SDSU Agricultural Experiment Station Research

FY15

FINAL

SDSRPC RESEARCH REPORT

South Dakota State University

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Sponsored by

SOUTH DAKOTA SOYBEAN RESEARCH & PROMOTION COUNCIL

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South Dakota Soybean Research and Promotion Council 2014-2015 project report

Achieving 100 bu/a soybean yields: Developing, testing, and sharing high yield protocols with South Dakota soybean producers.

Objective 1: Targeted research to assess soybean seeding rates, planting dates, planting spacing and seed treatments (Thandiwe Nleya and Matthew Schutte)

1. Row Spacing/Seeding Rate /Variety for Maximizing Yield

Introduction

This research builds on the project conducted from 2009 to 2013 on soybean seeding rates in a range of soybean maturity zones (South Shore, Volga, Beresford) in South Dakota. Data from this research revealed that narrow row yields were equal to or greater than yields in 30-inch row spacing and that higher seeding rates also increased yield. Additionally, variety performance was affected by row spacing in some instances. Unfortunately, there has been a 24% shift in acres planted back to wider rows (20-inch to 30-inch) from 2009 to 2013 in South Dakota according to USDA-NASS. Some important changes in the treatment structure are needed to address current producer trends and concerns on variety selection for narrow versus wider row spacing.

Materials and Methods

In 2014 research was conducted at the SDSU Southeast experimental farm (Beresford), Volga, and Aberdeen. Treatments included two soybean varieties, one variety adapted to narrow rows and white mold resistance and the other, adapted to wide rows and susceptible to white mold. The varieties were Beresford: 2306R2 (resistant) and 2408R2 (susceptible) ; Volga: 2108R2 (resistant) and 2207R2 (susceptible); Aberdeen: 0906R2 (resistant) and 1108R2 (susceptible). At each location the soybean varieties were planted at two row spacings (8 and 30-inch), and four seeding rates (100K, 135K, 170K, and 205K). The experiments were planted on 30 May, 28 May, and 9 June at Volga, Southeast Farm, and Aberdeen, respectively.

Results

Stand count showed an average emergence rate of 80%. White mold assessment did not show any significant differences in white mold incidence between 8 and 30-inch rows but higher plant populations had slightly greater white mold incidence compared to lower plant populations but this was not translated into yield. When data were combined over two locations, no yield differences were observed due to soybean variety (resistant vs susceptible (Table 1)). Soybean yields were greatest at Beresford (70.6 bu/ac) and lowest at Aberdeen (59 bu/ac). Data collected at Volga were not analyzed due to a high number of missing plots. Overall, soybean yield increased with increase in plant population with greatest yield recorded at the population of 205K. Seed protein and seed oil content showed insignificant changes with changes in row spacing, soybean variety, or seeding rate.

The effect of row spacing and seeding rate however, changed with location (Table 2). At Beresford the two row spacings gave similar yields (70.9 bu/ac for 8-inch vs 70.4 bu/ac for 30-inch) while at Aberdeen the 8-inch row spacing had greater yield than the 30-inch row spacing (62.3 vs 56.0 bu/ac) (Table 2). Soybean seed yield increased as plant population was increased at the two locations, Aberdeen and Beresford. Greatest yields were obtained at the population of 205K at both locations. However, the difference in yield between the 100K and the 205K plant populations was only 3 bu/ac at Aberdeen and slightly more (5 bu/ac) at Beresford. Protein content at individual locations, showed a slight increase with increasing seeding rate (Table 2).

These results are preliminary. The second season experiment is currently in the field and the 2-year results will be reported next year.

Table 1. Mean effects of location, row spacing, soybean variety, and seeding rate on yield, seed protein and seed oil content for soybean in 2014.

	Yield (bu/ac)	**Seed Protein (%)**	**Seed Oil (%)**
Location			
Aberdeen	59.0	33.3	18.0
Beresford	70.6	34.6	17.8
Mean	**64.8**	**33.9**	**17.9**
LSD (0.05)	**1.11**	**ns**	**ns**
Spacing (inches)			
8	66.6	33.9	17.9
30	63.1	34.0	17.1
Mean	**64.8**	**33.9**	**17.5**
LSD (0.05)	**1.12**	**ns**	**ns**
White Mold			
Resistant	64.4	34.0	17.9
Susceptible	65.4	33.9	17.9
Mean	**64.9**	**33.9**	**17.9**
LSD (0.05)	**ns**	**ns**	**ns**
Seeding rate			
100K	62.5	33.5	18.0
135K	64.8	33.8	17.1
170 K	65.6	34.1	17.9
205 K	66.7	34.3	17.8
Mean	**64.9**	**33.9**	**17.7**
LSD (0.05)	**1.30**	**ns**	**ns**

Table 2. Influence of location on yield and seed protein content for two soybean varieties grown with two row spacings, variety, and at four seeding rates in 2014.

	Aberdeen	Beresford	Aberdeen	Beresford
	Yield (bu/ac)		Seed Protein (%)	
Spacing (inches)				
8	62.3	70.9	33.0	34.8
30	56.0	70.3	33.6	34.4
Mean	**59.1**	**70.6**	**33.3**	**34.6**
LSD (0.05)	**2.6**	**ns**	**ns**	**ns**
Variety				
Resistant	57.8	70.9	33.6	34.4
Susceptible	60.6	70.4	32.9	34.8
Mean	**59.2**	**70.6**	**33.2**	**34.6**
LSD (0.05)	**1.3**	**ns**	**ns**	**ns**
Seeding rate				
100K	57.5	67.6	32.7	34.3
135K	58.9	70.6	33.3	34.4
170 K	59.3	71.9	33.6	34.6
205 K	60.9	72.4	33.6	35.0
Mean	**59.1**	**70.6**	**33.3**	**34.6**
LSD (0.05)	**1.9**	**1.8**	**0.5**	**0.2**

2. Planting Date/Seeding Rate/Variety for Maximizing Yield

Introduction

Climate change trends and simple year-to-year variability in weather often pushes the limits of crop insurance coverage for early (April 26) and late planting (June 10 with reduced coverage until July 5). Risk Management Agency (RMA) reviews planting dates for insurance coverage and data from long-term planting date studies have been used to make revisions. As a result, it is important to initiate a long-term date of planting study for soybeans to assess the yield response curve and appropriate reductions in insurance coverage.

Materials and Methods

In 2014 this research was conducted at Volga. The treatments included:

- Four planting dates: May 16, May 30, June 13 and June 27.
- Two seed treatments (with and without fungicide),
- Two soybean variety two maturities (1.4 -1405R2) and 2.4-2402R2)
- Four seeding rates (100K, 135K, 170K, and 205K) using 30 inch row spacing.

Results

Stand counts showed little variation among planting dates. Over the two locations, yield, seed protein and seed oil content decreased with delayed planting (Table 3). Seed yield from the June 27 planting was less than half of the yield from the May 16 planting date. The earlier maturing soybean variety (1.4 maturity) had greater yield than the later maturing variety (2.4 maturity). Seed yield increased with increasing seeding rate. The fungicide treatment did not influence soybean yield.

The effect of individual planting dates on soybean yield is shown on Tables 4 and 5. With regard to seeding rates, there was a slight increase of yield as population increased with the greatest yield reached 170K irrespective of planting date (Table 4). Also late planting resulted in significant differences in yield due to variety maturity group. The earlier maturing variety (1.4 maturity) yielded significant greater than the later maturing variety (2.4 maturity) at later planting dates. At the earliest planting date, there was a very slight yield loss for using 2.4 maturity (1.5 bushels). At later planting dates the yield difference was much greater, with 2nd planting date resulting in a 2.2 bushel loss, 3rd planting date having 4.5 bushel loss, and 4th planting date having 15.5 bushel loss. These significant yield losses from differences in maturity groups can partly be due to early frost that occurred at the Volga location.

The R1 data showed that soybean planted on May 16 took on average 53 days to reach R1, soybean planted on May 30 took 47 days, and soybean planted June 13 and June 27 took only 45 days. Comparing R1 and R8 showed significant differences in the number of days the soybeans were in the reproductive phase depending on planting date. For the first two planting dates, the number of days was similar but as planting date was delayed, there was a sharp decrease in the number of days that soybean plants spent in the reproductive phase. There is a strong correlation between the number of days spent in the reproductive phase and yield.

Oil percentage dropped significantly as planting date was delayed while protein stayed relatively the same for the first three planting dates while the last planting date had a drop in protein percentage.

Table 3. Mean effects of planting date, variety maturity group, plant population and fungicide on yield, seed protein and seed oil content for soybean grown at Volga, SD in 2014.

PD	**Yield (bu/ac)**	**Seed Protein (%)**	**Seed Oil (%)**
May 16	60.0	34.2	17.7
May 30	53.6	34.9	16.9
June 13	39.7	34.2	16.1
June 27	22.3	33.6	14.9
Mean	**43.9**	**34.2**	**16.4**
LSD (0.05)	**2.0**	**0.8**	**0.4**
Maturity			
1405R2 (1.4)	46.9	35.0	16.8
2402R2 (2.4)	40.9	33.5	16.0
Mean	**43.9**	**34.2**	**16.4**
LSD (0.05)	**0.6**	**0.2**	**ns**
Seeding rate			
100K	42.1	33.8	16.7
135K	44.4	34.1	16.4
170K	44.9	34.5	16.2
205K	44.3	34.6	16.4
Mean	**43.9**	**34.2**	**16.4**
LSD (0.05)	0.8	ns	ns
Fungicide			
With	44.6	34.2	16.4
Without	44.2	34.3	16.4
Mean	**44.4**	**34.2**	**16.4**
LSD (0.05)	**ns**	**ns**	**ns**

Table 4. Influence of planting date (PD) and seeding rate on soybean yield (bu/ac)

	PD1	PD2	PD3	PD4
Seeding rate	**Yield (bu/ac)**			
100K	58.4	52.1	37.3	20.6
135K	60.5	54.5	40.9	21.6
170K	61.3	53.9	41.4	23.0
205K	60.0	53.9	39.2	24.1
Mean	**60**	**53.6**	**39.7**	**22.3**
LSD (0.05)	ns	1.6	1.6	0.94

Table 5. Influence of soybean maturity group on yield, seed protein content and seed oil content for soybean grown at four planting dates (PD) at Volga, SD.

	PD1	PD2	PD3	PD4
Maturity Group	**Yield (bu/ac)**			
1	61.0	54.7	41.9	30.2
2	59.1	52.9	37.4	14.5
Mean	**60**	**53.8**	**39.6**	**22.3**
LSD (0.05)	**ns**	**0.9**	**1.2**	**1.3**
Maturity Group	**Seed Protein (%)**			
1	34.4	36.2	35.4	34.0
2	34.0	32.3	34.5	33.2
Mean	**34.2**	**34.2**	**34.9**	**33.6**
LSD (0.05)	**ns**	**0.6**	**ns**	**0.6**
Maturity Group	**Seed Oil Content (%)**			
1	18.2	17.3	17.3	15.6
2	17.3	16.6	16.6	14.2
Mean	**17.8**	**16.1**	**16.1**	**14.9**
LSD (0.05)	**0.4**	**0.3**	**0.3**	**0.4**

Conclusions

The first year results show that farm location is of important consideration when deciding the row spacing to use in soybean production. For some locations, there is a clear increase in yield when using 8” rows while in other locations the yield is similar between the two row spacings (8” and 30”). This is likely due to weather and/or soil type in the respective locations being more or less favorable to 8” row spacing however, it can be safely concluded that there is little to no yield loss due to planting in narrow rows compared to 30” rows. The economic benefits are different for each location. Farmers in areas similar to Beresford can save money in a corn/soybean rotation by continuing to use a 30” planter and having to only pay for and maintain one planter at a time without worrying about yield loss. Farmers in areas similar to Aberdeen can get a significant yield gain by using 8” rows and the economic benefit can come from increased yield. As far as seeding rate is concerned, the increase in yield with increasing seeding rate is small hence it can be up to the farmer on how much inputs they want to utilize in their farming operation.

In white mold comparison, there is little difference in plant loss between rows widths. Using resistant varieties is by far more important for reducing yield loss due to white mold than row width, reducing the amount of plants infected by 90% compared to susceptible varieties.

In the date of planting study it is important to plant sooner than later but if replanting or planting later than usual, it is much better to be on the safer side of the maturity rating since it is a matter of high risk and low reward if freezing temperatures come earlier in the fall. There was a significant noticeable drop in oil content as planting date was delayed while protein content stayed relatively the same throughout all planting dates. Also there was significant drop in the number of days that the plants spent in reproductive phase as planting date is delayed beyond May 30. This has a strong correlation with yield since there is less time for the soybeans to develop seed. In both studies, 170K seeding rate was the best option but in reality there was small differences in yield between seeding rates and it is best for farmers to go with what is economically feasible for them.

Objective 2. On-farm testing of variable rate and varieties soybean seeding (P. Sexton).

This on-farm study will use the new Raven variable rate seeder. In experiments (two on-farm and one SE research station) variable soybean varieties and rates will be seeded according to landscape position. Varieties selection will be selected by our collaborators at Pioneer Hi-Bred based on the best information available.

Multi-variety planting of soybeans was evaluated using our proto-type planter (based on a Monosem model NG-66-33-0 modified by Raven Industries to switch between lines on the go). The two lines used were Pioneer '92Y70' (lowland) and Pioneer '92Y83' (upland) as selected by our collaborators at Pioneer. Both lines were sole seeded across the field and also variable variety-seeded according to landscape position. Both lines were also compared when seeded as twin versus single rows. Yield samples for data analysis are based on weigh wagon data taken from each strip at harvest. Note that in 2013 the same trial was run, but the Pioneer line '92Y51' was used as the upland line. Replicated trials were conducted with a farmer-cooperator at Tripp as well as at the Southeast Research Farm. Heavy rains in June, 2014, at Lennox flooded out the lowland parts of the field there. Unlike the previous season (2013) we did not detect an advantage for variable-line seeding for soybeans in the 2014 season. Part of this may have been due to better moisture conditions in August (less advantage for the drought-resistant line in the upland positions). '92Y83' did not appear to confer an advantage in upland portions of the landscape. Following this we took the decision to go back to '92Y51' for the upland portion of the on-farm trials in the 2015 season.

Soybean yield data from the 2014 study evaluating variable-variety seeding. Data is pooled data across the Beresford and Tripp sites.

Variety	System	Row Configuration	Yield (bu/ac)
92Y70	sole	Single	52.4
Y70 / Y83	variable	Single	51.8
92Y83	sole	Single	51.0
92Y83	sole	Twin	54.3
92Y70	sole	Twin	52.1
Y70 / Y83	mixed	Twin	49.4
Mean			*51.8*
CV (%)			*7.4*
LSD (0.05)			*NS*

Project Update for the current growing season:

Based on our previous work, Kinze Manufacturing has provided the use of a new 16-row multi-hybrid planter (Model 4900 MH) for the Southeast Farm. Using this new planter, we set out on-farm trials at Lennox and Beresford to further evaluate multi-variety seeding using Pioneer '92Y51' on upland areas, and Pioneer '92Y70' on lowland parts of each field (the same combination used in 2013). A variable rate treatment (lower population in lowland areas to decrease disease pressure and higher population in upland areas) was also included in each on-farm trial. At the Southeast Research Farm, a similar trial was run with '92Y70' in the lowland position and 'PT22T69R' in the upland position. Variable rate seeding treatments (both low seed rate in lowland positions and high seed rate in upland positions, and vice versa) were included in this trial. These trials are currently in the field. We also have a plot study looking at seed rate and row width (30" versus twin-rows, along with a drilled treatment) at the Southeast Farm.

Objective 3: Has corn stalk harvesting increased soybean responses to K fertilizer? (C.G. Carlson)

Corn stover removal has the potential to dramatically reduce exchangeable and soluble soil potassium that otherwise could be used to feed following year's crops. An experiment was conducted in Aurora, SD, USA, to observe the effects of corn stover removal on water soluble and exchangeable potassium values and how nitrogen rates, irrigation practices, tillage practices, sampling depth, and residue maintenance programs from 2008 to 2012 accelerate this depletion. Abundant potassium reserves were recorded between the initial and final sampling periods and corn grain yields appeared unharmed.

We extended this experiment and worked with 5 on-farm cooperators who have had an extensive history of corn stover removal, applying 250 lbs K_2O and 0 lbs K_2O per acre across half mile strips during the 2014 growing season in soybean crops. Yield data was collected from 3 of the 5 collaborators. In each field, initial (spring) and final (fall) soil sample were collected and analyzed for soil K. Yield monitor data from treatment strips were returned from producer combines and cleaned. Yield difference maps were generated through statistical software programs to examine yield responses to K+ fertilizer. In addition, stomatal conductance was measured and tissue samples were collected and analyzed for a suite of soil nutrients. Potassium recycling was tested in another fashion by using a column study conducted in a laboratory. We sought to determine the leaching potential of K+ off of corn stover residue following corn plant maturity, expanding upon work conducted on K+ uptake across the growing season. Whole corn plant portions were collected and similarly tested for potassium under varying precipitation rates to reflect average precipitation totals commonly expressed across winter and spring months in South Dakota, USA. We estimated the portion of K leached related to total plant K+ concentration. This research is being used to develop an MS thesis.

Objective 4: Are winter cover crops needed to produce 100 bu/acre?

1. In season cover crops in soybeans (S.A. Clay and A. Bich)

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 SD 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 study 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) examined whereas at the earlier plantings, only a drill treatment was used.

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 2.5 maturity rating was planted at approximately 160,000 seeds ac^{-1} on May 18. Cover crops were interseeded on the following dates and growth stages: July 10 at R1, July 23 at late-R2, and Sept. 15 at late-R6 just prior to leaf drop. A broadcast treatment was also performed on Sept. 15 to examine the effectiveness of soybean leaf cover on germinating cover crop species. The cover crops treatments were either a cool season mix, warm season mix, or both. The cool season mix contained forage radish (4.2 lbs ac^{-1}) and crimson clover (14.7 lbs ac^{-1}). The warm season mix contained cowpea (33.7 lbs ac^{-1}) and grain sorghum (3.7 lbs ac^{-1}). If seeded as a cool or warm season treatment, the mix was seeded in a single row half-way between two soybean rows with a hand push drill. In the treatment that received both cool and warm season species, the cool season and warm season mixes were each seeded in separate rows, each 7.5" apart. Cover crop biomass sampling was performed on Oct. 15 just prior to the soybean harvest. Due to a frost on Oct. 3, the cowpeas had lost their leaves and were just stems. The other crops were not hurt by the frost. A 1 ft. square was dropped over the cover crop row at three random places in each plot and the biomass was clipped, dried, and weighed. A plot combine was used to harvest the middle two soybean rows from each plot.

Results

Cover crops were sampled late in the season, after frost, and this may have resulted in less biomass than if sampled earlier. Nonetheless, cowpea was the highest biomass yielding cover crop (Table 1), at 60.5 to 65.5 lbs ac^{-1} when seeded into R1 soybeans. Cowpea biomass was reduced by about 75% of when seeded two weeks later at R2. The cowpea was large enough to interfere with soybean harvest, however, these plants were killed by frost just prior to the 2014 harvest. The cowpea did not set seed but remained in vegetative stages.

Forage radish, a cool season species, did the best when interseeded at R7 with a drill technique. Broadcast treatments at R7 had minimal cover crop establishment and growth. This lack of establishment in broadcast treatments is similar to the data that Bich et al. (2014) for interseeding cover crops into corn. It appears there may have been some soybean yield benefit from interseeded cover crops when seeding was performed at R1 in early-July. Yield gains up to 7 bu ac^{-1} were recorded when comparing no cover crop to the drilled cool season species mix seeded at R1. It's important to note, however, that any of the R7 treatments could also be considered a control, as any cover crop seeded this late in the season likely did not impact yields. When using many of the R7 treatments as a control instead of the named control, the soybean yield is similar with or without cover crops. It should be noted that this is only one year of data. Additional studies need to be performed to confirm possible yield increases associated with interseeded cover crops in soybeans. Earlier cover crop seeding dates should also be evaluated, as the R1 treatment did not adversely impact yields.

Table 1. Soybean yields and interseeded cover crop biomass production near Aurora, SD in 2014.

Species	Seeding Method	Timing	Soybean Yield	Crimson Clover	Forage Radish	Cowpea	Grain Sorghum	Total Biomass
			---bu ac^{-1}---	--------------------------lbs ac^{-1}--------------------------				
Cool	Drilled	R1	51.2 a	14.3 a	9.1 ab			23.4 c
Warm	Drilled	R1	51.0 ab			43.5 a	8.0 a	51.4 ab
Cool + Warm	Drilled	R1	49.3 abc	11.8 ab	4.6 abc	38.5 a	2.0 b	56.9 a
Cool	Drilled	R2	47.3 bcd	5.4 bc	12.4 a			17.8 cd
Warm	Drilled	R2	46.1 cd			36.2 a	4.7 ab	40.9 b
Cool + Warm	Drilled	R2	48.6 abcd	7.6 b	9.7 ab	19.8 b	2.7 ab	39.9 b
Cool	Drilled	R7	48.8 abc	1.0 c	6.2 abc			7.2 de
Warm	Drilled	R7	47.9 bcd			5.8 c	0.0 b‡	5.8 de
Cool + Warm	Drilled	R7	46.4 cd	0.4 c	4.0 bc	4.1 c	0.0 b‡	8.5 cde
Cool	Broadcast	R7	48.4 abcd	0.3 c	0.3 c			0.6 e
Warm	Broadcast	R7	46.2 cd			0.3 c	0.0 b‡	0.3 e
Cool + Warm	Broadcast	R7	46.8 cd	0.7 c	0.1 c	0.0 c‡	0.0 b	0.9 e
None			45.4 d					

† Values followed by the same letter within the same column are significant at the 0.05 probability level.

‡No measureable cover crop growth.

Table 2. Soybean yields and interseeded cover crop biomass production near Beresford, SD in 2014.

Species	Seeding Method	Timing	Soybean Yield	Crimson Clover	Forage Radish	Cowpea	Grain Sorghum	Total Biomass
			--bu ac^{-1}-	-------------------------lbs ac^{-1}-------------------------				
Cool	Drilled	R1	61.4 a†	2.96 ab	0.71 b			3.7 b
Warm	Drilled	R1	61.0 ab			65.5 a	0.97 ab	66.5 a
Cool + Warm	Drilled	R1	59.1 abc	4.03 ab	1.69 b	60.5 a	2.15 a	68.4 a
Cool	Drilled	R2	56.8 bcd	0.00 b	0.00 b			0.0 b‡
Warm	Drilled	R2	55.3 cd			13.4 b	0.78 ab	14.2 b
Cool + Warm	Drilled	R2	58.4 abcd	1.94 ab	2.33 b	18.9 b	1.40 ab	24.6 b
Cool	Drilled	R7	58.6 abc	5.80 a	13.33 a			19.1 b
Warm	Drilled	R7	57.5 bcd			0.1 b	0.12 ab	0.2 b
Cool + Warm	Drilled	R7	55.7 cd	1.21 ab	11.71 a	1.2 b	0.00 b‡	14.1 b
Cool	Broadcast	R7	58.1 abcd	1.26 ab	1.61 b			2.9 b
Warm	Broadcast	R7	55.5 cd			0.0 b	0.00 b	0.0 b‡
Cool + Warm	Broadcast	R7	56.1 cd	0.40 b	1.46 b	0.0 b‡	0.00 b‡	1.9 b
None			54.4 d					

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

References

Bich, A.D., C.L. Reese, A.C. Kennedy, D.E. Clay, and S.A. Clay. 2014. Corn yield is not reduced by mid-season establishment of cover crops. Crop Mgt. 13:1-8.

Acknowledgements

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2. Interseeded Cover Crop Species and Timing on Biomass Production and Soybean (*Glycine max*) Yield in Eastern South Dakota (Clay, S.A, D.E. Clay, G.W. Reicks, and J. Chang)

Integrating cover crops into 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. Interseeding cover crops into a wide-row soybean crop may be an alternative to either surface broadcasting just prior to leaf drop or drilling after soybean harvest. A study was performed near Beresford and Aurora in the SE and East-Central parts of the state, respectively. In mid-May, soybeans with a 2.9 and 2.0 maturity group rating were planted in 76 cm rows at 65,000 seeds ha^{-1} near Beresford and Brookings, respectively. The warm season mix included cowpea (*Vigna unguiulata*) and grain sorghum (*Sorghum bicolor)* at 37.8 kg ha^{-1} and 4.1 kg ha^{-1}, respectively. The cool season mix included forage radish *(Raphanus sativus)* and crimson clover at 4.7 and 16.5 kg ha^{-1}, respectively. In treatments 1 and 2, seeds were planted in a single furrow half-way between two soybean rows at approximately 1.3 cm deep with a hand-push drill. In treatment 3, warm and cool mixes were seeded each in separate furrows, each spaced approximately 19 cm apart. Seeding was performed at R1, R2, and R7. On the R1 seeding date of July 10, canopy closure was approximately 50%. The canopy was nearly closed by the second seeding date just two weeks later. The final seeding date was performed just as the leaves were beginning to turn yellow and also included a surface broadcast of all treatments. When averaged over both sites, seeding time significantly affected soybean yield (p=0.01) but species composition did not. Cover crops seeded at R1 increased soybean yields by 200 kg ha^{-1} compared to the R2 and R7 treatments, which were not significantly different. There was a significant interaction between species composition and seeding time on total cover crop biomass production (p=0.01). For example, only half as much biomass (67.5 vs. 33.5 kg ha^{-1}) was produced by the warm and warm+cool treatments when seeding was delayed from R1 to R2. At R7 seeding, essentially no warm season biomass was produced. Seeding date however did not affect the biomass yields of the cool season treatment, which produced biomass yields averaging 13.3 kg ha^{-1}.

Objective 5: Intensive early and late season management impact on soybean yields,

High-Input Soybean Studies in 2014 (David Clay, Sharon Clay, Gregg Carlson, Graig Reicks, Michael Devens)

Introduction

There are many products on the market that may increase soybean yields. A trial was initiated in 2013 and continued in 2014 near the eastern South Dakota locations of Beresford, Aurora, South Shore, Pierre, and Aberdeen that 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 1.4 maturity rating was planted on both May 20 and June 10 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.

Table 1. Characteristics of each site in the 2014 South Dakota High-Input Soybean Trials.

Site	Variety	MG	Planting Date(s)	Irrigation
Aurora	AG2031	2.0	May 22	No
Pierre	AG1431	1.4	May 18	No
	AG2431	2.4	May 17	Yes
Beresford	AG2933	2.9	May 22	No
			June 11	No
South Shore	AG1431	1.4	May 20	No
			June 10	No
Aberdeen	Rea 75G12	1.5	May 19	No
			June 10	No

Table 2. Products applied in the 2014 South Dakota High-Input Soybean Trials.

Product	Purpose	Growth Stage	Rate ac^{-1}
Cobra	Herbicide	V4	12 oz
Urea	N Fert	V4	75 lbs N
ESN Urea	Slow release N Fert	V4	75 lbs N
Task Force 2	Foliar Fert Blend	R1	64 oz
Ascend	Plant Growth Regulator	R3	6.4 oz
Bio-Forge	Ethylene Inhibitor	R3	16 oz
Quilt Xcel	Strob + Prop Fungicide	R3	21 oz
Domark	Prop Fungicide	R5	5 oz

Table 3. Soybean yields from high-input studies in 2014. Values are expressed as bu ac^{-1} differences from the control at each of the eight sites.

TRT	Aurora	Pierre Irrigated	Pierre Dryland	SE Farm Norm PD	Aber. Norm PD	Aber. Late PD	S. Shore Norm PD	S. Shore Late PD
	--			bu ac^{-1}				--
Control	**54.4**	**85.4**	**36.1**	**40.2**	**46.6**	**49.2**	**56.1**	**46.0**
QuiltXcel	-0.9 p=0.27	-3.7 p=0.20	11.1 p=0.08	7.0 p=0.06	-3.1 p=0.61	-0.8 p=0.64	0.9 p=0.78	-4.5 p=0.06
2 Fungicides	-0.3 p=0.69	-0.1 p=0.98	4.9 p=0.23	5.5 p=0.14	5.1 p=0.26	-6.8 p=0.13	2.7 p=0.38	-3.7 p=0.12
TaskForce 2	-0.2 p=0.78	-1.4 p=0.50	-3.4 p=0.16	3.9 p=0.27	1.6 p=0.26	5.4 p=0.16	-0.9 p=0.74	-3.6 p=0.09
Ascend	-0.6 p=0.52	-8.6 p=0.01	-4.5 p=0.16	4.5 p=0.22	2.5 p=0.31	0.9 p=0.85	0.5 p=0.78	-1.4 p=0.07
Bio-Forge	0.0 p=0.99	-2.6 p=0.42	6.0 p=0.23	6.1 0.10	-5.8 p=0.28	-1.0 p=0.76	0.2 p=0.97	-2.6 p=0.19
Cobra	-3.0 p=0.01	-4.7 p=0.19	0.4 p=0.92	0.9 p=0.79	1.1 p=0.59	-5.0 p=0.07	-5.6 0.21	-7.4 p=0.07
Full N	2.0 p=0.16	-2.9 p=0.34	8.4 p=0.14	7.9 p=0.04	6.3 p=0.06	6.8 p=0.01	5.4 p=0.06	-4.0 p=0.09
Urea	0.1 p=0.93	-0.4 p=0.84	3.6 p=0.21	2.5 p=0.60	7.8 p=0.10	1.7 p=0.47	-2.8 p=0.60	-1.4 p=0.32
Full N + Asc	1.6 p=0.20	-11.8 p=0.01	6.1 p=0.06	5.1 0.21	-0.7 p=0.87	5.9 p=0.08	5.4 p=0.10	-1.8 p=0.46
Full N + Asc + 2 Fung	0.2 p=0.94	-8.4 p=0.03	7.1 p=0.07	8.4 p=0.07	-3.3 p=0.75	-2.9 p=0.15	3.9 p=0.01	-4.9 p=0.14
All (but Cobra)	0.7 p=0.55	-4.7 p=0.10	0.7 p=0.82	4.3 p=0.32	2.2 p=0.42	1.5 p=0.59	3.4 p=0.14	-3.4 p=0.10

Key Finding

N fertilizer appeared to be the most consistent yield enhancing input, with significant yield increases ($p<0.15$) in five of the eight environments tested. This yield increase was not likely attributed to the urea, but the ESN slow-release component.

On-farm research (C.G. Carlson, D.E. Clay, and G.W. Reicks)

This research was conducted by a number of farmers during the past year. Reports for each farmer were completed and distributed to the producers. A list of the activities are provided below.

On-Farm Participants for 2014 and 2015.

Name	Location	2014 Project	2015 Project	Number of trials in 2015
Alverson, Keith	Chester		Anhydrous and ESN	2
Anderson, Gordon	Beresford		ESN, K, K+ESN	5
Blindert, Zac	Salem		Interseeded companion crop	6
Bolander, Brady	Herrick	10-34-0+micro blend		
Carlson, Scott	Badger	Trehalose Sugar, Bio-Forge, Quadris, Vitazyme, Ascend, Sprint	Two row spacing fields, trehalose sugar, Ascend	10
Converse, Craig	Arlington	ESN	Planting combos of Optimize, Tagteam, Vitazyme	13
Downer, Leslie	Flandreau	ESN	Slow release foliar N, and a Foliar N+K blend	17
Despiegler, Steve			Starters	20
Eggleson, Scott	Huron	K strips after stov. rem.		
Fischbach, Chris	Mansfield		Planting combos of Tagteam and Vitazyme	23
Gilchrist, Terry	Bath	K strips after stov. rem.		
Hanson, Joey	Elk Point	Ratchet + Stratego Yld at V4 and R2		
Hanten, Todd	Goodwin		ESN In-furrow, Vault seed treatment, fly on ESN	
Hefty, Darren & Brian	Baltic	ESN		24
Henricks, Jon	Watertown	ESN		25
Hillestad, Austin	Volga	UAN and Bonus Plus starter		
Hoitsma, Lynn	Castlewood	ESN	ESN	26
Hoffman, Jerrad	Edmunds Co.	dd		
Holler, Morgan	Pierpont	ESN, row spacing, Quilt Xcel, Vitazyme, Bio-Forge	Urea preplant, two timings of ESN, 3 or 4 fungicides	31
Kleinjan, Jon	Volga	Interseeded companion crop		32
Knutson, Jason/Lynn Nelson	Viborg	Row Spacing		

Kralicek, Frank	Yankton	Seed Treatments	3 or 4 fungicides	
Lee, Jarrett	Oldham	Quilt Xcel		
Malone, Chad	Lake Preston	Bio-Forge	Bio-Forge	33
McHenry, Jason	Pierre	Starters and Ascend	Same as 2014	38
Meyer, Dan	Wilmot	Ascend	Ascend	39
Miron, Al	Crooks	ESN	Seed treatment	40
Nachtigal, Colin	Herrold		3 or 4 fungicides	43
Strom, Cory	Kimball		Maybe Bio-Forge	44
VanOverschold, Rod	Mitchell		Maybe Vitazyme foliar	45
Vasgaard, Richard	Centerville	Quilt Xcel, Sugar		
Weier, Jim	Freemont	ESN		
	Three sites	Multi-Variety Planter	Four sites in 2015	48

Objective 6: Communication and outreach strategy (S. Hansen)

Soy100 meeting
140 pre-registered
38 no-shows
67 walk-ins (Or didn't get on pre-registration list we had at the tables)
169 total attendees

SOY100 2015 Agenda

7:45 – 8:30 am	**REGISTRATION,** *Rotunda D*
8:30 – 8:45 am	**WELCOME** Moderator: Heather Clay **Daniel Scholl,** *Director, South Dakota Ag Experiment Station* **Adam Herges,** *Market Development & Research Director, SD Soybean*
8:45 – 9:45 am	**KEYNOTE SPEAKER: Al Kluis,** *Commodity Advisor & Broker, Kluis Commodities*
9:45 – 10:30 am	**LESSONS LEARNED FROM ON-FARM RESEARCH** **Dr. Cheryl Reese,** *SDSU*
10:30 – 10:45 am	**BREAK**
10:45 – 11:45 am	**ROAD MAP TO 100-BUSHEL BEANS** **Dr. Gregg Carlson,** *SDSU, with Farmer Panel*
11:45 am – 12:15 pm	**SOYBEAN SUCCESS TO 100 BUSHELS WITH TOP TEN STRATEGIES** **Adam Herges**
12:15 – 1:00 pm	**Palmer Amaranth** *and On-Farm Lunch Discussion Announcement* **LUNCH,** *provided by the South Dakota Soybean Research and Promotion Council*
1:00 – 2:30 pm	**BREAKOUT SESSIONS** **DRONES/UAV, Dr. David Clay,** *SDSU* **COVER CROPS/SOIL HEALTH, Dan Forgey** **WHERE ARE YOUR SOYBEANS GOING?, Lisa Elliott,** *SDSU Economist*

Soybean bus tour was also conducted. The program is below.

A Free Event

August 14, 2014

Brookings, SD

&

Nearby Locations

DUE TO LIMITED VEHICLE SPACE, PLEASE RSVP BY AUGUST 6, 2014

TO REGISTER:
STEPHANIE.HANSEN@SDSTATE.EDU
CALL: 605-688-6243 OR 690-5435

Soybean On-Farm High Yield & Small Plot Tour

Agenda

8:00 AM	Registration- Northern Plains Biostress Lab
8:30 AM	"Higher Yield with On-Farm Trials"
9:10 AM	Aurora Research Farm – Cover Crops, High Input Practices, Herbicide Drift Trials
10:00 AM	Hillestad Farm – On Farm Research
11:00 AM	Converse Farm – On Farm Research
Noon	Lunch in Brookings provided by: **South Dakota Soybean Research and Promotion Council**

SOUTH DAKOTA SOYBEAN RESEARCH & PROMOTION COUNCIL

SDSU Extension