	a	219	a
Corvus + Atrazine & RU Powermax + Laudis + DiFlexx + Destiny HC +AMS	3.5 oz + 1 qt & 32 oz + 3 oz + 8 oz + 0.5% + 1.7 lb	99	a	99	a	99	a	99	a	99	a	99	a	99	a	213	a
Balance Flexx + Atrazine & Laudis + RU Weathermax + Destiny HC + AMS	3.5 oz + 1.5 pt & 3 oz + 28 oz + 0.5% + 1.5 lb	99	a	98	a	99	a	99	a	99	a	99	a	99	a	223	a
Balance Flexx + Atrazine & DiFlexx + Destiny HC + AMS	3.5 oz + 1.5 pt & 8 oz + 0.5% + 1.5 lb	99	a	99	a	98	a	95	ab	98	a	99	a	99	a	211	a
Balance Flexx + Atrazine & Liberty + AMS	3.5 oz + 1.5 pt & 22 oz + 2.5 lb	99	a	99	a	99	a	99	a	98	a	99	a	99	a	223	a
Breakfree NXT + Atrazine + Instigate + & Abundit Extra + AMS	1.75 pt + 1 pt + 5.25 oz & 32 oz + 1.7 lb	98	a	95	a	99	a	99	a	99	a	99	a	99	a	216	a

Treatment	Rate/A	Vele 5/28/15	Vele 6/9/15	Cowh 6/9/15	Cowh 6/24/15	Vele 6/24/15	Cowh 7/23/15	Vele 7/23/15	Yield bu/A 10/14/15
Epost									
Breakfree NXT + Realm Q + Atrazine + Abundit Extra + AMS	1.75 pt + 4 oz + 1 pt + 32 oz + 1.7 lb	--	99 a	99 a	99 a	98 a	99 a	99 a	216 a
Surestart II + Durango DMA + AMS	2 pt + 32 oz + 2.5%	--	99 a	99 a	97 ab	99 a	99 a	99 a	218 a
Armezon + Atrazine + RU Powermax + Outlook + COC + AMS	0.65 oz + 1 pt + 22 oz + 16 oz + 1% + 1.7 lb	--	99 a	99 a	99 a	95 bc	99 a	99 a	221 a
Anthem + Atrazine + RU Powermax +AMS	8 oz + 1 pt + 22 oz + 2.5 lb	--	99 a	99 a	99 a	97 ab	99 a	99 a	214 a
Solstice + Atrazine + RU Powermax + COC + AMS	2.5 oz + 1 pt + 22 oz + 1% + 1.7 lb	--	99 a	99 a	99 a	99 a	99 a	99 a	223 a
Roundup Powermax + AMS	22 oz + 2.5 lb	--	99 a	98 a	91 c	94 c	95 b	91 b	218 a
Epost & Lpost									
Roundup Powermax + AMS & Roundup Powermax + AMS	22 oz + 2.5 lb & 22 oz + 2.5 lb	--	99 a	99 a	94 b	98 a	98 a	99 a	226 a
Liberty + AMS & Liberty + AMS	22 oz + 2.5 lb & 22 oz + 2.5 lb	--	99 a	99 a	95 ab	99 a	98 a	99 a	221 a

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Pre: 4/29/15
Epost: 6/3/15 Corn V3, 7-9 in; Vele 2-4 lf, 2-3 in; Cowh 1-3 in.
Post: 6/9/15 Corn V4, 9-15 in; Vele 1-4 in; Cowh 2-4 in.
Lpost: 6/17/15 Corn V6, 24 in; Vele 2-8 in; Cowh 2-4 in.

Precipitation: (inches)
Pre: 1^{st} week 0.63 2^{nd} week 0.48
Epost: 1^{st} week 1.36 2^{nd} week 1.71
Post: 1^{st} week 1.70 2^{nd} week 0.24
Lpost: 1^{st} week 0.23 2^{nd} week 0.40

Soil: Silty Clay; 3.5% OM; 6.6 pH

Vele=Velvetleaf
Cowh=Common waterhemp

P=0.05

Comments: Moderate to heavy weed pressure as shown by the reduced check yield. Excellent control of waterhemp and velvetleaf by all program treatments. One application of glyphosate applied early post had the poorest late season weed control, as would be expected with weeds that germinate throughout the season.

2015
PREEMERGENCE HERBICIDES IN CORN
Southeast Research Farm

Treatment	Rate/A	Vele 5/28/15	Vele 6/9/15	Cowh 6/9/15	Cowh 6/24/15	Vele 6/24/15	Cowh 7/23/15	Vele 7/23/15	Yield bu/A 10/14/15
Check	---	0 c	0 e	0 b	0 c	0 d	0 c	0 e	145 c
Pre									
Surestart II	2 pt	85 ab	86 ab	98 a	96 a	85 a	99 a	88 b	220 ab
Harness Xtra 6L	1.8 qt	72 b	70 c	98 a	97 a	64 b	99 a	82 c	208 ab
Bicep Lite II Mag	1.1 qt	68 b	56 d	98 a	86 b	43 c	97 a	66 d	195 b
Acuron	3 qt	99 a	99 a	99 a	99 a	99 a	99 a	98 a	218 ab
Lumax EZ	2.7 qt	97 a	99 a	99 a	99 a	98 a	99 a	98 a	222 ab
Anthem + Atrazine	8 oz + 1 pt	81 ab	82 b	98 a	97 a	78 ab	99 a	81 c	213 ab
Zidua + Verdict	2 oz + 10 oz	99 a	97 a	99 a	99 a	89 a	99 a	95 a	226 a
Verdict	13 oz	97 a	97 a	99 a	98 a	89 a	99 a	95 ab	217 ab
Outlook + Atrazine	14 oz + 1.5 pt	73 b	64 cd	99 a	94 a	40 c	99 a	65 d	199 ab
Corvus + Atrazine	3.5 oz + 1.5 pt	98 a	97 a	99 a	95 a	88 a	99 a	95 ab	216 ab
Balance Flexx + Atrazine	3.5 oz + 1.5 pt	99 a	93 a	99 a	96 a	89 a	95 b	94 ab	219 ab

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Pre: 4/29/15

Soil: Silty Clay; 3.5% OM; 6.6 pH

Precipitation: (inches)
Pre: 1st week 0.63 2nd week 0.48

Vele=Velvetleaf
Cowh=Common waterhemp

P=0.05

Comments: Moderate to heavy weed pressure as shown by the reduced check yield. Pre applied herbicides were evaluated for weed control without a follow up post treatment. All treatments had excellent yields. Six treatments provided over 90 percent season long weed control. These treatments were all in the top yield group.

2015
POST BROADLEAF OPTIONS in CORN
Southeast Research Farm

Treatment	Rate/A	VCRR Necrosis 6/17/15	VCRR Stunt 6/17/15	Vele 6/24/15	Cowh 6/24/15	Cowh 7/16/15	Vele 7/16/15	Yield bu/A 10/14/15
Check	---	0 d	0 b	0 b	0 e	0 f	0 c	118 c
Pre								
Roundup Powermax + AMS	22 oz + 1.7 lb	0 d	0 b	97 a	52 c	76 c	97 ab	210 a
Liberty + AMS	22 oz + 1.7 lb	0 d	0 b	86 a	73 ab	74 c	97 ab	193 a
Laudis + MSO + AMS	3 oz + 1% + 1.7 lb	0 d	0 b	89 a	85 a	93 a	96 ab	213 a
Capreno + COC + AMS	3 oz + 1% + 1.7 lb	0 d	9 a	94 a	89 a	95 a	98 a	217 a
Aim + COC	1 oz + 1%	13 a	0 b	93 a	56 c	48 d	98 a	189 a
Resource + COC + AMS	6 oz + 1% + 2.5 lb	14 a	0 b	92 a	30 d	29 e	98 a	147 b
Cadet + COC + AMS	0.4 oz + 1% + 1.7 lb	4 c	0 b	94 a	25 d	33 e	96 ab	159 b
Solstice +COC + AMS	3.15 oz + 1% + 1.7 lb	6 b	0 b	97 a	88 a	95 a	98 a	216 a
Callisto + COC + AMS	3 oz + 1% + 1.7 lb	0 d	0 b	92 a	85 a	93 a	98 a	214 a
Realm Q + COC + AMS	4 oz + 1% + 1.7 lb	0 d	0 b	95 a	87 a	94 a	98 a	219 a
Status + MSO +AMS	5 oz + 1 pt + 1.7 lb	0 d	0 b	89 a	81 a	86 ab	97 ab	201 a
Diflexx + MSO + AMS	8 oz + 0.5% + 1.7 lb	0 d	0 b	84 a	66 b	81 bc	95 b	194 a
Impact + MSO + AMS	0.75 oz + 1% + 1.7 lb	0 d	0 b	93 a	84 a	89 ab	95 b	217 a
Buctril + Atrazine	1.5 pt + 1.5 pt	13 a	0 b	88 a	81 a	84 b	95 b	212 a

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Post: 6/8/15 Corn V4 10-14 in; Vele 3-5 in; Cowh 1-6 in.

Soil: Silty Clay; 3.5% OM; 6.6 pH

Precipitation: (inches)
Post: 1st week 0.80 2nd week 0.97

Vele=Velvetleaf
Cowh=Common waterhemp
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Heavy broadleaf weed pressure as shown by reduced yield of check. Postemergence only treatments were evaluated for broadleaf weed control in corn. Five treatments provided above 90 percent weed control for the season and also were in the top yield group.

2015
EARLY POSTEMERGENCE WEED CONTROL PROGRAMS in CORN
Southeast Research Farm

Treatment	Rate/A	VCRR 6/9/15	Vele 6/9/15	Cowh 6/9/15	Vele 6/24/15	Cowh 6/24/15	Cowh 7/23/15	Vele 7/23/15	Yield bu/A 10/14/15
Epost									
Armezon + Outlook + MSO + AMS	0.73 oz + 17.6 oz + 1% + 1.7 lb	0 a	91 c	99 a	94 bc	93 b	99 a	96 a	226 a
Armezon + Outlook + Atrazine + COC + AMS	0.73 oz + 17.6 oz + 1 lb + 1% + 1.7 lb	0 a	99 a	99 a	96 ab	99 a	99 a	98 a	231 a
Armezon + Outlook + Atrazine + NIS + AMS	0.73 oz + 17.6 oz + 1 lb + 0.25% + 1.7 lb	0 a	99 a	99 a	96 ab	99 a	99 a	98 a	233 a
Capreno + COC + AMS	3 oz + 1% + 1.7 lb	0 a	93 b	99 a	95 b	96 ab	99 a	98 a	228 a
Capreno + Atrazine + COC +AMS	3 oz + 1 lb + 1% + 1.7 lb	0 a	99 a	99 a	97 ab	99 a	99 a	98 a	227 a
Armezon + Outlook + Roundup Powermax +COC +AMS	0.73 oz + 17.6 oz + 16 oz + 1% + 1.7 lb	0 a	99 a	99 a	89 d	97 a	99 a	86 c	228 a
Armezon + Outlook + Roundup Powermax + NIS + AMS	0.73 oz + 17.6 oz + 16 oz + 0.25% + 1.7 lb	0 a	99 a	99 a	91 c	96 ab	99 a	90 b	228 a
Halex GT + NIS + AMS	64 oz + 0.25% + 1.7 lb	0 a	99 a	99 a	99 a	99 a	99 a	99 a	223 a
Armezon + Outlook + Atrazine + Roundup Powermax + NIS + AMS	0.73 oz + 17.6 oz + 1 lb + 16 oz + 0.25% + 1.7 lb	0 a	99 a	99 a	97 ab	99 a	99 a	98 a	228 a
Armezon + Outlook + Atrazine + Roundup Powermax +COC +AMS	0.73 oz + 17.6 oz + 1 lb + 16 oz + 1% + 1.7 lb	0 a	99 a	99 a	96 ab	99 a	99 a	97 a	226 a
Halex GT + Atrazine + NIS + AMS	64 oz + 1 lb + 0.25% + 1.7 lb	0 a	99 a	99 a	98 a	99 a	99 a	99 a	218 a
Check	---	0 a	0 d	0 b	0 e	0 c	0 b	0 d	154 b

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Epost: 6/3/15 Corn V3, 6-8 in; Vele 2-4 lf, 2-3 in; Cowh 1-3 in.

Precipitation: (inches)
Epost: 1st week 1.36 2nd week 1.71

Soil: Silty Clay; 3.5% OM; 6.6 pH

Vele=Velvetleaf
Cowh=Common waterhemp
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: The purpose of the study was to compare Armezon and Outlook tank-mix partners and adjuvants for weed control and crop response. Moderate to heavy weed pressure as shown by yield of check. All but one treatment provided above 90 percent weed control for the season. All program treatments had excellent yields. No injury was noted with any of the treatments.

2015
DIFLEXX & LAUDIS COMBINATIONS for WEED CONTROL in CORN
Southeast Research Farm

Treatment	Rate/A	Vele 5/28/15	Vele 6/9/15	Cowh 6/9/15	Vele 6/24/15	Cowh 6/24/15	Vele 7/16/15	Cowh 7/16/15	Yield bu/A 10/14/15
Check	---	0 c	0 c	0 b	0 b	0 b	0 b	0 b	150 b
Pre & Post									
Corvus + Atrazine & Roundup Powermax + AMS	5.6 oz + 1 qt & 32 oz + 3.4 lb	99 a	99 a	99 a	99 a	99 a	99 a	99 a	219 a
Corvus + Atrazine & Roundup Powermax + DiFlexx + Superb HC + AMS	3.5 oz + 1 qt & 32 oz + 6 oz + 0.5% + 3.4 lb	98 a	99 a	99 a	99 a	99 a	99 a	99 a	214 a
Corvus + Atrazine & Roundup Powermax + DiFlexx + Superb HC + AMS	3.5 oz + 1 qt & 32 oz + 8 oz + 0.5% + 3.4 lb	98 a	99 a	99 a	99 a	99 a	99 a	99 a	218 a
Corvus + Atrazine & RU Powermax + Laudis + DiFlexx + Destiny HC + AMS	3.5 oz + 1 qt & 32 oz + 3 oz + 8 oz + 0.5% + 3.4 lb	99 a	98 a	99 a	99 a	99 a	99 a	99 a	212 a
Corvus + Atrazine & Roundup Powermax + Status + Superb HC + AMS	3.5 oz + 1 qt & 32 oz + 3 oz + 0.5% + 3.4 lb	99 a	97 a	99 a	99 a	99 a	99 a	99 a	215 a
Tripleflex II & Roundup Powermax + AMS	2 pt & 32 oz + 3.4 lb	91 b	89 b	99 a	96 a	99 a	99 a	99 a	220 a
Epost									
Laudis + Atrazine + RU Powermax + COC + AMS	3 oz + 1 pt + 32 oz + 1% + 3.4 lb	--	99 a	99 a	98 a	99 a	98 a	99 a	210 a
Laudis + Atrazine + RU Powermax + DiFlexx + COC + AMS	3 oz + 1 pt + 32 oz + 6 oz + 1% + 3.4 lb	--	99 a	99 a	98 a	99 a	99 a	99 a	218 a
Halex GT + Atrazine + NIS + AMS	3.6 pt + 1 pt + 0.25% + 3.4 lb	--	99 a	99 a	99 a	99 a	99 a	99 a	214 a
Tripleflex II + RU Powermax + AMS	2 pt + 32 oz + 3.4 lb	--	99 a	99 a	97 a	97 a	99 a	98 a	217 a

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Pre: 4/29/15
Epost: 6/3/15 Corn V3, 7-9 in; Vele 2-4 lf, 2-3 in; Cowh 1-3 in.
Post: 6/17/15 Corn V6, 24 in; Vele 2-4 in; Cowh 2-4 in.

Precipitation: (inches)
Pre: 1st week 0.16 2nd week 1.61
Epost: 1st week 1.36 2nd week 1.71
Post: 1st week 0.23 2nd week 0.40

Soil: Clay Loam; 3.3% OM; 7.2 pH

Vele=Velvetleaf
Cowh=Common waterhemp

P=0.05

Comments: The purpose of the experiment was to evaluate DiFlexx tank-mixes and adjuvants for weed control and crop response. Moderate to heavy weed pressure as shown by yield of check. All treatment programs provided greater than 98 percent season long weed control. No injury was noted at any time throughout the season.

2015
PREEMERGENCE WEED CONTROL COMPARISONS in CORN
Southeast Research Farm

Treatment	Rate/A	Vele 5/21/15	VCRR 5/21/15	Vele 6/24/15	Cowh 6/24/15	Vele 10/7/15	Cowh 10/7/15	Yield bu/A 10/14/15
Check	---	0 d	0 a	0 c	0 c	0 c	0 c	146 b
Pre								
Acuron	3 qt	97 a	0 a	99 a	99 a	99 a	99 a	221 a
Surestart II	2.5 pt	86 c	0 a	82 b	97 ab	84 b	97 ab	214 a
Corvus	5 oz	90 b	0 a	95 a	96 b	96 a	98 ab	219 a
Instigate	6 oz	92 b	0 a	92 a	96 b	93 a	98 ab	222 a
Verdict	15 oz	93 b	0 a	84 b	97 ab	84 b	97 b	212 a

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Pre: 4/29/15

Soil: Silty Clay; 3.5% OM; 6.6 pH

Precipitation: (inches)
Pre: 1st week 0.16 2nd week 1.61

Cowh=Common waterhemp
Vele=Velvetleaf
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Moderate to heavy weed pressure as shown by yield of check. Three treatments provided above 90 percent weed control. No visible injury was noted at any time during the growing season.

2015
SOLSTICE TANK-MIXES in CORN
Southeast Research Farm

Treatment	Rate/A	VCRR Necrosis 6/17/15	Colq 7/7/15	Cowh 7/7/15	Vele 7/7/15	Colq 8/4/15	Cowh 8/4/15	Vele 8/4/15	Yield bu/A 10/13/15
Post									
Solstice + Roundup Powermax +AMS	3.15 oz + 22 oz + 1.7 lb	1 c	99 a	96 a	99 a	99 a	96 a-d	99 a	212 a
Solstice + Roundup Powermax + COC + AMS	3.15 oz + 22 oz + 0.5% + 1.7 lb	9 a	99 a	97 a	99 a	99 a	95 bcd	99 a	211 a
Solstice + Atrazine + Roundup Powermax + COC + AMS	2.5 oz + 1 pt + 22 oz + 0.5% + 1.7 lb	3 bc	99 a	99 a	99 a	99 a	99 a	99 a	211 a
Solstice + Atrazine + Roundup Powermax + COC + AMS	2.5 oz + 1 qt + 22 oz + 0.5% + 1.7 lb	9 a	99 a	99 a	99 a	99 a	99 a	99 a	210 a
Solstice + Anthem + Roundup Powermax + COC + AMS	2.5 oz + 4 oz + 22 oz + 0.5% + 1.7 lb	8 a	99 a	97 a	99 a	99 a	97 a-d	99 a	217 a
Solstice + Anthem + Roundup Powermax + COC + AMS	2.5 oz + 2 oz + 22 oz + 0.5% + 1.7 lb	6 ab	99 a	96 a	99 a	99 a	94 d	99 a	207 a
Solstice + Anthem + Atrazine + Roundup Powermax + COC + AMS	2.5 oz + 4 oz + 1 pt + 22 oz + 0.5% + 1.7 lb	6 ab	99 a	99 a	99 a	99 a	99 ab	99 a	211 a
Solstice + Anthem + Atrazine + Roundup Powermax + COC + AMS	2.5 oz + 2 oz + 1 pt + 22 oz + 0.5% + 1.7 lb	6 ab	99 a	99 a	99 a	99 a	99 a	99 a	214 a
Solstice + DiFlexx + Roundup Powermax + COC + AMS	2.5 oz + 8 oz + 22 oz + 0.5% + 1.7 lb	5 abc	99 a	99 a	99 a	99 a	99 ab	99 a	211 a
DiFlexx + Roundup Powermax + COC + AMS	8 oz + 22 oz + 0.5% + 1.7 lb	0 c	99 a	87 b	92 b	99 a	90 e	96 a	216 a
Halex GT + AMS	3.6 pt + 1.7 lb	0 c	99 a	98 a	99 a	99 a	98 abc	99 a	209 a
Laudis + Roundup Powermax + COC + AMS	3 oz + 22 oz + 1% + 1.7 lb	0 c	99 a	96 a	92 b	99 a	95 cd	87 b	215 a
Check	---	0 c	0 b	0 c	0 c	0 b	0 f	0 c	112 b

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Post: 6/8/15 Corn V4, 10-14 in; Vele 3-5 in; Cowh 1-6 in; Colq 2-5 in.

Soil: Clay Loam; 3.3% OM; 7.2 pH

Precipitation: (inches)
Post: 1st week 0.80 2nd week 0.97

Vele=Velvetleaf
Cowh=Common waterhemp
Colq=Common lambsquarters
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Solstice contains fluthiacet (Cadet) and mesotrione (Callisto). Heavy weed pressure as shown by yield of check. All but one treatment provided above 90 percent weed control for the season. All treatments had excellent yield. A small amount of necrosis noted 1 week after application.

2015
ANTHEM TANK-MIX COMPARISONS in CORN
Southeast Research Farm

Treatment	Rate/A	Vele 5/28/15	Grft 6/17/15	Cowh 6/17/15	Vele 6/17/15	VCRR-Necrosis 6/17/15	Vele 7/1/15	Cowh 7/1/15	Colq 8/4/15	Cowh 8/4/15	Vele 8/4/15	Yield bu/A 10/13/15
Pre												
*Anthem	10 oz	85 b	89 b	95 b	76 c	0 b	95 a	99 a	99 a	99 a	96 a	215 a
*Anthem + Atrazine	8 oz + 1 qt	87 b	88 b	98 ab	78 c	0 b	96 a	99 a	99 a	99 a	95 a	214 a
Anthem + Stanza	8 oz + 3 oz	90 ab	90 b	97 ab	91 ab	0 b	86 bc	98 a	99 a	99 a	81 b	221 a
*Dual II Magnum	1.4 pt	5 c	93 ab	92 c	30 d	0 b	71 d	98 a	99 a	99 a	78 b	214 a
*Outlook	16 oz	5 c	93 ab	96 ab	18 e	0 b	81 c	99 a	99 a	99 a	84 b	212 a
Acuron	3 qt	99 a	95 ab	98 ab	98 a	0 b	99 a	99 a	99 a	99 a	99 a	207 a
Lumax EZ	2.7 qt	99 a	94 ab	98 ab	95 ab	0 b	96 a	99 a	99 a	99 a	99 a	223 a
Surestart II	2 pt	86 b	93 ab	98 ab	86 bc	0 b	92 ab	98 a	99 a	98 a	81 b	209 a
Epost												
Anthem + RU Powermax +AMS	8 oz + 22 oz + 1.7 lb	--	99 a	97 ab	99 a	3 a	98 a	97 a	99 a	97 b	99 a	217 a
Anthem + Atrazine + RU Powermax +AMS	8 oz + 1 pt + 22 oz + 1.7 lb	--	99 a	99 a	99 a	2 ab	98 a	99 a	99 a	99 a	98 a	212 a
Halex GT + AMS	3.6 pt + 1.7 lb	--	99 a	99 a	99 a	0 b	99 a	99 a	99 a	98 a	99 a	213 a
Check	---	0 c	0 c	0 d	0 f	0 b	0 e	0 b	0 b	0 c	0 c	115 b

*Roundup Powermax applied at 22 oz/A on 6/17/15.

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Pre: 4/29/15
Epost: 6/3/15 Corn V3, 6-8 in; Vele 2-4 lf, 2-3 in; Cowh 1-3 in; Colq 2-3 in; Grft 2-4 in.

Precipitation: (inches)
Pre: 1st week 0.16 2nd week 1.61
Epost: 1st week 1.36 2nd week 1.71

Soil: Clay Loam; 3.3% OM; 7.2 pH

Vele=Velvetleaf
Cowh=Common waterhemp
Colq=Common lambsquarters
Grft=Green foxtail
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Heavy weed pressure as shown by yield of check. Seven treatments provided above 90 percent season long weed control. No yield differences. Very slight necrosis was noted on a couple of post treatments 2 weeks after application. An as needed glyphosate application was applied to four of the pre treatments due to poor velvetleaf control.

2015
IMPACT PROGRAMS
Southeast Research Farm

Treatment	Rate/A	Vele 6/9/15	Cowh 6/9/15	VCRR Lodging 6/22/15	Vele 6/24/15	Cowh 6/24/15	Colq 7/7/15	Cowh 7/7/15	Vele 7/7/15	Yield bu/A 10/13/15
Check	---	0 d	0 c	0 b	0 d	0 c	0 b	0 b	0 b	180 b
Pre & Post										
Harness & Roundup Powermax + AMS	1.75 pt & 32 oz + 2.5%	20 c	98 b	0 b	89 c	98 b	99 a	99 a	98 a	210 a
Harness & Impact + RU Powermax + Aatrex + MSO + AMS	1.75 pt & 0.75 oz + 32 oz + 1 pt + 0.5% + 2.5%	26 b	98 b	0 b	92 bc	99 ab	99 a	99 a	99 a	218 a
Harness & Impact + Status + Aatrex + MSO + AMS	1.75 pt & 0.75 oz + 5 oz + 1 pt + 1% + 2.5%	20 c	98 b	13 a	95 ab	99 a	99 a	99 a	99 a	209 a
Epost										
Harness + Impact + RU Powermax + Aatrex + MSO + AMS	1.75 pt + 0.75 oz + 32 oz + 1 pt + 0.5% + 2.5%	99 a	99 a	0 b	96 ab	99 a	99 a	99 a	98 a	212 a
Halex GT + Aatrex + NIS + AMS	3.6 pt + 1 pt + 0.25% + 2.5%	99 a	99 a	0 b	99 a	99 a	99 a	99 a	99 a	220 a

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Pre: 4/29/15
Epost: 6/3/15 Corn V3, 7-9 in; Cowh 1-3 in;
Vele 2-4 lf, 2-3 in; Colq 2-3 in.
Post: 6/17/15 Corn V6, 24 in; Vele 2-8 in; Colq 3-7 in.

Soil: Clay Loam; 3.3% OM; 7.2 pH

Precipitation: (inches)
Pre: 1st week 0.16 2nd week 1.61
Epost: 1st week 1.36 2nd week 1.71
Post: 1st week 0.23 2nd week 0.40

Cowh=Common waterhemp
Vele=Velvetleaf
Colq=Common lambsquarters
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Moderate weed pressure as shown by yield of check. All treatments provided greater than 98 percent weed control for the season. One treatment had some early season lodging; however plants recovered. Excellent yields from all treatment programs.

2015
CALLISTO ADDITIVES in CORN
Southeast Research Farm

Treatment	Rate/A	VCRR Necrosis 6/17/15	Cowh 6/24/15	Colq 6/24/15	Vele 6/24/15	Cowh 7/1/15	Colq 7/1/15	Vele 7/1/15	Cowh 7/16/15	Colq 7/16/15	Vele 7/16/15	Yield bu/A 10/14/15
Post												
Callisto + Superb HC + AMS	2 oz + 0.5% + 1.7 lb	0 b	92 b	85 b	93 b	97 b	99 a	99 a	96 b	98 a	99 a	217 a
Callisto + Atrazine + Superb HC + AMS	2 oz + 8 oz + 0.5% + 1.7 lb	0 b	97 a	97 a	97 a	99 a	99 a	99 a	98 a	99 a	99 a	217 a
Callisto + Atrazine + Superb HC + AMS	2 oz + 1 pt + 0.5% + 1.7 lb	0 b	98 a	98 a	99 a	99 a	99 a	99 a	99 a	99 a	99 a	217 a
Callisto + Moxy + Superb HC + AMS	2 oz + 4 oz + 0.5% + 1.7 lb	0 b	96 a	96 a	96 a	99 a	99 a	99 a	98 a	99 a	99 a	213 a
Callisto + Moxy + Superb HC + AMS	2 oz + 8 oz + 0.5% + 1.7 lb	13 a	95 a	95 a	98 a	99 a	98 a	99 a	98 a	98 a	99 a	213 a
Check	---	0 b	0 c	0 c	0 c	0 c	0 b	0 b	0 c	0 b	0 b	111 b

RCB: 4 reps
Variety: DKC 53-56 RIB
Planting Date: 4/29/15
Post: 6/9/15 Corn V4, 12-16 in; Vele 2-8 in; Cowh 3-8 in; Colq 3-8 in.

Soil: Clay Loam; 3.3% OM; 7.2 pH

Precipitation: (inches)
Post: 1st week 1.70   2nd week 0.24

Vele=Velvetleaf
Cowh=Common waterhemp
Colq=Common lambsquarters
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Heavy weed pressure as shown by yield of check. All treatment programs provided greater than 96 percent weed control for the season. All treatments had excellent yields. The Callisto tank-mix with the higher rate of bromoxynil (Moxy) showed some slight leaf burn which dissipated by the next evaluation.

2015
SOYBEAN HERBICIDE DEMONSTRATION
Southeast Research Farm

Treatment	Rate/A	VCRR Necrosis 6/22/15	Cowh 6/22/15	Vele 6/22/15	Cocb 6/22/15	Cowh 7/16/15	Vele 7/16/15	Cocb 7/16/15	Cowh 10/6/15	Colq 10/6/15	Yield bu/A 10/6/15
Check	---	0 b	0 e	0 g	0 i	0 d	0 d	0 c	0 d	0 d	21 e
PPI & Post											
Treflan & Roundup Powermax + AMS	1.5 pt & 22 oz + 2 qt	0 b	91 abc	50 e	48 fg	98 a	99 a	99 a	95 a	99 a	61 abc
Pursuit Plus & Roundup Powermax + AMS	2.5 pt & 22 oz + 2 qt	0 b	91 abc	96 a	92 ab	98 a	99 a	99 a	95 a	99 a	59 abc
Pre & Post											
Sonic & Flexstar + Select Max + COC	7 oz & 0.75 pt + 12 oz + 0.25%	0 b	98 a	97 a	94 a	98 a	99 a	88 b	99 a	97 a	58 abc
Authority MTZ & Avalanche Ultra + Section Three + NIS	14 oz & 1.5 pt + 5.33 oz + 0.25%	0 b	91 abc	82 ab	86 ab	97 a	89 c	97 a	99 a	95 b	57 abc
Authority MTZ & Cobra + Select Max + COC	14 oz & 12.5 oz+ 14 oz + 1 pt	0 b	92 abc	82 ab	83 abc	97 a	91 b	96 a	99 a	93 c	53 cd
Warrant & Roundup Powermax + AMS	1.5 qt & 22 oz + 2 qt	0 b	86 c	33 f	25 h	97 a	99 a	99 a	94 a	99 a	61 abc
Boundary & Flexstar GT + MSO + AMS	1.5 pt & 3.5 pt + 1% + 1.7 lb	0 b	95 ab	56 de	65 c-f	99 a	99 a	99 a	99 a	99 a	65 abc
Broadaxe XC & Flexstar GT + MSO + AMS	25 oz & 3.5 pt + 1% + 2.5%	0 b	96 a	87 a	70 b-e	99 a	99 a	99 a	99 a	99 a	60 abc
Sonic & Durango DMA + AMS	3 oz & 32 oz + 2.5%	0 b	95 ab	91 a	92 ab	98 a	99 a	99 a	99 a	99 a	65 abc
Sonic + Dimetric & Durango DMA + AMS	3 oz + 3 oz & 32 oz + 2.5%	0 b	94 ab	93 a	70 b-e	98 a	99 a	99 a	98 a	99 a	66 ab
Sonic & Durango DMA + Firstrate + AMS	3 oz & 32 oz + 0.3 oz + 2.5%	0 b	95 ab	95 a	75 a-d	99 a	99 a	99 a	99 a	99 a	61 abc
Authority MTZ & Roundup Powermax + AMS	11 oz & 22 oz + 2 qt	0 b	92 abc	71 bc	40 gh	96 a	99 a	99 a	98 a	99 a	63 abc
Spartan & Roundup Powermax + AMS	4.5 oz & 22 oz + 2 qt	0 b	73 d	63 cd	40 gh	95 a	99 a	99 a	94 a	99 a	65 abc
Panther & Roundup Powermax + AMS	2 oz & 22 oz + 2 qt	0 b	88 bc	87 a	50 efg	98 a	99 a	99 a	97 a	99 a	65 abc
Fierce & Roundup Powermax + AMS	3 oz & 22 oz + 2 qt	0 b	96 a	91 a	55 efg	98 a	99 a	99 a	99 a	99 a	60 abc
Valor + Dimetric & Roundup Powermax + AMS	2 oz + 5.33 oz & 22 oz + 2 qt	0 b	95 ab	89 a	58 d-g	99 a	99 a	99 a	99 a	99 a	63 abc
Surveil & Durango DMA + AMS	2.8 oz & 32 oz + 2.5%	0 b	96 a	94 a	90 ab	99 a	99 a	99 a	99 a	99 a	64 abc
Afforia & Cinch + Abundit Extra + Assure II + NIS + AMS	2.5 oz & 1 pt + 32 oz + 5 oz + 0.25% + 2 qt	0 b	94 ab	87 a	53 efg	99 a	99 a	99 a	99 a	99 a	62 abc
Afforia + Dimetric & Abundit Extra + Assure II + NIS + AMS	2.5 oz + 4 oz & 32 oz + 5 oz + 0.25% + 2 qt	0 b	96 a	87 a	78 abc	98 a	99 a	99 a	99 a	99 a	62 abc
Enlite & Abundit Extra + Assure II + NIS + AMS	2.8 oz & 32 oz + 5 oz + 0.25% + 2 qt	0 b	95 ab	92 a	82 abc	98 a	99 a	99 a	98 a	99 a	62 abc
Sharpen & Roundup Powermax + AMS	1 oz & 22 oz + 2 qt	0 b	91 abc	87 a	91 ab	98 a	99 a	99 a	98 a	99 a	64 abc
Zidua + Verdict & Roundup Powermax + AMS	2.5 oz + 5 oz & 22 oz + 2 qt	0 b	98 a	94 a	95 a	99 a	99 a	99 a	99 a	99 a	66 a

Treatment	Rate/A	VCRR Necrosis 6/22/15	Cowh 6/22/15	Vele 6/22/15	Cocb 6/22/15	Cowh 7/16/15	Vele 7/16/15	Cocb 7/16/15	Cowh 10/6/15	Colq 10/6/15	Yield bu/A 10/6/15
Epost											
Anthem+Roundup Powermax+AMS	7 oz + 22 oz + 2 qt	16 a	--	--	--	86 b	99 a	99 a	78 b	99 a	54 bcd
Roundup Powermax + AMS	22 oz + 2 qt	0 b	--	--	--	82 c	99 a	99 a	68 c	99 a	47 d
Epost & Post											
Roundup Powermax + AMS & Roundup Powermax + AMS	22 oz + 2 qt & 22 oz + 2 qt	0 b	--	--	--	95 a	99 a	99 a	94 a	99 a	61 abc

RCB: 4 reps
Variety: AG 2035
Planting Date: 5/19/15
PPI/Pre: 5/19/15
Epost: 6/17/15 Soy 3 tri, 6-7 in; Cowh 2-5 in; Vele 2-5 in; Cocb 2-7 in; Colq 1-5 in.
Post: 6/23/15 Soy 3 tri, 10 in; Cowh 2-10 in; Vele 4-8 in; Cocb 3-10 in; Colq 8-12 in.

Soil: Clay; 3.8% OM; 7.4 pH

Precipitation: (inches)
Pre: 1st week 0.53 2nd week 0.30
Epost: 1st week 0.23 2nd week 0.40
Post: 1st week 0.21 2nd week 2.82

Cowh=Common waterhemp
Vele=Velvetleaf
Cocb=Common cocklebur
Colq=Common lambsquarters
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Heavy weed pressure as shown by yield of check. Most program treatments were in the top yield group and provided above 90 percent weed control season long. The early ratings show how the pre or ppi programs performed before the follow up post treatment was applied. No major injury was noted, only some leaf speckling noted after the post application.

2015
LIBERTY LINK SOYBEAN DEMONSTRATION
Southeast Research Farm

Treatment	Rate/A	Cowh 6/9/15	Vele 6/9/15	VCRR 6/22/15	Cowh 7/16/15	Vele 7/16/15	Cowh 10/6/15	Yield bu/A 10/6/15
Check	---	0 b	0 c	0 b	0 c	0 b	0 c	24 b
Pre & Post								
Authority First & Liberty + AMS	6.5 oz & 29 oz + 1.7 lb	98 a	98 a	0 b	99 a	99 a	99 a	54 a
Fierce & Liberty + AMS	3.5 oz & 29 oz + 1.7 lb	98 a	98 a	0 b	99 a	99 a	99 a	55 a
Optill + Outlook (Optill Pro) & Liberty + AMS	2 oz + 10 oz & 29 oz + 1.7 lb	98 a	98 a	0 b	99 a	99 a	99 a	50 a
Pre & Epost								
Valor & Liberty + Zidua + AMS	3 oz & 29 oz + 2 oz + 1.7 lb	98 a	89 b	8 a	99 a	99 a	99 a	51 a
Enlite & Liberty + Outlook + AMS	2.8 oz & 29 oz + 14 oz + 1.7 lb	98 a	95 a	0 b	99 a	99 a	99 a	52 a
Epost & Lpost								
Cheetah + AMS & Cheetah + AMS	29 oz + 1.5 lb & 29 oz + 1.5 lb	--	--	0 b	99 a	99 a	99 a	55 a
Post								
Cheetah Max + Dual Magnum + AMS	1 qt + 1 pt + 1.5 lb	--	--	0 b	96 b	99 a	92 b	51 a

RCB: 4 reps
Variety: LC 2384
Planting Date: 5/19/15
Pre: 5/19/15
Epost: 6/17/15 Soy 3 tri. 6-7 in; Cowh 2-4 in; Vele 2-4 in.
Post: 6/23/15 Soy 3 tri. 10 in; Cowh 2-10 in; Vele 4-8 in.
Lpost: 7/1/15 Soy 6 tri. 14 in; Cowh 1-4 in.

Soil: Clay; 3.8% OM; 7.4 pH

Precipitation: (inches)
Pre: 1st week 0.53 2nd week 0.30
Epost: 1st week 0.23 2nd week 0.40
Post: 1st week 0.21 2nd week 2.82
Lpost: 1st week 2.63 2nd week 0.00

Cowh=Common waterhemp
Vele=Velvetleaf
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Moderate to heavy weed pressure as shown by yield of check. All programs provided 90 percent or better weed control and were in the top yield group. Slight visual response on one of the early post treatments, but symptoms dissipated by the next evaluation.

2015
CHEETAH MAX EFFICACY IN LL SOYBEANS
Southeast Research Farm

Treatment	Rate/A	VCRR Bronzing 6/22/15	Cowh 6/24/15	Vele 6/24/15	VCRR 6/24/15	Vele 7/1/15	Cowh 7/1/15	Grft 7/16/15	Cowh 8/4/15	Vele 8/4/15
Check	---	0 d	0 b	0 c	0 d	0 b	0 b	0 d	0 c	0 b
Post										
Cheetah Max + AMS	1 qt + 1.5 lb	14 b	98 a	96 ab	15 b	92 a	95 a	92 a	87 a	81 a
Cheetah + AMS	29 oz + 1.5 lb	0 d	98 a	93 ab	1 cd	93 a	93 a	89 ab	83 ab	83 a
Cheetah Max + Dual Mag +AMS	1 qt + 1 pt + 1.5 lb	19 a	98 a	98 a	21 a	95 a	96 a	84 bc	87 a	83 a
Cheetah + Dual Magnum + AMS	29 oz + 1 pt + 1.5 lb	3 c	96 a	91 b	6 c	94 a	94 a	82 bc	84 ab	87 a
Cheetah + Dual Magnum + AMS	29 oz + 1.33 pt + 1.5 lb	6 c	97 a	96 ab	6 c	91 a	93 a	79 c	79 b	84 a

RCB: 4 reps
Variety: LC 2384
Planting Date: 5/19/15
Post: 6/17/15 Soy 2 tri, 6-7 in; Cowh 2-5 in; Vele 2-5 in; Grft 4-6 in.

Precipitation: (inches)
Post: 1st week 0.23 2nd week 0.40

Soil: Clay; 3.8% OM; 7.4 pH

Cowh=Common waterhemp
Vele=Velvetleaf
Grft=Green foxtail
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Heavy weed pressure. Cheetah Max contains glufosinate (Liberty) and fomesafen (Flexstar). Some early crop leaf response noted; however there were no lasting effects. Some late season germination of waterhemp and velvetleaf observed at the late season evaluation.

2015
BROADAXE XC COMPARISONS in SOYBEANS
Southeast Research Farm

Treatment	Rate/A	Cowh 6/22/15	Vele 6/22/15	Cocb 6/22/15	Colq 7/7/15	Cowh 7/7/15	Vele 7/7/15	Cowh 10/6/15	Yield bu/A 10/6/15
Check	---	0 c	0 d	0 c	0 b	0 b	0 b	0 c	22 b
Pre & Post									
Broadaxe XC & Flexstar GT + MSO + AMS	25 oz & 3.5 pt + 1% + 2.5%	97 a	76 b	88 ab	99 a	99 a	99 a	98 a	69 a
Boundary & Flexstar GT + MSO + AMS	1.8 pt & 3.5 pt + 1% + 2.5%	96 a	85 ab	82 ab	99 a	99 a	99 a	99 a	69 a
Broadaxe XC & Touchdown Total +AMS	25 oz & 32 oz + 2.5%	96 a	84 ab	81 ab	99 a	99 a	99 a	99 a	70 a
Boundary & Touchdown Total + AMS	1.8 pt & 32 oz + 2.5%	96 a	79 ab	76 b	99 a	99 a	99 a	98 a	69 a
Prefix & Touchdown Total + AMS	2 pt & 32 oz + 2.5%	95 a	45 c	84 ab	99 a	99 a	99 a	98 a	70 a
Valor XLT & Roundup Powermax +AMS	3 oz & 29 oz + 2.5%	96 a	85 ab	82 ab	99 a	99 a	99 a	99 a	70 a
Fierce & Roundup Powermax + AMS	3 oz & 29 oz + 2.5%	95 a	87 ab	80 ab	99 a	99 a	99 a	99 a	69 a
Sonic & Roundup Powermax + AMS	4 oz & 29 oz + 2.5%	88 b	89 ab	84 ab	99 a	99 a	99 a	95 b	68 a
Valor + Dual Magnum & Roundup Powermax + AMS	2 oz + 1.25 pt & 29 oz + 2.5%	97 a	90 ab	85 ab	99 a	99 a	99 a	99 a	70 a
Broadaxe XC + Tricor DF & Flexstar GT + MSO + AMS	25 oz + 5 oz & 3.5 pt + 1% + 2.5%	97 a	87 ab	88 ab	99 a	99 a	99 a	99 a	70 a
Optill + Outlook (Optill Pro) & Roundup Powermax + AMS	2 oz + 10 oz & 29 oz + 2.5%	97 a	94 a	90 a	99 a	99 a	99 a	99 a	71 a
Enlite & Roundup Powermax + AMS	2.8 oz & 29 oz + 2.5%	96 a	93 a	84 ab	99 a	99 a	99 a	99 a	68 a

RCB: 4 reps
Variety: AG 2035
Planting Date: 5/19/15
Pre: 5/19/15
Post: 6/23/15 Soy 3 tri, 10 in; Cowh 2-10 in; Vele 4-8 in; Colq 8-12 in; Cocb 2-10 in.

Soil: Clay; 3.8% OM; 7.4 pH

Precipitation: (inches)
Pre: 1st week 0.53 2nd week 0.30
Post: 1st week 0.21 2nd week 2.82

Cowh=Common waterhemp
Vele=Velvetleaf
Colq=Common lambsquarters
Cocb=Common cocklebur

P=0.05

Comments: Very heavy weed pressure as shown by yield of check. Early control ratings show pre comparisons before follow up post treatments. No visible injury noted anytime throughout the season. Excellent yields from all treatments.

2015
PANTHER COMBINATIONS for WEED CONTROL in SOYBEANS
Southeast Research Farm

Treatment	Rate/A	Cowh 6/9/15	Vele 6/9/15	Cowh 6/24/15	Vele 6/24/15	Cowh 7/1/15	Vele 7/1/15	Cowh 10/6/15	Colq 10/6/15	Yield bu/A 10/6/15
Check	---	0 c	0 c	0 c	0 d	0 e	0 d	0 e	0 c	20 b
Pre										
Panther	2.5 oz	99 a	95 a	93 a	89 b	93 ab	92 b	87 ab	87 b	--
Pursuit	4 oz	86 b	99 a	68 b	98 a	69 d	98 a	20 d	99 a	--
Metribuzin 75DF	7.5 oz	98 a	89 b	92 a	85 c	83 c	78 c	55 c	99 a	--
Panther + Pursuit + Metribuzin	2 oz + 3.2 oz + 6 oz	99 a	99 a	99 a	98 a	96 a	99 a	98 a	99 a	61 a
Panther + Pursuit + Metribuzin	2.5 oz + 4 oz + 7.5 oz	99 a	98 a	99 a	99 a	97 a	99 a	96 a	99 a	62 a
Authority Assist	8 oz	99 a	99 a	94 a	99 a	95 a	99 a	87 ab	99 a	54 a
Optill	1.5 oz	99 a	99 a	90 a	99 a	88 bc	98 a	78 b	99 a	52 a

RCB: 4 reps
Variety: AG 2035
Planting Date: 5/19/15
Pre: 5/19/15

Soil: Clay; 3.8% OM; 7.4 pH

Precipitation: (inches)
Pre: 1st week 0.53 2nd week 0.30

Cowh=Common waterhemp
Vele=Velvetleaf

P=0.05

Comments: Heavy weed pressure as shown by yield of check. These treatments were not followed with a post treatment. Four treatments provided good weed control and were taken to yield. No injury was noted with any of the treatments.

2015
ENLIST SOYBEAN PROGRAMS
Southeast Research Farm

Treatment	Rate/A	Cowh 6/22/15	Grft 7/7/15	Colq 7/7/15	Cowh 7/7/15	Grft 7/16/15	Cowh 7/16/15
Check	---	0 c	0 b	0 b	0 b	0 b	0 b
Pre & Post							
Sonic & Durango DMA + AMS	4.5 oz & 32 oz + 2.5%	93 b	99 a	99 a	99 a	99 a	99 a
Sonic & Enlist Duo + AMS	4.5 oz & 56 oz + 2.5%	93 b	99 a	99 a	99 a	99 a	99 a
Sonic & Enlist Duo + AMS	4.5 oz & 75 oz + 2.5%	94 b	99 a	99 a	99 a	99 a	99 a
Surveil & Enlist Duo + AMS	2.8 oz & 56 oz + 2.5%	99 a	99 a	99 a	99 a	99 a	99 a

RCB: 4 reps

Precipitation: (inches)
Pre: 1st week 0.53 2nd week 0.30
Post: 1st week 0.21 2nd week 2.82

Planting Date: 5/19/15
Pre: 5/19/15
Post: 6/23/15 Soy 3 tri, 9 in; Cowh 3-7 in; Grft 3-11 in; Colq 4-7 in.

Soil: Silty Clay Loam; 3.7% OM; 7.2 pH

Cowh=Common waterhemp
Grft=Green foxtail
Colq=Common lambsquarters

P=0.05

Comments: Purpose of the study was to evaluate new Enlist soybean programs. Moderate to heavy weed pressure. Programs provided full season weed control. Enlist Duo contains glyphosate and 2,4-D choline.

2015
SOYBEAN PROGRAMS with AUTHORITY PRODUCTS
Southeast Research Farm

Treatment	Rate/A	VCRR 6/9/15	Cowh 6/9/15	Vele 6/9/15	Cowh 7/16/15	Vele 7/16/15	Cowh 8/17/15	Vele 8/17/15	Yield bu/A 10/6/15
PPI									
Prowl H2O & RU Powermax + AMS	3 pt & 22 oz + 1.7 lb	0 a	88 b	48 b	97 a	99 a	92 c	99 a	68 a
Prowl H2O + Authority MTZ & Roundup Powermax + AMS	2 pt + 12 oz & 22 oz + 1.7 lb	0 a	88 b	85 a	97 a	99 a	95 b	99 a	68 a
Pre & Post									
Authority Elite & RU Powermax + AMS	28 oz & 22 oz + 1.7 lb	0 a	99 a	99 a	99 a	99 a	99 a	99 a	66 a
Authority Elite & Anthem + Roundup Powermax + AMS	24 oz & 5 oz + 22 oz + 1.7 lb	0 a	98 a	94 a	99 a	99 a	99 a	99 a	67 a
Authority Elite & Marvel + RU Powermax + AMS	24 oz & 6 oz + 22 oz + 1.7 lb	0 a	97 a	93 a	99 a	99 a	98 a	99 a	66 a
Authority Assist & RU Powermax +AMS	8 oz & 22 oz + 1.7 lb	0 a	99 a	99 a	99 a	99 a	99 a	99 a	67 a
Authority Assist & Anthem + Roundup Powermax + AMS	8 oz & 5 oz + 22 oz + 1.7 lb	0 a	99 a	99 a	99 a	99 a	98 a	99 a	65 a
Authority MTZ & RU Powermax + AMS	14 oz & 22 oz + 1.7 lb	0 a	97 a	94 a	98 a	99 a	96 ab	99 a	66 a
Authority Elite + Authority MTZ & Roundup Powermax + AMS	24 oz + 10 oz & 22 oz + 1.7 lb	0 a	98 a	95 a	99 a	99 a	99 a	99 a	69 a
Authority Elite + Authority MTZ & Roundup Powermax + Marvel + AMS	24 oz + 10 oz & 22 oz + 6 oz + 1.7 lb	0 a	98 a	98 a	99 a	99 a	99 a	99 a	67 a
Optill + Outlook (Optill Pro) & Roundup Powermax + AMS	2 oz + 10 oz & 22 oz + 1.7 lb	0 a	98 a	98 a	99 a	99 a	99 a	99 a	67 a
Fierce & Roundup Powermax + AMS	3.75 oz & 22 oz + 1.7 lb	0 a	98 a	98 a	99 a	99 a	99 a	99 a	67 a
Verdict & Roundup Powermax + AMS	5 oz & 22 oz + 1.7 lb	0 a	98 a	98 a	99 a	99 a	99 a	99 a	68 a
Epost									
Roundup Powermax + AMS	32 oz + 1.7 lb	0 a	--	--	93 b	99 a	88 d	99 a	62 a
Check	---	0 a	0 c	0 c	0 c	0 b	0 e	0 b	27 b

RCB: 4 reps
Variety: AG 2035
Planting Date: 5/19/15
Pre: 5/19/15
Epost: 6/17/15 Soy 3 tri, 6-7 in; Cowh 2-5 in; Vele 2-5 in.
Post: 6/23/15 Soy 3 tri, 10 in; Cowh 3-9 in; Vele 3-8 in.

Soil: Clay; 3.8% OM; 7.4 pH

Precipitation: (inches)
Pre: 1st week 0.53 2nd week 0.30
Epost: 1st week 0.23 2nd week 0.40
Post: 1st week 0.21 2nd week 2.82

Cowh=Common waterhemp
Vele=Velvetleaf
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)
P=0.05

Comments: Heavy weed pressure as shown by yield of check. Excellent weed control provided by all program treatments. Roundup alone had reduced common waterhemp control and was the lowest yielding treatment. No injury noted anytime during the season.

2015
AMS WATER CONDITIONERS with GLYPHOSATE
Southeast Research Farm

Treatment	Rate/A	Vele 7/1/15	Cowh 7/1/15	Cowh 7/7/15	Vele 7/7/15
Post					
Cornerstone 5 Plus	8 oz	45 d	20 b	48 b	58 c
Cornerstone 5 Plus + AMS	8 oz + 2.5%	88 a	45 a	53 ab	96 a
Cornerstone 5 Plus + Class Act NG	8 oz + 1.25%	73 c	43 a	58 ab	88 ab
Cornerstone 5 Plus + Class Act NG	8 oz + 2.5%	81 b	45 a	64 a	94 ab
Check	---	0 e	0 c	0 c	0 d

RCB: 4 reps
Variety: AG 2035
Planting Date: 5/21/15
Post: 6/23/15 Soy 3 tri, 10 in; Cowh 4-11 in; Vele 6-9 in.

Precipitation: (inches)
Post: 1st week 0.21 2nd week 2.82

Soil: Clay; 3.8% OM; 7.4 pH

Cowh=Common waterhemp
Vele=Velvetleaf

P=0.05

Comments: Heavy weed pressure. Low glyphosate rates were used to evaluate differences in additives. Study shows an additive response compared to glyphosate alone, however only the early velvetleaf evaluation had differences between additives.

2015
FOXTAIL BARLEY CONTROL in SPRING WHEAT
Southeast Research Farm

Treatment	Rate/A	Dobr 6/9/15	Ftba 6/9/15	Dobr 6/24/15	Ftba 6/24/15	Ftba 7/23/15	Dobr 7/23/15
Check	---	0 b	0 b	0 b	0 c	0 e	0 f
Post							
Varro + Carnivore + AMS	6.85 oz + 1 pt + 0.5 lb	87 a	90 a	84 a	42 b	20 d	63 e
Varro + Carnivore + Olympus + AMS	6.85 oz + 1 pt + 0.2 oz + 0.5 lb	78 a	90 a	90 a	85 a	37 c	78 d
Huskie Complete + AMS	13.7 oz + 0.5 lb	78 a	85 a	86 a	43 b	30 cd	80 cd
Huskie Complete + Olympus + AMS	13.7 oz + 0.2 oz + 0.5 lb	84 a	88 a	93 a	84 a	53 b	83 bc
Pre & Post							
Olympus & Varro + Carnivore + AMS	0.2 oz & 6.85 oz + 1 pt + 0.5 lb	77 a	92 a	89 a	67 ab	55 b	88 ab
Olympus & Varro + Carnivore + Olympus +AMS	0.2 oz & 6.85 oz + 1 pt + 0.2 oz + 0.5lb	84 a	91 a	94 a	87 a	88 a	90 a
Olympus & Huskie Complete + AMS	0.2 & 13.7 oz + 0.5 lb	78 a	92 a	88 a	62 ab	42 bc	85 abc
Olympus & Huskie Complete + Olympus + AMS	0.2 & 13.7 oz + 0.2 oz + 0.5 lb	83 a	92 a	95 a	81 a	79 a	85 abc

RCB: 4 reps
Variety: Brick
Planting Date: 4/1/15
Pre: 4/5/15 Dobr 1 lf, 1-1.5 in; Ftba 1 lf, 1-1.5 in.
Post: 5/21/15 Sp Wht tiller; Dobr joint; Ftba tiller

Soil: Silty Clay; 3.5% OM; 6.1 pH

Precipitation: (inches)
Pre: 1st week 0.63 2nd week 0.48
Post: 1st week 0.32 2nd week 0.38

Dobr=Downy brome
Ftba=Foxtail barley

P=0.05

Comments: Moderate weed pressure. Foxtail barley control fair to good depending on treatment. Area was very wet at times and that may have kept wheat from being more competitive with foxtail barley.

2015
HUSKIE for BROADLEAF WEED CONTROL in SORGHUM
Southeast Research Farm

Treatment	Rate/A	VCRR 7/7/15	Cowh 7/16/15	Vele 7/16/15	Cowh 8/4/15	Vele 8/4/15	Cowh 10/15/15	Vele 10/15/15	Yield bu/A 11/3/15
Check	---	0 e	0 c	0 c	0 c	0 c	0 c	0 c	35 b
Post									
Huskie + Atrazine + AMS + NIS + Iron Chelate	13 oz + 1 pt + 1 lb + 0.25% + 13 oz	8 d	98 a	99 a	99 a	99 a	99 a	99 a	101 a
Huskie + Atrazine + AMS + NIS + Iron Chelate	16 oz + 1 pt + 1 lb + 0.25% + 16 oz	11 c	97 a	99 a	99 a	99 a	99 a	99 a	104 a
Huskie + Atrazine + AMS + NIS	13 oz + 1 pt + 1 lb + 0.25%	16 b	98 a	99 a	99 a	99 a	99 a	99 a	101 a
Huskie + Atrazine + AMS + NIS	16 oz + 1 pt + 1 lb + 0.25%	15 b	99 a	99 a	99 a	99 a	99 a	99 a	108 a
Huskie + Atrazine + 2,4-D ester + AMS + NIS + Iron Chelate	13 oz + 1 pt + 4 oz + 1 lb + 0.25% + 13 oz	5 d	99 a	99 a	99 a	99 a	99 a	99 a	104 a
Huskie + Atrazine + Starane Ultra + AMS + NIS + Iron Chelate	13 oz + 1 pt + 3 oz + 1 lb + 0.25% + 13 oz	6 d	98 a	99 a	99 a	99 a	99 a	99 a	102 a
Atrazine + Buctril	1 pt + 1 pt	0 e	85 b	95 b	88 b	93 b	89 b	97 b	90 a
Huskie + AMS + NIS	16 oz + 1 lb + 0.25%	21 a	99 a	99 a	99 a	99 a	99 a	99 a	95 a

RCB: 4 reps
Variety: DK 28E
Planting Date: 6/2/15
Post: 7/1/15 Sorghum V5 15 in; Cowh 3-10 in.

Soil: Silty Clay Loam; 3.0% OM; 6.8 pH

Precipitation: (inches)
Post: 1st week 2.63 2nd week 0.00

Cowh=Common waterhemp
VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

P=0.05

Comments: Heavy weed pressure as shown by yield of check. All Huskie treatments provided excellent control of velvetleaf and waterhemp. Some early season crop response was noted. Combination treatments with iron chelate had less response than Huskie alone.

SOUTHEAST RESEARCH FARM ANNUAL REPORT
South Dakota State University
2015 Progress Report
Agricultural Experiment Station
Plant Science Department
South Dakota State University, Brookings, SD 57007
Southeast Research Farm, Beresford SD 57004

Observations on Soil Temperature and Moisture in Relation to Tillage, Cover Crops, and Grazing

Peter Sexton*, Howard Woodard,
Sara Berg, and Ruth Stevens

INTRODUCTION

Tillage, cover crops, and grazing all impact residue levels for the following crop. Residue, in turn, influences soil temperature which is one of many factors influencing crop growth. This is particularly true for corn since its growing point is below ground up to the V6 growth stage (which generally occurs about 4 to 5 weeks after planting), so its rate of development early in the season is largely governed by soil temperature. With this in mind, soil temperature sensors were placed in several corn trials at the Southeast Farm to begin collect data on how different management systems impact soil temperature.

METHODS

Individual data loggers (model Hobo Pendant Data Loggers, Onset Computer Corp., Bourne, MA) were placed at 2" depth in three trials with corn: a trial with no-till corn following several different cover crop blends; another trial looking at impacts of grazing of cover crops on yield of the following corn crop; and also in a long-term rotation trial comparing no-till versus tilled systems in a corn/soybean rotation. In each of these trials sensors were placed in one replicate of the study – so this is a preliminary set of data. In addition to the above, soil moisture sensors (model Em50 Data Logger with 5 TM Sensors, Decagon Devices, Pullman, WA) were placed at depths of 12" and 24" in three replicates comparing tilled versus no-tilled plots in a corn/soybean rotation. Due to problems with damage to wiring, the conventional till soybean treatment is only represented by a single replicate through the season. Because of the limited replicates for this data, these results should be viewed as preliminary observations. Data on corn yields from each of these trials is given in other sections of this annual report.

RESULTS AND OBSERVATIONS

Figures 1 through 4 show diurnal soil temperature change at a 2" depth under a tilled and a no-till plot from the rotation study at the Southeast Farm – these two plots were seeded to corn following soybeans. Figure 5 shows the hourly temperature differential through the season

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for the two plots. Basically we see that initially the maximum soil temperatures in the no-till plot were cooler than in the tilled plots, then as the canopy began to close the difference in temperature was essentially lost, with a weak trend for the no-till plot to be slightly warmer during seed-filling. Average soil temperature from May 15 to June 30 was 1.8 F cooler in the no-till versus the tilled plot. Assuming it took 35 days for the no-till plants to reach the V6 growth stage (where the growing point rises above the soil surface) this represents a difference of approximately 60 gdd, or 2 to 3 days of relative maturity.

It should be noted that the 2015 season at the Southeast Farm was marked by mild temperatures and above average rainfall in July, August and September - receiving over 7" more rainfall than normal in fairly dispersed rains (i.e. not extremely excessive at any one point in time). In a season with drought stress, results would be different than those observed in this almost ideal season; in a drought season one might expect the two systems to separate more during seed-filling as the tilled soil would dry out faster without residue on the surface, the canopy would tend to open with leaves rolling, and these two factors would push up soil temperature (and water demand) higher in the tilled plots. So the reader should keep in mind that temperature differentials between tilled and no-till systems will of course depend on soil moisture status and will most likely be different where water is limiting versus where it is adequate or excessive.

Figure 6 shows diurnal soil temperature early in the season for no-till corn seeded into oat stubble with three different cover crop treatments from the fall of the previous season. In this trial, the no-cover crop treatment showed wider diurnal variation, with the ungrazed cover crop showing less diurnal variation, and the grazed treatment intermediate. This is most likely a function of residue on the surface, where grazing removed about half the residue from the cover crop. With heavier residue we see cooler day temperatures and warmer night temperatures in the ungrazed cover crop plot.

Figures 7, 8, and 9 show soil temperature hourly differential between the treatments (control minus grazed, control minus ungrazed, and grazed minus ungrazed, respectively). In these plots up to July, the no cover crop treatment tended to be warmer than the cover crop plots, and the grazed cover crop plot tended to be warmer than the ungrazed plot. The average temperature difference from mid-May to the mid- June was 1.0 F for grazed versus ungrazed, 1.0 F for control versus grazed, and 2.0 F for control versus ungrazed. Over a 35 day period, this would correspond to about a 70 gdd difference between the control and the ungrazed treatment, with the grazed treatment lying between the two (35 gdd difference either way). Temperature differences between the treatments tended to fade away after the end of June as the corn canopy closed.

Figure 10 compares hourly soil temperature difference between two different cover crop treatments – grass based (75 % grasses) versus broadleaf based (75 % broadleaves) cover blends from the previous season on winter rye stubble. In this case, the broadleaf-based blend (which tends to breakdown faster than the grass-based blend) showed slightly warmer soil temperature at a 2” depth until canopy closure (averaging 0.6 F warmer temperature from June 5 through June 30). Again, differences between the two plots tended to be lost after canopy closure.

Figures 11 through 14 show soil moisture and temperature at deeper depths, 12” and 24”, in no-till and conventional till plots that are in a corn/soybean rotation within the long-term rotation study at the Southeast Farm. The conventional till soybeans were represented by only one replicate through the season while the other treatments were represented by two or three replicates through the season (there was some variation on replication number due to damage to wires from wildlife). The main trends here were that the no-till plots tended to have higher levels of soil moisture than did the conventional tilled plots, and the soybeans tended to show higher soil moisture than did the corn plots. Residue in the no-till plots would slow evaporation and would support higher rates of infiltration during rainfall events; hence greater soil moisture levels with no-till in general. Within the no-till plots, soybeans would be growing in corn residue whereas corn would be growing in soybean residue, which would favor greater soil moisture in the no-till soybean plots (due to higher levels of residue from the previous crop). Differences in soil temperature at these depths were minimal through the season (Fig. 13 and 14), although the no-till corn appeared to have slightly lower soil temperature during seed filling.

ACKNOWLEDGEMENT

The authors wish to acknowledge the Sand County Foundation, Madison, Wisconsin; for financial support to purchase and place soil moisture sensors and data loggers in corn and soybean plots in the long-term tillage study being conducted at the SDSU Southeast Farm.

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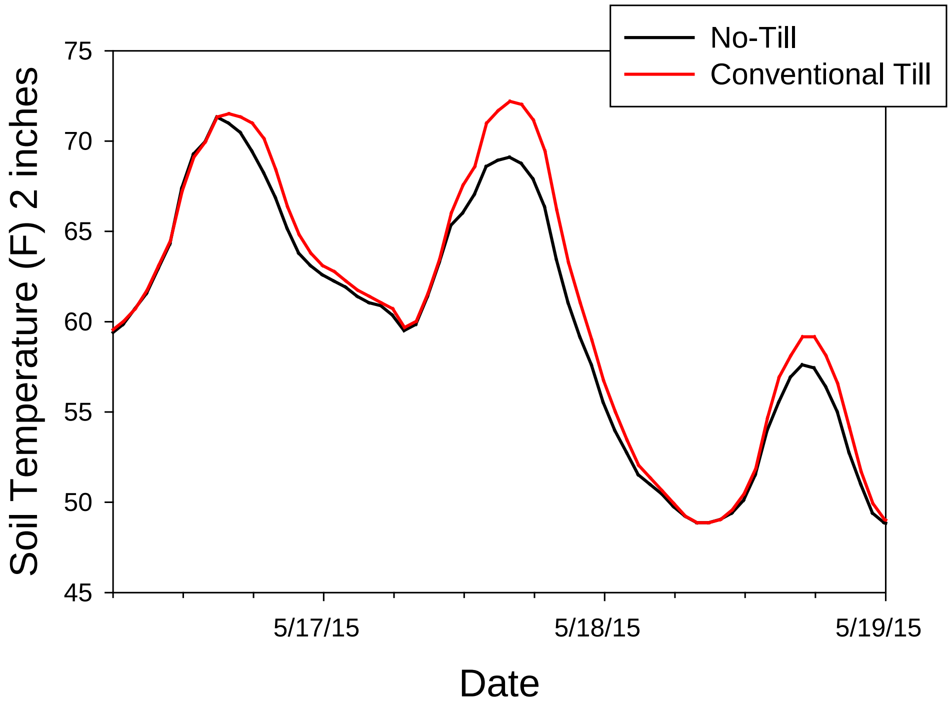

Fig. 1. Example of diurnal temperature change when corn is in the seedling stage in no-till and conventional tilled plots, seeded to corn on May 5, in the long-term rotation study at the SDSU Southeast Research Farm in 2015. The previous crop was soybeans.

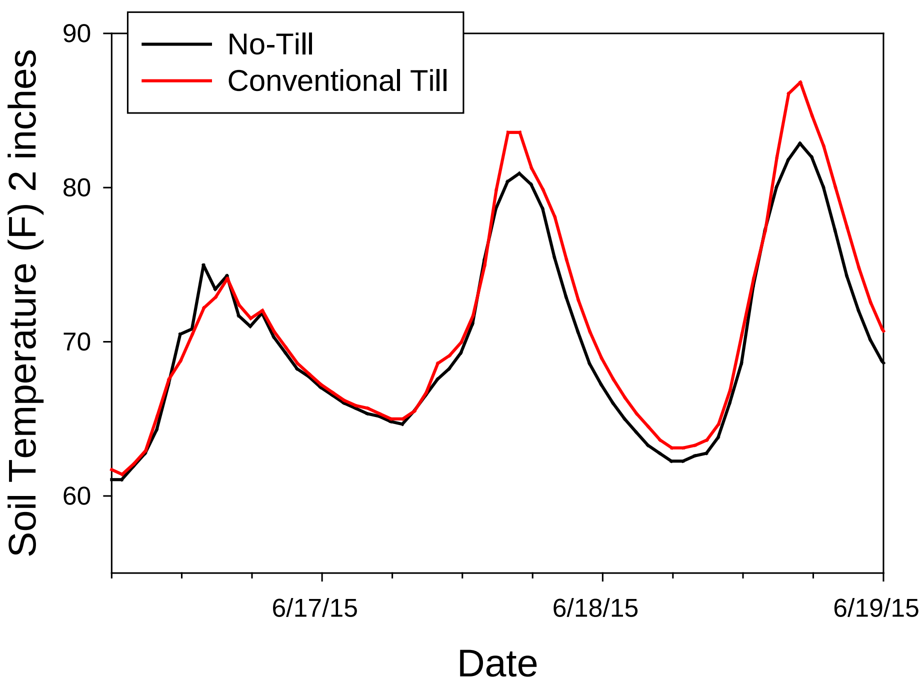

Fig. 2. Example of diurnal temperature change in mid-June, with corn approaching canopy closure, in no-till and conventional tilled plots. These plots were seeded to corn on May 5 in the long-term rotation study at the SDSU Southeast Research Farm in 2015. The previous crop was soybeans.

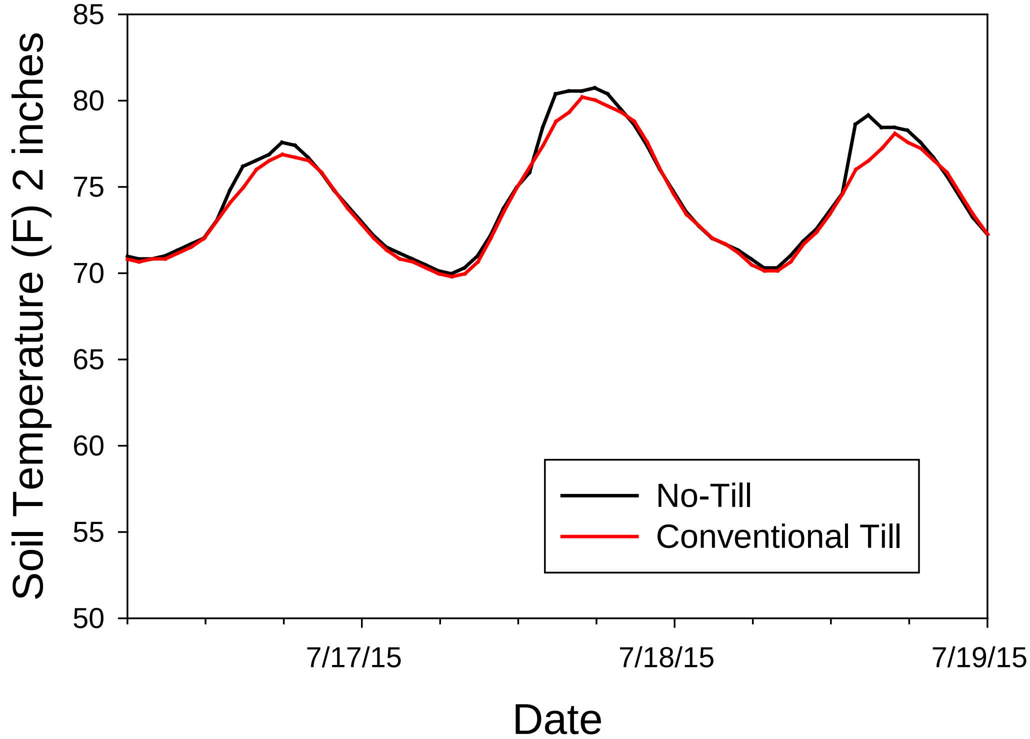

Fig. 3. Example of diurnal temperature change in mid-July, after canopy closure, in no-till and conventional tilled plots. These plots were seeded to corn on May 5 in the long-term rotation study at the SDSU Southeast Research Farm in 2015. The previous crop was soybeans.

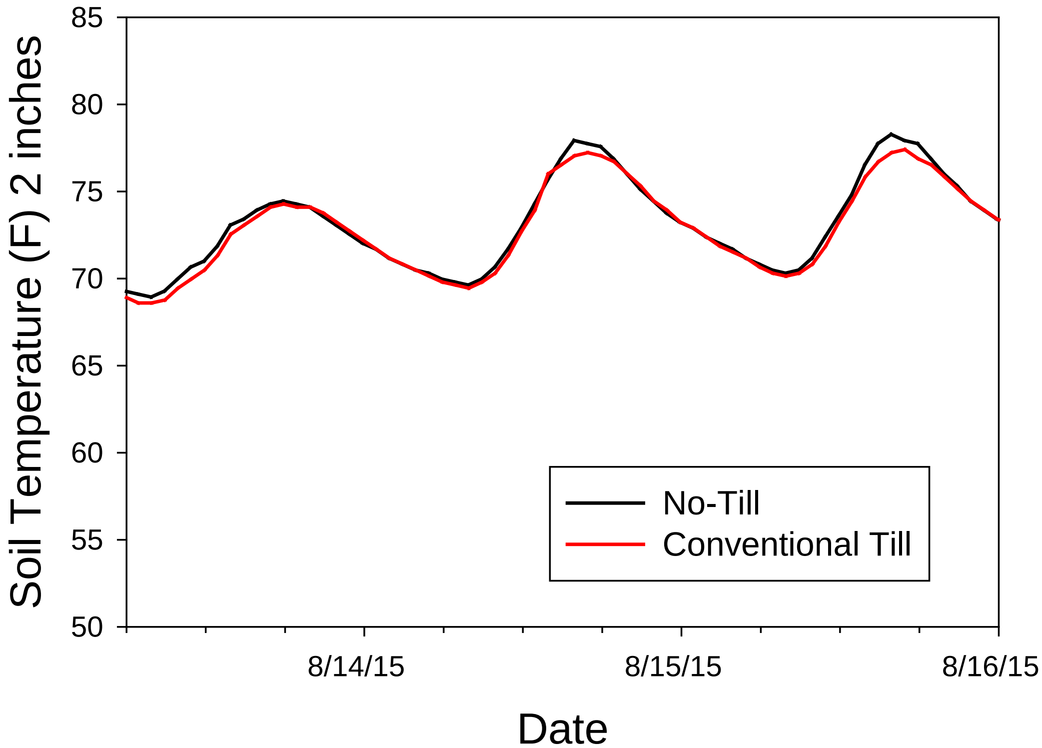

Fig.4. Example of diurnal temperature change in mid-August, during seed-filling, in no-till and conventional tilled plots. These plots were seeded to corn on May 5 in the long-term rotation study at the SDSU Southeast Research Farm in 2015. The previous crop was soybeans.

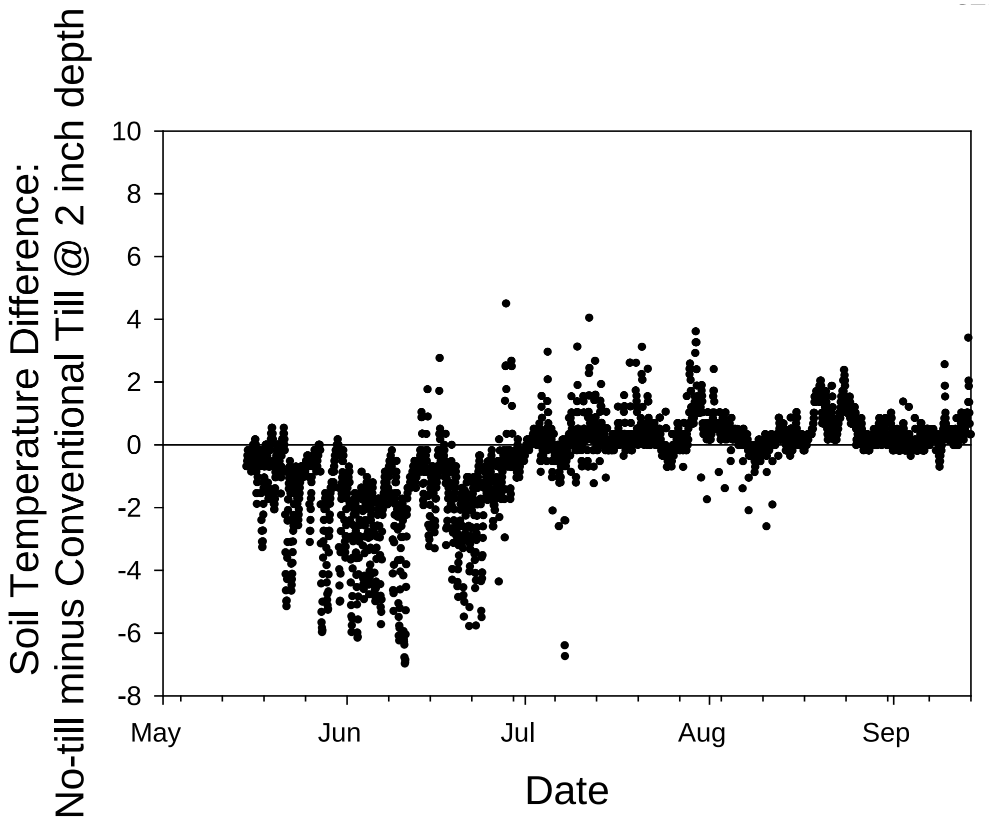

Fig. 5. Temperature difference, recorded on an hourly basis, between no-till and conventional till corn plots across the season from May 6 to Sept. 14, 2015. Each point represents an hourly temperature measurement. These plots were seeded to corn on May 5 in the long-term rotation study at the SDSU Southeast Research Farm in 2015. The previous crop was soybeans.

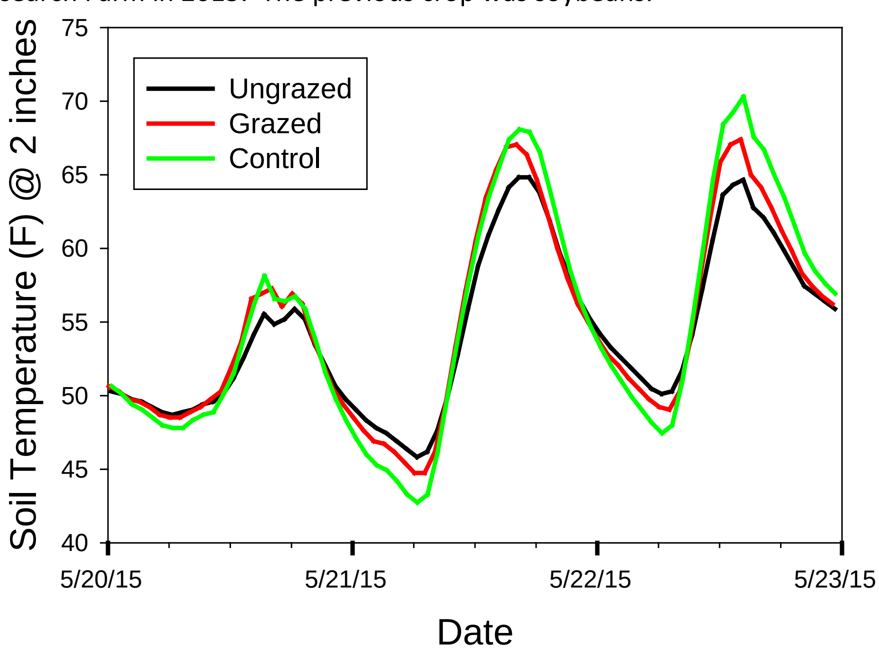

Fig. 6. Example of diurnal temperature change when corn is in the seedling stage in no-till plots that had different cover crop treatments ('control' = no cover crop; grazed cover crop; ungrazed cover crop) imposed the previous fall. The cover crop consisted of a broadleaf-based blend seeded into oat stubble in August 2014. Note the wider diurnal change in temperature in the control treatment (no cover crop).

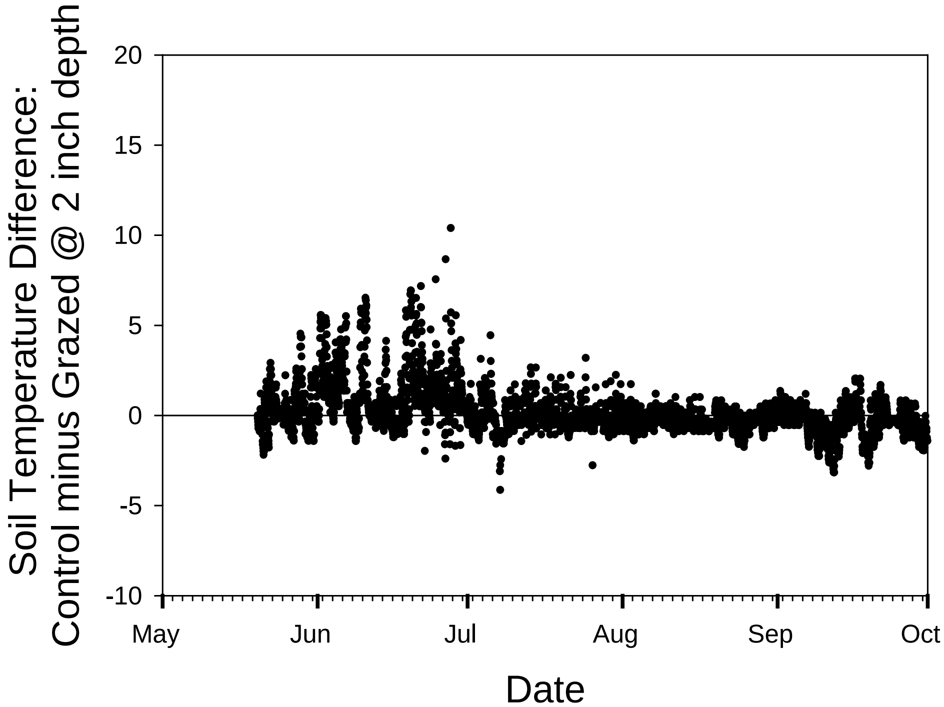

Fig. 7. Temperature difference, recorded on an hourly basis, between control (no-cover crop) and grazed cover crop treatments from 2014 seeded to corn in 2015 under no-till management. The previous grain crop was oats. Each point represents an hourly temperature measurement. This was part of a grazing study conducted at the at the SDSU Southeast Research Farm.

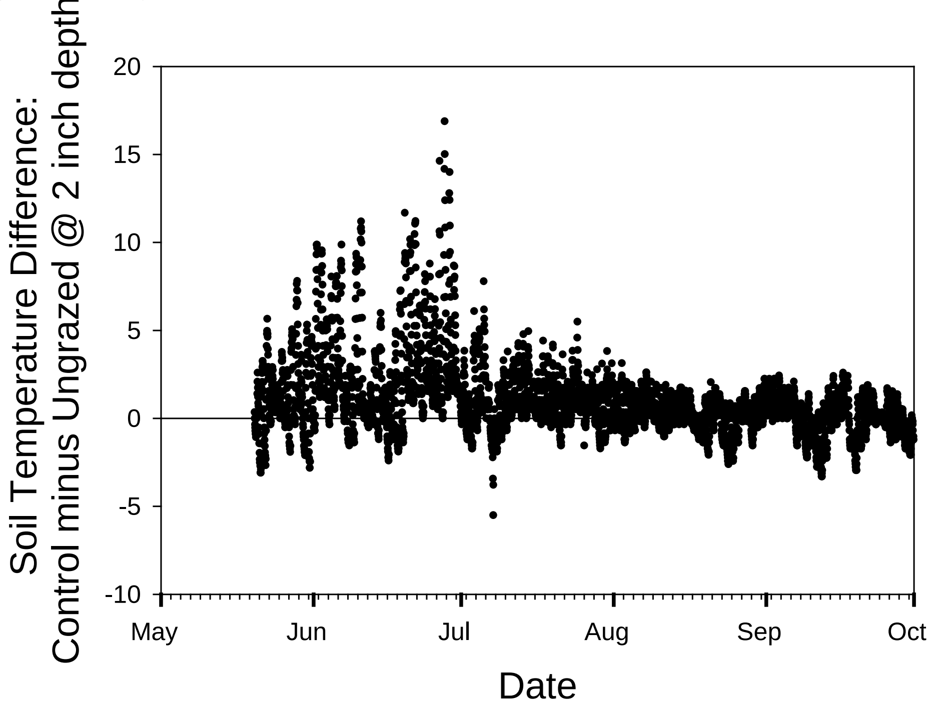

Fig. 8. Temperature difference, recorded on an hourly basis, between control (no-cover crop) and ungrazed cover crop treatments from 2014 seeded to corn in 2015 under no-till management. The previous grain crop was oats. Each point represents an hourly temperature measurement. This was part of a grazing study conducted at the SDSU Southeast Research Farm. By way of comparison, this data is plotted on the same scale as Fig. 7 and 9.

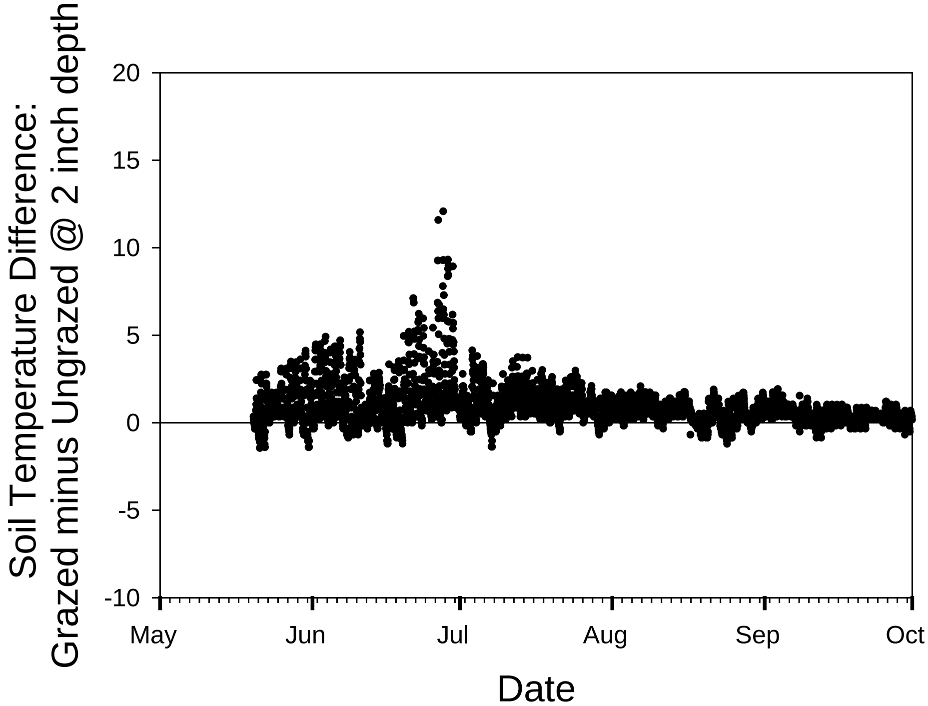

Fig. 9. Temperature difference, recorded on an hourly basis, between grazed and ungrazed cover crop treatments from 2014 seeded to corn in 2015 under no-till management. The previous grain crop was oats. Each point represents an hourly temperature measurement. This was part of a grazing study conducted at the SDSU Southeast Research Farm.

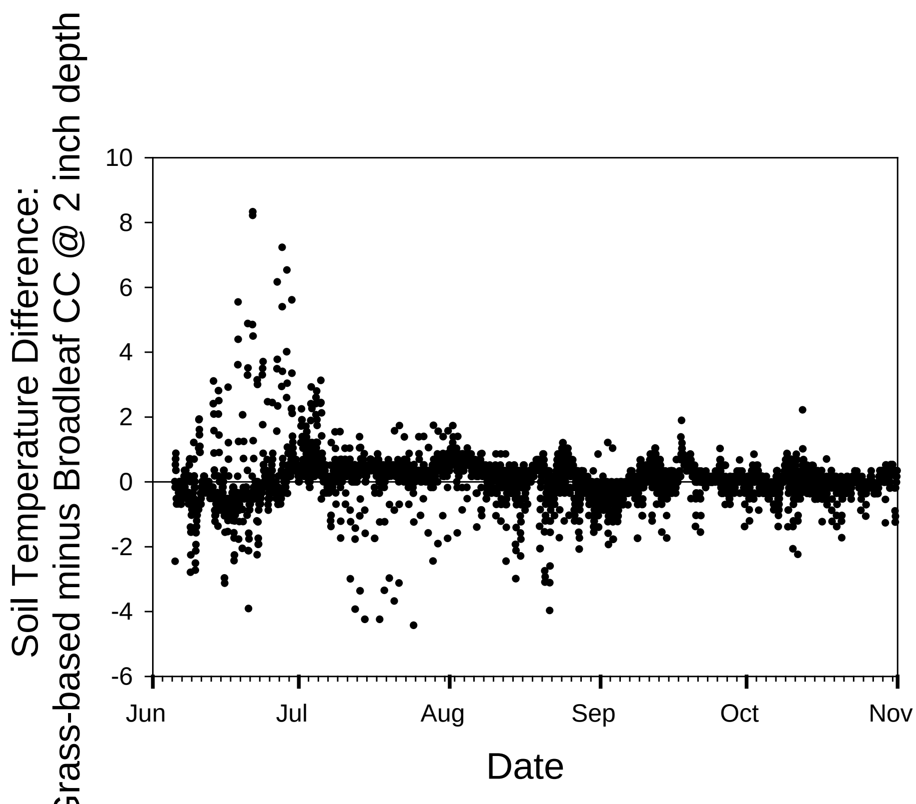

Fig. 10. Temperature difference, recorded on an hourly basis, between a grass-based and broadleaf-based cover crop treatments from 2014 seeded to corn in 2015 under no-till management. The previous grain crop was winter rye. Each point represents an hourly temperature measurement. This was part of a cover crop study conducted at the SDSU Southeast Research Farm.

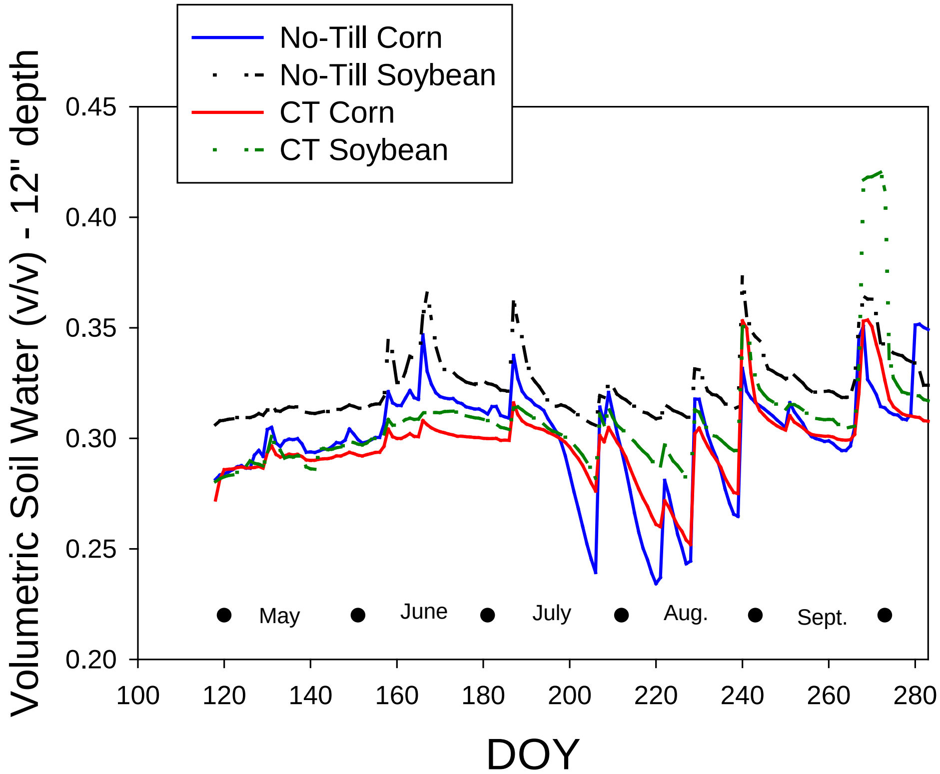

Fig. 11. Volumetric water content at 12” depth over the course of the season for corn and soybeans under tilled and no-till management in a long-term trial at the SDSU Southeast Research Farm in 2015. For the most part, data are means of three replications. However, due to damage to wiring, the conventional till soybean data is only represents data from a single replicate.

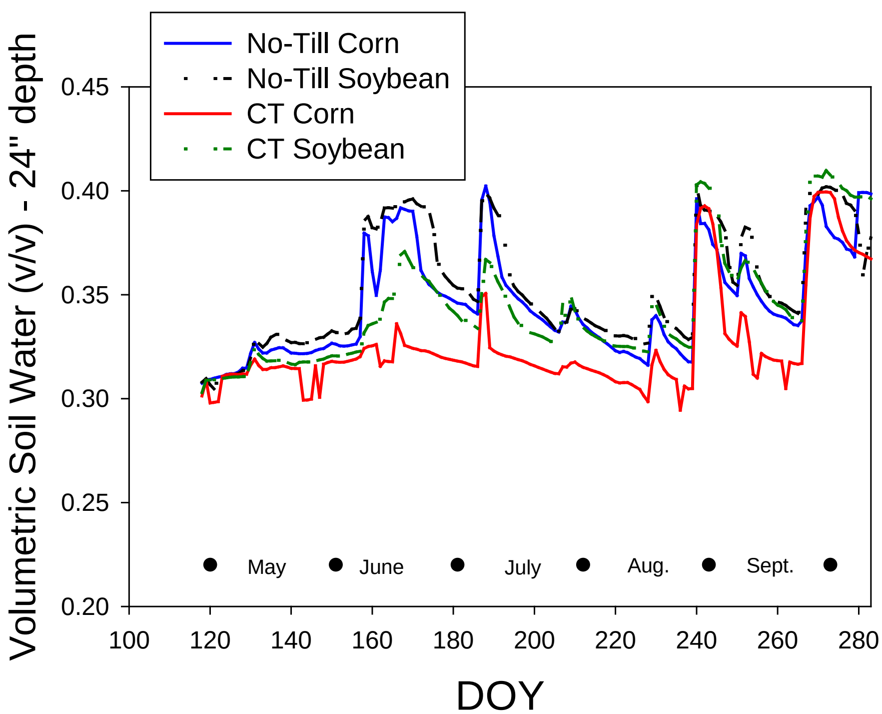

Fig. 12. Volumetric water content at 24” depth over the course of the season for corn and soybeans under tilled and no-till management in a long-term trial at the SDSU Southeast Research Farm in 2015. However, due to damage to wiring, the conventional till soybean data is only represents data from a single replicate.

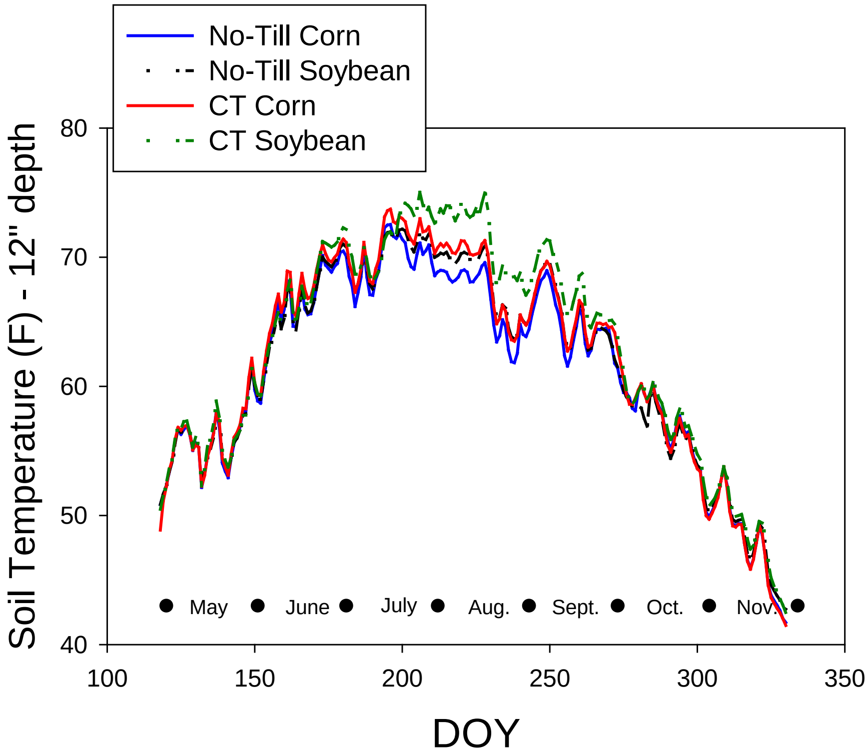

Fig. 13. Soil temperature at 12" depth over the course of the season for corn and soybeans under tilled and no-till management in a long-term trial at the SDSU Southeast Research Farm in 2015. However, due to damage to wiring, the conventional till soybean data is only represents data from a single replicate.

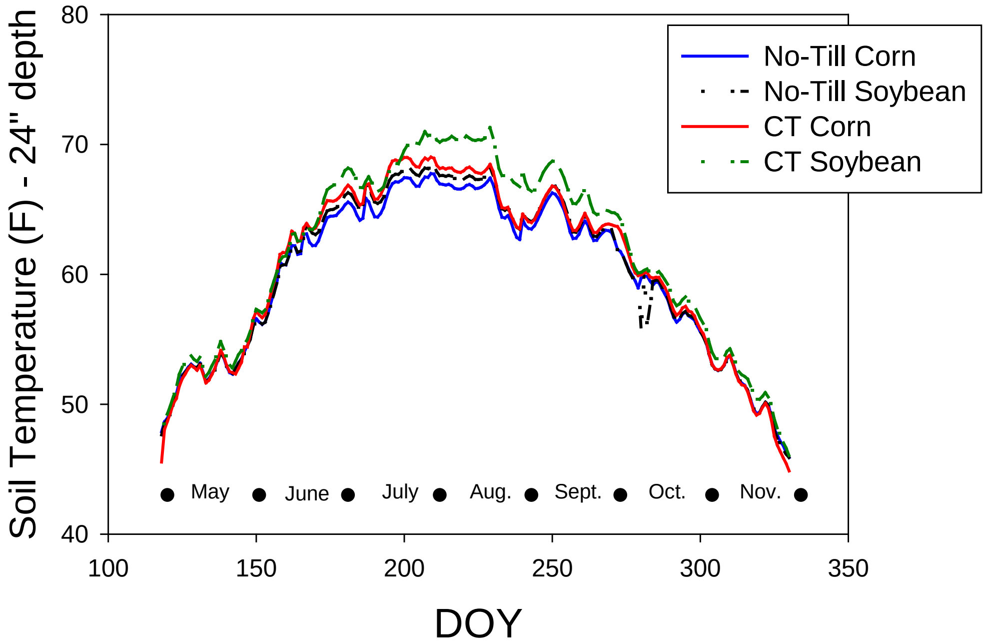

Fig. 14. Soil temperature at 24" depth over the course of the season for corn and soybeans under tilled and no-till management in a long-term trial at the SDSU Southeast Research Farm in 2015. However, due to damage to wiring, the conventional till soybean data is only represents data from a single replicate.

SOUTHEAST RESEARCH FARM ANNUAL REPORT
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Commentary by Doug: *They said it could be worse and they were right.*

Doug Johnson*

An old Chinese curse says "*May you live in interesting times.*" Well, it's starting to look interesting. Most, if not all, commodities are lower. Metals, such as steel, brass, and copper, are down because of the slowing world economy. I have heard the bid for scrap iron locally is as low as $20/ton. Even gold and silver have been weaker in spite of the wild swings of world stock markets, but they are starting to wake up. Oil has been under $30.00/bbl. and looking very unstable.

There is talk of oil company failures in the near future. Of course, cheap oil lowers the value of ethanol which means the corn market takes pressure.

Livestock was a bright spot in the markets a year ago. A serious pig disease had lowered slaughter numbers, and southern droughts had reduced cow herds. Feed costs were low (ouch!! if you only raise grain). If you had livestock to sell, you were doing really well.

The hog numbers have increased back to normal, and a little bit more. Prices are radically down. I recently was told of a large lot of cull sows selling for $.15/lb. at auction. Market hogs are $.40/lb. and losing money.

Cattle are even worse than the hogs. According to the USDA, cattle on feed more than 120 days are up 12.2%. This past fall cash trade was under $120/cwt. This was a drop of more than $40/cwt and losses were around $500/hd. The price is up to around $130/cwt at present, but that is still far below breakeven cost of production. The only ones who made out very well last year were the ones selling feeder calves (and not buying more cows). Of course, the price of feeder cattle has dropped because of the fat cattle prices. However, the price of feeders is still better than in the past.

Next, let's go on to the grains. There are multi-year record high supplies of corn and soybeans in the USA, and even worse, internationally. Because of the strong dollar in world money markets and high grain supplies all over the world, exports are down from last year. According to the USDA, corn exports are 23% below this time last year. Soybean exports are down 14%. Corn and soybean prices are much lower than two years ago.

I have included a couple of graphs (Fig. 1 and Fig. 2) showing the USDA's twenty year production and average yearly crop price for corn and soybeans. The first thing to notice is that inventory of both crops is a lot larger in the last ten years, in spite of weather challenges. The second thing is that prices have had wilder swings in the same period because of the drought and highly variable exports. This is also when ethanol and biodiesel became very important. The big thing to notice is how often the highs in one line roughly match the lows in the other line. Bigger supplies means lower prices and smaller crops give you the opposite. Right now, there is a large supply hanging over the market.

The best example in both crops is the drought year of 2012. The corn graph shows prices spiking to an all-time high with the small

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crop. Soybeans show an even more extreme reaction. In fact, the price part of the graphs had to be expanded to fit the higher price. Since the larger crops of the next three years were produced, prices have steadily fallen. They have fallen from the extreme highs into a range that roughly matches the average prices of the recent past. This does not bode well for a return to 2012 prices. If you take the drought year out, present prices may even be considered to be in a normal range.

A large amount of the 2015 corn and bean crop is setting in farmer's bins unpriced, hoping for a rise in prices. Every grain trader knows that after Dec. 31, farmers will sell grain to cover loan payments and expenses. The only real chance of increasing prices is a weather scare next summer. In the six months between then and now, the traders are not going to raise their bids until, and if, that happens. In fact, if enough grain moves into the market, I would expect the bids to drop.

Argentina's new government has let the *peso* value drop in world currency markets to slow high inflation and help increase exports. There is a lot of grain stored in farmer's bins as a hedge against inflation. As long as you have the grain in your ownership, you have some inflation protection. If the inflation rate drops, you don't need as much protection and the then sold grain can enter the export market; at least that's the theory. Brazil is in recession and needs exports to help the economy improve. Both countries have a lot of grain and it needs to be sold for export; and the yield estimates are pointing to record crops this winter in both countries. A lot of grain could move to the world markets this next year from just these two countries.

I know that the above issues make this look like doom and gloom thinking, and maybe that is right. A bright spot in the picture is the high yields of high quality grain in 2015. Many farmers were able to make some money by producing more bushels than they projected. That is going to be difficult to do two years in a row.

Most farmers are going to have to reduce spending and that is going to be hard. The other way is to increase income and that is even harder. If there are facilities, and an agreeable banker, you can look for livestock that might make some money. An off farm job may have to be considered, especially if it has health insurance. A new business on the side is a possibility. A vacation can be taken in the Black Hills instead of Mexico. Maybe the pickup or car can be driven for another year. I have heard some farmers are being told by bankers that their personal living expenses have gotten higher than they can justify in today's farm economy. And the living expenses WILL HAVE TO DROP if they expect a loan for 2016.

The USDA thinks that 2015 farm income will drop 55% from 2013. This is not the time to wish it would all go away. The general feeling among lenders is that crop expenses need to drop $100/acre or more to get to breakeven. Iowa State has a study that shows land prices have dropped 15% in the last two years, but rents have dropped only 9%. Landlords are not happy about lower rents. After all, to a lot of them it is a big part of their living, and if they do lower rents, it is unlikely to be anywhere near the $100/acre needed. A choice may have to be made if it is worth keeping the land just to work for nothing or even less. Rents will be slow to fall as long as somebody else will pay the price.

A hopeful sign is much cheaper fuel. I have heard of farm diesel fuel selling at just over $1.10/gal. This will be a big expense saving. I have not heard of lower nitrogen prices, but with oil so low, it must be on the way. If a soil test is done, and P & K are high enough, it is possible to lower the application rates for year or two.

Seed and pesticides are tricky to lower. A lot of times what you save up front is more than lost on the yield. I know because I've been there, done that, and it did not work. Maybe you can find another dealer who will bid to get your business. Look for another brand of seed for the same genetics, or really close. Another company may package chemicals that provide the same weed control, but is cheaper. At the least, check around and see if there is a better deal to be had.

Cheap fuel, CAREFUL fertilizer application, and a possible better deal on some other inputs will all add up. Shave a little rent expense if you have reasonable landlord. Think about dropping really high priced rented land. Most of those high rent landlords will take the land away as soon as somebody bids more anyhow. Now is not the time to buy machinery without careful thinking and planning. If you manage cash flow this year, there may be some good deals.

This is going to be a tough year. This will not be the year to just do business as usual. Look for better deals. Do not do tillage just because you think it looks nicer. A number of people do not agree with that theory anyhow. Do some of the jobs that you have been hiring someone else to do. Maybe you can do custom work or trade with neighbors. Make every expense count.

If you plan on still farming two years from now, you do not want to be planning business as usual. The plan may be to lose as little as possible now and be ready for the good times when they show up. At the very least, be careful. Do not expect different results unless you change what you are doing.