Partners in Progress
SOYBEANS

Soybean Research at OSU 2011

Supported by the

Oklahoma Soybean Board

and the

United Soybean Board

Oklahoma State University
Division of Agricultural Sciences and Natural Resources
Oklahoma Agricultural Experiment Station
Oklahoma Cooperative Extension Service

P-1034

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Partners in Progress SOYBEANS

Foreword

Does the "fifth" stay the same as last year?

This is the only place that said Oklahoma Soybean Commission, so I changed it. Let me know if it's incorrect.

The *2011 Partners in Progress—Soybeans* publication is the fifth in a series of annual reports from the Oklahoma State University's Division of Agricultural Sciences and Natural Resources summarizing work supported by the Oklahoma Soybean Board (OSB) and the United Soybean Board (USB).

As partners, we have a history of cooperation that began when the first furrows were turned in Oklahoma soil. This collaboration continues to this day. In keeping with this spirit of cooperation, it is our intention that soybean research be directed as closely as possible to the needs of our state's producers.

Although this report focuses on soybean research progress of the past year, it is the continued support of a project over time that leads to successes such as variety releases and development of new technology.

History has proven that a united effort between soybean producers and Oklahoma Agricultural Experiment Station (OAES) agricultural scientists is beneficial to Oklahoma agriculture. Progress in OAES soybean research means progress for Oklahoma soybean producers.

Clarence Watson, Associate Director
Oklahoma Agricultural Experiment Station
Division of Agricultural Sciences and Natural Resources
Oklahoma State University

Oklahoma State University
Division of Agricultural Sciences and Natural Resources
Mission Statement

The Mission of the Oklahoma State University Division of Agricultural Sciences and Natural Resources is to discover, develop, disseminate, and preserve knowledge needed to enhance the productivity, profitability, and sustainability of agriculture; conserve and improve natural resources; improve the health and well-being of all segments of our society; and to instill in its students the intellectual curiosity, discernment, knowledge, and skills needed for their individual development and contribution to society.

Research and Producer Partnerships

As the name suggests, the OSB and OSU have enjoyed a partnership designed to help Oklahoma soybean producers to produce at a profit. The Soybean Check Off Board is proud to continue the symbiotic relationship with the researchers at OSU. Research priorities have changed over the course of time, but the partnership has been cultivated to produce the objective data needed by soybean producers to make informed decisions.

The proof is in the production, and soybean production has improved as a direct result of the research projects conducted by the university staff. In addition, the university effectively utilizes their mission of Extension that is a part of the land grant university, to disseminate the research results to the growers. Their use of grower meetings and their involvement in the annual soybean meeting produced by the soybean board has extended the reach of their research results.

With the assistance of the Soybean Check Off monies from the OSB, the university can conduct research that is practical, objective and timely. This productive partnership will continue to benefit an increasing number of Oklahoma soybean farmers.

Rick Reimer, Secretary
Oklahoma Soybean Board

Oklahoma Soybean Quality Program

Nurhan T. Dunford
Biosystems and Agricultural Engineering

Chad Godsey
Plant and Soil Sciences

2011 progress made possible through OSB/USB support

- **Soybean samples from 2010 and 2011 crop years were analyzed for their fatty acid, protein, oil, ash and moisture contents using standard wet chemistry protocols.**
- **Palmitic, stearic, oleic, linoleic and linolenic acids were the major fatty acids in all soybean samples. Linoleic acid comprised more than 50 percent of the fatty acids.**
- **It appears in general oil content of the 2011 samples was lower than 2010 samples.**
- **The soybean samples from Vinita had the highest amount of green beans as compared to the samples from Stillwater, Fort Cobb and Miami.**

Problem Statement:

Both seed and oil quality are very important factors affecting market value, processing aspects and storage quality of soybeans. Although there is a national soybean quality program, information on Oklahoma grown soybeans is very limited.

The main objective of this study is to establish a "Soybean Seed and Oil Quality Program" at OSU and provide technical assistance to soybean Extension personnel, growers and processors in the state.

Material and Methods

In 2010, 30 soybean samples were collected from OSU soybean variety field trials. These samples were analyzed for their protein, oil, ash, moisture and fatty acid composition using standard wet chemistry protocols. The soybean oil extracted from the samples was analyzed for its fatty acid composition.

In 2011, about 30 soybean samples were collected from OSU soybean variety field trials in Stillwater, Fort Cobb, Vinita and Miami. Due to bad weather conditions, we were able to obtain only one sample from a farmer's field. Similar to the previous year, these samples were analyzed for their protein, oil, ash, moisture and fatty acid compositions. This year's samples also were evaluated for the presence of green and unacceptable (dark color and deformed bean shape) beans and seed weight (weight of 100 beans). Color of the seed samples also was measured.

Results

We reported protein, oil, moisture and ash content of the soybean samples from the 2010 crop year in the Oklahoma Soybean Board (OSB) and United Soybean Board (USB) *2010 Partners in Progress - Soybeans* report. In this article, we report fatty acid compositions of the 2010 samples (Table 1). Palmitic, stearic, oleic, linoleic and linolenic acids were the major fatty acids in all the samples. More than 50 percent of the fatty acids comprised of linoleic acid. Although there were slight variations in the fatty acid composition among the soybean samples, the differences were not significant for practical purposes.

Table 1: Fatty acid composition (%, w/w) of soybean varieties grown at different locations in Oklahoma in 2010.

What is w/w?

Sample Name	Fatty Acid Name				
	Palmitic	Stearic	Oleic	Linoleic	Linolenic
24WE	11.1	4.1	24.8	54.0	7.3
35WE	10.7	4.0	24.5	54.3	8.3
16NE	11.9	4.4	25.0	53.8	6.6
24NE	12.3	4.4	25.4	53.3	5.9
24PA	11.5	4.5	26.5	53.1	6.6
35NE	10.5	4.3	24.6	55.5	6.4
2NE	11.4	4.3	24.0	55.9	5.5
35PA	11.3	4.1	23.9	53.8	8.9
42PA	11.7	4.2	23.5	53.9	8.2
16PA	11.6	4.4	25.2	53.9	5.4
15NE	9.6	4.0	23.5	56.7	7.8
42NE	11.3	4.2	23.0	55.2	7.1
42WE	11.0	4.1	24.4	53.7	7.5
2WE	8.7	4.0	29.0	55.0	4.3
15PA	9.6	4.0	23.6	55.8	8.7
16WE	8.4	3.8	26.1	57.1	5.5
2PA	9.4	4.2	26.3	54.8	7.5
15WE	8.1	3.7	25.8	57.2	6.6
2FT	8.9	4.0	28.4	54.3	6.0
15CH	10.2	4.3	26.3	55.0	5.1
16CH	11.2	4.2	23.9	55.7	5.9
35CH	10.7	4.2	24.1	55.3	6.9
2CH	11.0	4.2	24.9	55.5	5.2
24CH	11.4	4.4	24.6	54.6	6.4
42FT	10.3	4.1	25.4	56.1	4.3
16FT	8.3	4.1	28.4	56.5	4.1
42CH	10.9	4.0	22.3	56.7	6.6
24FT	10.5	4.0	24.4	55.6	5.7
15FT	8.6	4.2	29.2	55.9	3.4
35FT	9.8	4.0	26.0	55.4	6.0

Sample label abbreviations are as follows: 2=Rev4.5R10MG4.5; **15**=S51-T8MG5.1; 1**6**= MOR-SOYRTS4824MG4.8; **24**= RC5007SMG5.0; **35**=570RRSMG5.7; **42**=HBKR5425MG5.4.

MG refers to soybean maturity group.

FT = FORT COBB; **CH**=CHEROKEE; **NE**= NEWKIRK; **PA**=PAULS VALLEY; **WE**= WEBBERS FALLS;

I don't see MG in the table. Does it need to be referenced?

This year's soybean samples were received in our laboratory in November 2011. The chemical compositions of the samples, which have been analyzed so far are shown in Table 2. It appears that in general oil and protein contents of the 2011 samples were lower than those for 2010 samples.

Table 2: Chemical composition of 2011 soybean samples.

Sample Name*	Chemical Composition (%, w/w)			
	Oil	Ash	Moisture	Protein
EsStillwaterS46-A1#1	12.68±0.24	5.50±0.05	4.31±0.09	36.41±0.17
EsStillwaterS49-A5#3	14.59±0.22	5.17±0.00	4.29±0.01	35.44±0.40
VinitaAG5605#4	11.51±0.28	4.69±0.03	3.98±0.02	39.27±0.34
VinitaP4910#5	12.43±0.27	4.82±0.04	4.02±0.02	38.54±0.11
VinitaP5191#6	11.61±0.14	4.64±0.04	5.53±0.05	40.35±0.06
ESFTCobbS47-R3#2	12.99±0.22	5.60±0.03	5.37±0.00	33.75±0.12
ESFTCobbAG4730#4	12.07±0.27	5.81±0.08	5.54±0.02	36.60±0.22
ESFTCobbAG4903#6	12.52±0.25	6.00±0.03	5.37±0.02	34.08±0.14
ESMiamiAG4903#6	11.17±0.13	5.01±0.04	5.76±0.01	39.91±0.33
ESMiamiRev48R21#27	12.46±0.29	4.56±0.06	5.29±0.01	38.83±0.35

*Detailed information (variety, planting and harvest date, weather, etc.) on soybean varieties examined in this study can be found at www.oilseeds.okstate.edu.

Table 3 shows the quality data (proportion of the green and unacceptable beans in the samples and seed weight, 100 seeds) for the 2011 samples. The highest amount of green beans was found in the samples collected from Vinita, 61 percent - 6.7 percent of the samples were green beans. The samples from Miami had the highest amount of unacceptable beans, about 5.2 percent of the sample. Progeny 4910, which belongs to maturity group 4.9, grown in Vinita, had the highest bean weight, about 16.3 g/100 beans.

Table 3: Soybean quality data for 2011 samples.

Sample Name	Green beans (%, w/w)	Unacceptable beans* (%, w/w)	Bean weight (g/100 beans)
EsStillwaterS46-A1#1	1.0	0.5	14.61±0.61
EsStillwaterS49-A5#3	4.6	0.3	13.78±0.59
VinitaAG5605#4	6.1	0.5	12.92±0.45
VinitaP4910#5	6.2	0.9	16.26±0.88
VinitaP5191#6	6.7	1.6	15.60±0.36
ESFTCobbS47-R3#2	1.1	0.3	11.04±0.22
ESFTCobbAG4730#4	1.1	0.2	13.34±0.09
ESFTCobbAG4	0.4	0.3	12.94±0.28
ESMiamiAG4903#6	1.0	5.2	12.98±0.21
ESMiamiRev48R21#27	3.5	5.2	14.74±0.64

*Does not include green beans.

Ongoing Work

Currently, 2011 crop year soybean samples, which are not reported in this article, are being analyzed for their proximate composition, fatty acid composition, bean quality parameters and color.

The Potential for Varying Soybean Seeding Rate

Chad Godsey
Plant and Soil Sciences

2011 progress made possible through OSB/USB support

- **Changing the soybean seeding rate based on soil maps and past yield history has potential to reduce seeding costs.**
- **Precision farming technologies are a valuable tool to help with on-farm research.**

Introduction

Precision agriculture technologies related to crop production have had a slow adoption rate in Oklahoma. Many Oklahoma producers recognize the role of these technologies in the midwestern corn and soybean belt but are concerned about their economic feasibility in this state. Automated or embedded technologies such as guidance systems and swath control are being adopted faster than management technologies such as yield monitors and variable rate controllers. One technology that may have a great amount of potential in Oklahoma is variable rate seeding. With the inherent variability in soil type, which affects soil water holding capacity and depth of top soil in the majority of dryland soybean fields in Oklahoma, it is likely that one flat seeding rate is not ideal. Currently, only a few producers have the capability of changing the seeding rate on the go, but as newer planters are purchased, producers need to know if this technology will pay in order to make the investment.

Everywhere else it's "variable seeding rate." Is it correct here?

Both yield data and soils maps can be a useful tool in identifying management zones. Typically, these management zones can be either consistently high yielding, consistently low yielding or average. Higher yielding areas may respond better to higher seeding rates, while low yielding areas may benefit from a lower seeding rate. With the technology and soil data readily available, the potential to improve yield and save on seed cost exists.

Sometimes it's "soils maps" and other times it's "soil maps." Is there a difference?

The objective of this project was to evaluate the feasibility of using soil maps and/or past yield to make variable rate seeding recommendations.

Methods

A soybean field in Kay County was identified where the producer had the capability to vary the seeding rate. The tractor was equipped with a GreenStar3 monitor. Areas of the field were targeted that we felt may respond differently to seeding rate. These areas were identified by using historical yield data that the producer partner had collected and soil maps through the Natural Resources Conservation Service (NRCS) website. To evaluate variable seeding rates, we randomly placed strips where the seeding rate was varied (Figure 1). The width of these strips were 60 ft wide. Seeding rates evaluated were 90,000 seeds/A; 125,000 seeds/A; and 140,000 seeds/A. Yield monitor data was collected by the producer.

All yield data points were filtered and erroneous data points were deleted.

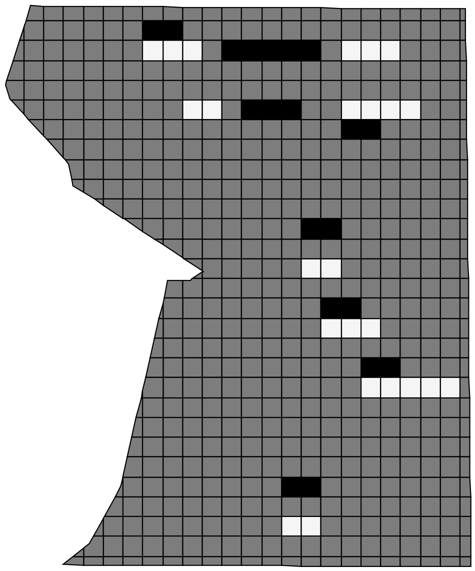

Figure 1. Variable rate soybean seeding map.

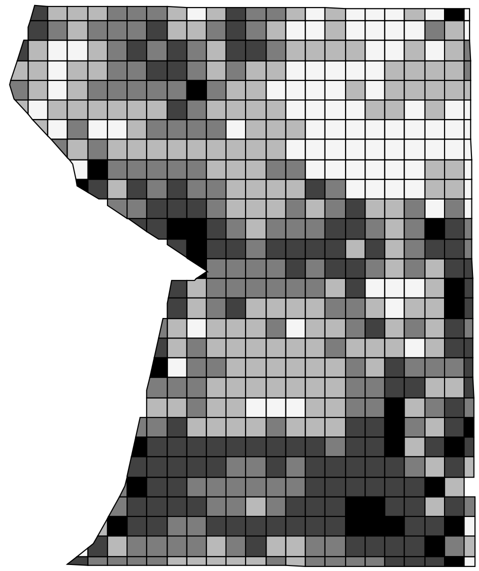

Figure 2. Soybean yield in 2011.

Should the cell color difference be explained?

Grid cells (60 ft x 60 ft) were created and yield data points within each cell were averaged. To compare response to the three populations, yield of grid cells (side by side) for the length of the strips were compared.

Results

In 2011, dryland soybean yields were low across the state due to low rainfall and high temperatures. The yield map from the field is illustrated in Figure 2. No response was observed between the three different populations (Table 4). If we would have experienced a higher yielding year, we could have separated seeding rates based on yield potential for different areas of the field.

Summary

Even with the poor yields observed in 2011, the potential exists to vary the soybean seeding rate to minimize seed costs and potentially increase yield. We need to continue to evaluate the potential when we have a better production year. If nothing else, we demonstrated precision farming technologies are a valuable tool to conduct on-farm research.

Table 4. Soybean yield in population strips.

	Seeding Rate (seeds/A)		
Strip	**90,000**	**125,000**	**140,000**
1	13.8	13.7	*
2		12.7	11.4
3	10.8	9.7	
4	13.0		8.9
5	11.6	10.4	13.0
6	14.7	9.4	
7		11.8	11.9
8		5.0	5.9
9	12.9	8.3	
10		7.1	9.1
11	7.7	7.2	
12	12.8	13.1	13.3
13		9.3	9.6
14	6.8	6.6	
15	12.9	8.3	
16	12.1	8.3	9.6
17		8.1	9.8
18		6.2	8.8
Avg.	11.7	9.1	10.1

*Blank cells indicate that cells were not evaluated adjacent to the other two populations.

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Effects of Row Spacing, Seed Rate and Maturity Group on Late-Planted Soybean Under Irrigated and Dryland Conditions in Oklahoma

A.S. Barreiro and Chad Godsey

Plant and Soil Sciences

2011 progress made possible through OSB/USB support

- **For irrigated soybean, a plant population of 180,000 resulted in the highest yields.**
- **Given the harsh environmental conditions, no response was observed among treatments at the dryland location.**

Introduction

Soybean production has increased significantly in Oklahoma the past few years. However, some production aspects, unique to the state, still need to be addressed. A majority of the soybean acreage is double cropped after winter wheat harvest in June. This results in a soybean planting date after June 10, which is the date that has been identified as the point when yield potential starts to decrease. The purpose of this study is to determine the best planting strategies in regard to row spacing, seeding rate and maturity group (MG) for late-planted soybean under irrigated and dryland conditions in Oklahoma.

This study was initiated in 2011 at the OSU Eastern Research Station in Haskell, under dryland conditions, and at the Agronomy Research Station in Stillwater under irrigated conditions. At both locations, the established plots were 10 ft x 25 ft. The two soybean varieties (REV 48R22 and AG 5632) used in the study were glyphosate-resistant and were selected based on their performance from previous variety trials (www.oilseeds.okstate.edu). Row spacings of 7.5 in, 15 in and 30 in were evaluated. Plots with 30 in row spacing were planted with a four-row Monosem vacuum planter (Monosem, Inc. Edwardsville, Kan.). Plots with 7.5 in and 15 in row spacing were planted with a Great Plains Drill model 3P600 (Great Plains Mfg., Salina, Kan.) with seven rows spaced at 7.5 in. Inoculants, soil fertility and pest management practices were conducted according to OSU recommended practices.

Irrigated Study

This experiment was planted June 27, using a complete randomized block design with three replications and three variables (MG, row spacing and seeding rate). Table 5 shows all different treatments utilized for each replication. One and a half inches of irrigation was applied weekly throughout the growing season.

Table 5. Maturity groups, row spacing and seed rates used on irrigated conditions at Stillwater.

Treatment	Maturity Group	Row Spacing inches	Seed Rate seeds/A
101	4.8	7.5	100,000
102			140,000
103			180,000
104		30	100,000
105			140,000
106			180,000
107	5.6	7.5	100,000
108			140,000
109			180,000
110		30	100,000
111			140,000
112			180,000

Dryland Study

This experiment was planted on July 14th, using the same experimental design and variables. Table 2 shows all different treatments utilized for each replication.

Table 2. Maturity groups, row spacing, and seed rates used on dryland conditions at Haskell.

Treatment	Maturity Group	Row Spacing inches	Seed Rate seeds/acre
101	4.8	7.5	80,000
102			105,000
103			130,000
104			155,000
105		15	80,000
106			105,000
107			130,000
108			155,000
109		30	80,000
110			105,000
111			130,000
112			155,000
113	5.6	7.5	80,000
114			105,000
115			130,000
116			155,000
117		15	80,000
118			105,000
119			130,000
120			155,000
121		30	80,000
122			105,000
123			130,000
124			155,000

All plots were harvested using a Wintersteiger Delta plot combine (WINTERSTEIGER Inc., Salt Lake City, UT), at maturity. Grain yield and moisture were determined. All harvested plots were collected in bags to determine seed mass.

Results for Irrigated Soybean

In 2011, climate conditions were not conducive to high yielding soybean, even with irrigation. The heat was extreme during reproductive stages, which limited yield potential. Yields from the irrigated location are given in Figure 3.

MG 4.8 (REV 48R22) soybean performed better when planted in 30 in row spacing compared to 7.5 in, regardless of plant population. No difference in yield was found between seed rate of 100,000 seeds/A and 140,000 seeds/A for both row spacing. However, plants at 180,000 seeds/A had greater yield, 36.2 bu/A and 42.3 bu/A for both row spacings compared to 100,000 seeds/Aand 140,000 seeds/A, respectively.

For the MG 5.6 (AG 5632), no difference in yield was observed between row spacing at the three plant populations. Similar to the MG 4.8, no difference in yield was found between a seeding rate of 100,000 seeds/A and 140,000 seeds/A for both row spacings. However, plants at 180,000 seeds/acre had slightly greater yield for both row spacing. There was no difference in yield between MG 4.8 and 5.6 at 100,000 seeds/A or 140,000 seeds/A regardless of row spacing. MG 4.8 at 180,000 seeds/acre showed greater yield than MG 5.6 at the same plant population for both row spacing.

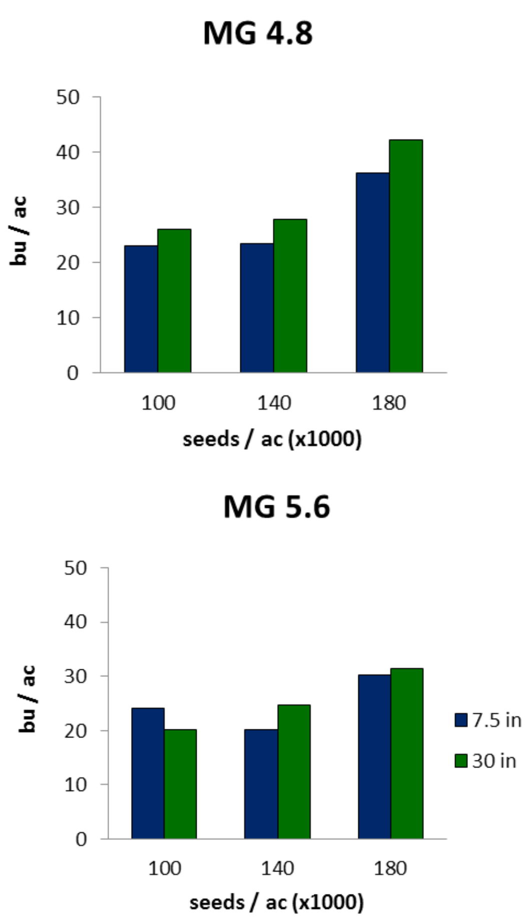

Figure 3. Soybean yield for both MG 4.8 and 5.6 in relation to seeding rate and row spacing under irrigation.

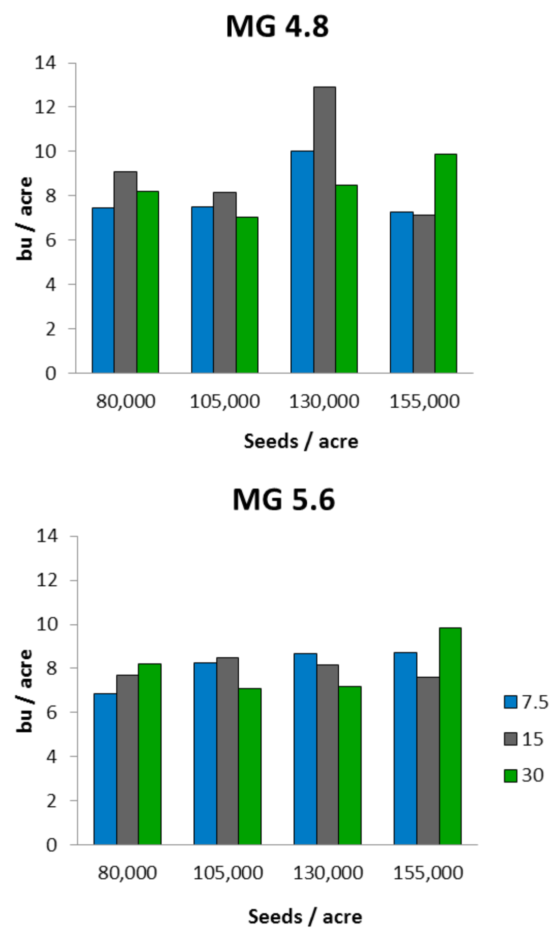

Figure 4. Soybean yield for both MG 4.8 and 5.6 in relation to seed rate and row spacing under dryland conditions.

Results for Dryland Soybean

As mentioned previously, very high temperatures and extensive periods without rainfall were observed in 2011. Our study under these conditions and with a late planting date provided poor soybean yields, however differences between some treatments were observed as shown in Figure 4.

For all three row spacings from MG 4.8, no difference in yield was observed between seed rate of 80,000 seeds/A and 105,000 seeds/A. Row spacings of 7.5 in and 15 in had greater yields, 10 bu/A and 12.9 bu/A, respectively, compared to 30 in at 130,000 seeds/acre. For both MG 4.8 and 5.6, 30 in row spacing performed better when planted at the highest population (155,000 seeds/A). For MG 5.6, with exception of soybean with 30 in row spacing at the highest seed rate, there were no differences in yield among the other treatments.

These studies will be expanded to more locations in 2012, and hopefully we will experience better growing conditions.

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Evaluation of Preemergence and Early Postemergence Herbicides to Improve Weed Control in Oklahoma Soybean Production

Joe Armstrong
Plant and Soil Sciences

2011 progress made possible through OSB/USB support

- **Many of the preemergence (PRE) herbicides evaluated in this trial provided excellent control of large crabgrass and Palmer amaranth, despite the drought conditions experienced after planting and application.**
- **Early postemergence (POST) herbicides can be used to control weeds that are present at the time of application and extend the period of soil-residual activity to prevent future weed emergence and growth.**
- **Preemergence herbicides give the opportunity to diversify chemical weed management strategies and are important to improve prevent the development and spread of herbicide-resistant weeds in Oklahoma.**

Is it improve or prevent?

Is it ok to remove the reference in text? No other articles have any.

Introduction

Weed control is a continual issue facing soybean producers in Oklahoma. Evaluation of herbicide options is essential for producers to make informed decisions for weed management in soybeans and other crops in rotation. PRE herbicides, such as Valor SX®, Authority®, and Prowl H_2O®, are valuable for early-season weed control; however, many producers have shifted to using only POST applications for weed control in soybean, especially when growing Roundup Ready®, or glyphosate-resistant, varieties.

The use of POST-only weed control programs presents several potential problems. First, by not using a soil-applied herbicide at planting or included with a burndown treatment, soybean yields may suffer due to early season weed competition. Research from Nebraska has shown that soybean yields for a crop planted in 30-in rows are negatively impacted by weeds as early as seven days after planting (Knezivic et al. 2003). PRE herbicides work through activity in the soil that controls weeds prior to or shortly after their emergence. As a result of improved early season weed control, PRE herbicides also can lengthen the window of time during, which POST applications need to be made to prevent yield loss during the growing season. This "cushion" can be very important if weather conditions or workload prevent timely application of POST treatments. Finally, most producers who use a POST-only program are using primarily a single herbicide (glyphosate) for weed control. Unfortunately, this over-reliance on glyphosate has led to the development of populations of marestail, waterhemp and other weeds throughout Oklahoma that can no longer be controlled with glyphosate. To prevent or delay the development of herbicide-resistant weeds, it is necessary to use additional herbicides from other modes of action to diversify the chemical weed control program. The easiest way to include additional herbicides is to use a PRE herbicide that will provide soil residual weed control during the growing season. Therefore, the objective of this study was to evaluate an extensive list of PRE herbicide options for soybean production in Oklahoma.

Materials and Methods

A field trial was established at the OSU Cimarron Valley Research Station near Perkins in 2011. Asgrow AG47360 was planted May 31 in 30-in rows following a tillage operation to control any weeds that were present. A total of 34 PRE and early POST herbicide treatments were evaluated. PRE treatments were applied June 1 and early POST treatments were applied June 17 when soybeans were at the cotyledon to second trifoliate growth stage. Each treatment was replicated four times and visual estimates of crop injury and weed control were collected by comparing herbicide treatments to the untreated control at multiple times during the growing season. Weed control was evaluated on a scale of 0 to 99 percent, where 0 represented no weed control and 99 percent represented complete control. In this report, weed control data collected 30 days after planting is presented.

Results and discussion

Despite the drought conditions after planting and application, many of the PRE and early POST herbicides evaluated in this study performed very well and provided excellent control of large crabgrass and Palmer amaranth through at least 30 days after planting (Table 7). For example, all of the Valor SX®- and Authority®-containing products provided good to excellent control of large crabgrass (≥86 percent) and Palmer amaranth (≥98 percent). Many other herbicides also provided excellent control of Palmer amaranth.

In addition to PRE herbicides with soil residual activity, four early POST herbicides that also have soil residual activity were evaluated. These products – Warrant™, Prefix™, Sequence® and Anthem™ – either have some POST activity on weeds or must be tank-mixed with glyphosate to control any weeds that are present. With the exception of Prefix™ and Sequence® on large crabgrass, all of these treatments provided excellent weed control. Early POST treatments are gaining in popularity because they allow for an extended period of soil activity when used following a traditional PRE application (also known as overlapping residuals). Glyphosate-resistant weeds, such as waterhemp, can grow very quickly and become difficult to control with POST treatments in a matter of only a few days. Therefore, maximizing the amount of soil activity with multiple herbicides is often the best solution for preventing these weeds from gaining a foothold.

Several herbicides provided poor control of the weeds evaluated in this trial. This is likely due to one of three different reasons. First, when selecting a PRE herbicide, it is very important to know which weeds are likely to present in each field. For example, FirstRate® provided 97 percent control of Palmer amaranth, but only 57 percent control of large crabgrass. This is simply due to the selective nature of this herbicide. Second, some herbicides may have shorter residual activity in the soil than others. Sharpen®, for example, is an excellent herbicide for burndown weed control, but has relatively short residual activity in the soil and will not successfully control weeds through the early stages of the growing season. Finally, the poor weed control for some herbicides can most likely be attributed to the lack of precipitation after planting and application. All soil-applied PRE herbicides require precipitation to be moved into the soil for maximum performance. The precipitation does not have come immediately after application, but must be received before the herbicide breaks down due to light, temperature and biological degradation.

Most of the products evaluated in this trial are commercially available; however, three yet-to-released herbicides were also investigated. Zidua®, a new PRE herbicide that will be sold by BASF, contains pyroxasulfone as its active ingredient. Pyroxasulfone also will be sold as part of pre-mix in Fierce™ (Valor SX® + pyroxasulfone) and Anthem™ (Cadet® + pyroxasulfone). Pyroxasulfone belongs to the same herbicide mode of action as Dual Magnum® and Outlook® and is very effective on a wide range of weed species. In this trial, PRE applications of Zidua®, Fierce™ and Anthem™ provided at least 97 percent control of large crabgrass and Palmer amaranth 30 days after application. Anthem™ also was evaluated as an early POST treatment and, when tank-mixed with glyphosate to improve weed control, appears to be an effective herbicide to provide residual activity in a POST application. These products are not currently available for use in Oklahoma, but registration is expected sometime in 2012.

Conclusions

Results from this trial indicate that several PRE herbicide options can provide excellent early season control of large crabgrass and Palmer amaranth, despite receiving minimal precipitation after application. However, not all PRE herbicides provided the same level of control. Therefore, the decision of which PRE herbicide to use should be made based on the weed species present, size of the weed populations in each individual field and subsequent crops to be planted in rotation.

PRE herbicides will not usually eliminate the need for POST applications, but will reduce weed populations present during the growing season and may reduce the number of treatments required for satisfactory weed control. Additionally, the use of PRE herbicides will improve control of marestail, Palmer amaranth or other weeds that are resistant or tolerant to glyphosate and other commonly used herbicides.

For more information on herbicide modes of action, please see OSU Fact Sheet PSS-2778 "Understanding Herbicide Mode of Action." For a detailed list of the herbicide pre-mixes and ratios of the component products evaluated in this trial, please see OSU Current Report CR-2781 "Components and Ratios of Pre-mix Herbicides for Use in Soybean." Both of these documents are available at www.weedscience.okstate.edu.

Acknowledgements

Thank you to the OSB for providing funding to conduct this trial and the various industry partners that provided support.

References

Knezevic, S.Z., S.P. Evans, and M. Mainz. 2003. Row spacing influences the critical timing for weed removal in soybean. Weed Technology 17:666-673.

Consider deleting the two paragraphs in red, since the beginning of this pub acknowledges the OSB and other partners.

Table 1. Large crabgrass and Palmer amaranth control 30 days after planting with various preemergence (PRE) and early postemergence (early-POST) herbicides in 2011. PRE treatments were applied on June 1, one day after planting and early-POST treatments were applied on June 17 when soybeans were in cotyledon to 2nd trifoliate growth stage. Control data with an asterisk (*) indicate the treatments with the statistically highest levels of control.

Herbicide treatment	Application timing	Rate/A	Pre-mix components	Large crabgrass	Palmer amaranth
				— — % control	— —
Valor® SX	PRE	3 oz	n/a	94*	99*
Valor® XLT	PRE	3 oz	Valor® SX + Classic®	88*	99*
Fierce™a	PRE	3 oz	Valor® SX + pyroxasulfone	98*	99*
Envive®	PRE	4 oz	Valor® SX + Classic® + Harmony®	92*	98*
Enlite®	PRE	2.8 oz	Valor® SX + Classic® + Harmony®	86*	99*
Authority® First / Sonic	PRE	4 oz	Authority® + FirstRate®	93*	99*
Authority® MTZ	PRE	10 oz	Authority® + Sencor®	91*	99*
Authority® Assist	PRE	5 fl oz	Authority® + Pursuit®	95*	98*
Authority® XL	PRE	4 oz	Authority® + Classic®	94*	99*
Spartan® / Authority®	PRE	6 fl oz	n/a	95*	99*
Sharpen®	PRE	1 fl oz	n/a	29	69
OpTill™	PRE	2 oz	Sharpen® + Pursuit ®	96*	97*
Verdict™	PRE	5 fl oz	Sharpen® + Outlook®	33	79
Sencor®	PRE	5.33 oz	n/a	82*	82
Linex®	PRE	1 pt	n/a	38	76
Python®	PRE	1.14 oz	n/a	86*	99*
Linex® + Dual Magnum®	PRE	1 pt + 1.33 pt	n/a	98*	99*
Linex®+ Valor® SX	PRE	1 pt + 3 oz	n/a	93*	99*
Linex® + Prowl® H_2O	PRE	1 pt + 2 pt	n/a	82*	71
Linex® + Sencor®	PRE	0.5 pt + 4 oz	n/a	74	92*
Canopy®	PRE	3 oz	Classic® + Sencor®	53	96*
FirstRate®	PRE	0.6 oz	n/a	57	97*
Boundary®	PRE	2.5 pt	Dual Magnum® + Sencor®	98*	98*
Dual Magnum®	PRE	1.33 pt	n/a	99*	95*
Outlook®	PRE	16 fl oz	n/a	92*	87
Prowl® H_2O	PRE	2 pt	n/a	63	36
Intrro®	PRE	2.5 qt	n/a	95*	94*
Zidua®a (pyroxasulfone)	PRE	2 oz	n/a	97*	98*
Anthem™a	PRE	6 fl oz	Cadet® + pyroxasulfone	97*	97*
Prefix™	PRE	2 pt	Reflex® + Dual Magnum®	97*	99*
Warrant™ + glyphosate	early-POST	3 pt + 0.75 lb ae	n/a	93*	97*
Prefix™	early-POST	2 pt	Reflex® + Dual Magnum®	71	93*
Sequence®	early-POST	2.5 pt	Dual Magnum® + glyphosate	73	96*
Anthem™a + glyphosate	early-POST	6 fl oz + 0.75 lb ae	n/a	90*	91*
Untreated				0	0

[a] Fierece™, Zidua® and Anthem™ are not currently registered for use in Oklahoma.

Partners in Progress
SOYBEANS

Soybean Disease Management

John Damicone, Tyler Pierson and J.J. Stoekel
Entomology and Plant Pathology

2011 progress made possible through OSB/USB support

- **Seed treatments provided limited improvement in plant stand, but not during late planting dates (June and July) when temperatures were high.**
- **Seed treatments did not increase yield on any of the planting dates under a low-yielding environment in 2011.**
- **In the absence of soybean rust and frogeye leaf spot, fungicide programs did not statistically increase yield of soybeans, although some numerical improvements in yield were observed.**
- **In 2011, soybean cyst nematode (SCN) pressure was not adequate to assess the effects of resistant varieties or a seed treatment developed for nematode control.**

Seedling Diseases and Stand Establishment

Soybeans are one of the few crops that do not normally include seed treatment with fungicide to control seedling disease (seed rot and damping off). Recent observations are that stand establishment is a problem in many soybean fields. In particular, stands appear to be more erratic in the production of full-season soybeans planted in June and July. Seedling diseases caused by the fungi *Fusarium*, *Rhizoctonia* and *Pythium* may be involved in stand establishment when conditions are not ideal for germination and emergence. The evaluation of seed treatments at various planting dates may provide growers useful information for maximizing stand establishment and yield potential.

Plant stand and yield responses to soybean seed treatments were evaluated at various planting dates at the Cimarron Valley Research Station in Perkins. Seed treatments were applied using a rotary drum in a total slurry volume of 8 oz/100 lbs seed. Planting dates were intended to be two weeks apart from April through June, but varied due to weather and soil conditions. Stand counts were taken 14 days to 21 days after each planting date. Plots were harvested on Dec. 1 and Nov. 4 with a plot combine. Yields were adjusted to 13 percent moisture.

Just want to double check dates. If correct, can I put Nov. before Dec.?

Compared to the 30-year average, rainfall was only 59 percent of normal from June through October. Average daily temperature was 5 to 8°F above normal each month from June through August and there were 61 days above 100°F. The summer cropping period was the hottest and one of the driest on record. The crop was under drought stress until September, when rain was received and the temperature cooled. Emergence was good (50 percent or more) for planting dates in May but was poor for the planting dates in June and July. Seed treatment effects on plant stand were statistically significant only for the May 31 planting date, when the Trilex+Gaucho treatment increased stand compared to the untreated check. The Trilex+Gaucho treatment numerically increased stand over all planting dates. However, yields were low because of the prolonged drought stress and did not differ among planting dates or treatments.

Foliar Diseases

Soybean rust is a new threat to soybean production in the U.S. Since 2004, rust has been a yearly problem in the southeastern U.S, and was found in Oklahoma each year from 2007 to 2009. However, rust was only a significant a problem in 2007 when it was first detected in July. The sentinel plot program and rust monitoring activities by soybean growers and crop advisers in the state have increased the awareness of the presence of other foliar diseases in addition to soybean rust. In Oklahoma, Septoria brown spot is present in most old soybean fields and causes noticeable premature defoliation. Other diseases

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Table 8. Soybean response to seed treatments at various planting dates in 2011.

Treatment and rate/cwt seed	Planting date May 10	May 31	June 16	July 1	average[z]
Plant stand (no./ft row)					
Check	5.2	3.9 b[y]	2.4	1.2	3.2
Thiram 42S 2 fl oz	6.1	4.3 b	2.2	0.9	3.4
Trixlex 2000 1 fl oz	5.5	4.1 b	2.8	0.6	3.3
Trilex 2000 1 fl oz + Gaucho 1.6 fl oz	5.9	5.5a	2.1	1.3	3.7
average[x]	5.7	4.4	2.4	1.0	
LSD (P=0.05)[w]	NS[u]	0.8	NS	NS	
Yield (bu/A)					
Check	8.0	8.1	8.1	7.7	8.0 a
Thiram 42S 2 fl oz	8.0	8.8	8.9	6.6	8.1 a
Trixlex 2000 1 fl oz	8.1	7.3	9.2	4.9	7.4 a
Trilex 2000 1 fl oz + Gaucho 1.6 fl oz	7.6	9.5	8.2	8.1	8.4 a
average[x]	7.9 a	8.4 a	8.6 a	6.8 a	

Are either of these a typo? Also, what do the "a" and "b" represent?

[z] Averaged over planting dates.
[y] Values in a column or row followed by the same letter are not statistically different at P=0.05.
[x] Averaged over treatment.
[w] Fisher's least significant difference.
[u] Treatment effect not significant at P=0.05.

This table isn't referenced in the text. Where can it be mentioned?

found in the state include frogeye leaf spot, bacterial blight, Cercospora blight and downy mildew. Frogeye leaf spot is generally accepted to reduce soybean yields when severe.

Fungicides registered for use on soybeans to control rust and other foliar diseases include strobilurins (Headline®, Quadris®) and triazoles (Alto®, Domark®, Folicur®, Laredo®, Tilt®) and pre-mixtures of triazoles and strobilurins (Quilt®, QuadrisXtra®, Stratego®). All of these fungicides act as protectants and have some degree of systemic activity. Triazoles are being promoted as having excellent activity in situations where rust is already present in the field. Strobilurin fungicides such as Headline® are being promoted for plant health benefits that claim increases in yield in the absence of disease.

Fungicide programs recommended for soybean rust and experimental fungicides were evaluated on the variety Pioneer® 95M82 at the Oklahoma Vegetable Research Station in Bixby. Treatments were applied broadcast at 25 gal/A at 40 psi at the R3 (beginning pod) growth stage. Disease incidence, the percentage of leaflets with symptoms, and defoliation, the percentage of leaflets defoliated was visually assessed in three areas per plot at the R5 (beginning maturity) growth stage on Sept. 14. Plots were harvested on Nov. 17 using a small-plot combine and yields were adjusted to 13 percent moisture.

Compared to the 30-year average, rainfall was only 64 percent of normal from June through October. Average daily temperature was 4°F to 7°F above normal each month from June through August and there were 37 days above 100°F. The summer cropping period was the hottest and one of the driest on record. The crop was under drought stress until September, when rains were received and the temperature cooled. Plants bloomed for an extended period of time that permitted a late crop set. Charcoal rot was severe, killing up to 20 percent of the plants prior to pod fill. Bacterial blight was the predominant foliar disease and reached severe levels. Fungicide treatments did not affect levels of disease, defoliation or yield. Yields were low and variable (cv=43.2 percent) due mostly to variable levels of drought stress and charcoal rot.

Fungicide programs recommended for soybean rust and experimental fungicides were evaluated at the Cimarron

Table 9. Evaluation of fungicides for control of foliar diseases of soybeans at Bixby in 2011.

Treatment and rate/A (timing[z])	Diseased leaves (%)	Defoliation (%)	Yield (bu/A)
Untreated check	57.8	9.9	15.0
Approach 2.08F 6 fl oz (R3)	55.8	13.7	18.4
Approach 2.08F 9 fl oz (R3)	66.7	19.2	17.8
Topguard® 1.04F 7 fl oz (R3)	51.1	22.2	10.1
Stratego® 2.08E 8 fl oz (R3)	70.0	16.7	13.9
Headline® 2.08E 6 fl oz (R3)	52.5	14.2	12.1
LSD (P=0.05)[y]	NS[x]	NS	NS

[z] Application timing was at growth stage R3Aug. 26.

[y] Fisher's least significant difference.

[x] Treatment effect not significant at P=0.05.

Valley Research Station in Perkinson the variety 95M82. Treatments were applied broadcast in 25 gal/A at the R3 (beginning pod) growth stage and/or at the R5 (beginning seed) growth stages. Disease incidence, the percentage of leaflets with symptoms, and defoliation, the percentage of leaflets defoliated, was visually assessed in three areas per plot at the R7 (beginning maturity) growth stage on Oct. 18. Plots were harvested on Dec. 1 using a small-plot combine and yields were adjusted to 13 percent moisture.

Compared to the 30-year average, rainfall was only 59 percent of normal from June through October. Average daily temperature was 5°F to 8°F above normal each month from June through August and there were 61 days above 100°F. The summer cropping period was the hottest and one of the driest on record. The crop was under drought stress until September, when rains were received and the temperature cooled. Plants bloomed for an extended period of time that permitted a late crop set. Disease pressure was low and consisted of a combination of brown spot and bacterial leaf spot. Fungicide treatments reduced levels of disease compared to the untreated check. Treatments did not affect defoliation, and delayed maturity (greening effects) was not obvious. Although several treatments had numerically less defoliation than the untreated check. Yields were low and did not differ among treatments.

Soybean Cyst Nematode

The SCN is the most serious soybean pest in the U.S. While soybeans can be produced in SCN-infested fields, up to 30 percent yield losses can occur without obvious symptoms. Therefore, farmers usually do not know that their fields are infested with SCN. SCN is known to occur in 19 counties in Oklahoma.

Soybean varieties resistant (Stine® 5420-4, Pioneer® 95M60, Pioneer® 95M50) and susceptible (Stine® 5400-4, Pioneer® 95Y30, Pioneer® 95Y70) to SCN were compared for response to a

Table 10. Evaluation of fungicides for control of foliar diseases of soybeans at Perkinsin 2011.

Treatment and rate/A (timing[z])	Diseased leaves (%)	Defoliation (%)	Yield (bu/A)
Untreated check	43.3 a[y]	45.0	20.1
Approach 2.08F 6 fl oz (R3)	31.7 b	56.6	23.6
Approach 2.08F 9 fl oz (R3)	26.7 b	38.3	21.5
Headline® 2.08E 6 fl oz (R3)	28.3 b	40.8	25.1
Headline® 2.08E 6 fl oz (R3, R5)	30.8 b	31.7	21.0
Quilt Xcel® 2.2F 10.5 fl oz (R3)	28.3 b	36.7	20.8
Quilt Xcel® 2.2F 10.5 fl oz (R3, R5)	33.7 b	31.6	22.8
LSD (P=0.05)[x]	8.3	NS[w]	NS

[z] Application timing was at growth stage R3 Aug. 25 and R5 Sept. 2.

[y] Values in a column followed by the same letter are not significantly different at P=0.05.

[x] Fisher's least significant difference.

[w] Treatment effect not significant at P=0.05.

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seed treatment (Poncho®/Votivo®) for control of SCN. The trial was conducted at the Oklahoma Vegetable Research Station in Bixbyin a field infested with SCN. The seed treatment was applied using a rotary drum in a total slurry volume of 8 oz/100 lbs seed. Soil samples (8-10 cores from the root zone of each sub plot) were taken Sept. 19. SCN eggs were extracted, stained and counted.

Compared to the 30-year average, rainfall was only 64 percent of normal from June through October. Average daily temperature was 4°F to 7°F above normal each month from June through August and there were 37 days above 100°F. The summer cropping period was the hottest and one of the driest on record. Heavy rain (4.38 in) in the two weeks after planting caused poor stand establishment. The trial was replanted in an adjacent field in early June, but an even poorer stand resulted from the hot weather. The crop was under drought stress until September, when rains were received and the temperature cooled. Plants bloomed for an extended period of time that permitted a late crop set. Charcoal rot was severe, killing up to 20 percent of the plants prior to pod fill. The trial was not harvested for yield because of the erratic stand, but soil samples were taken from surviving plants. SCN egg counts were very low and highly variable (cv=128). SCN levels were 20 times to 50 times below those observed in the same field in 2010. The effects of variety and seed treatment on SCN levels were not statistically significant. SCN levels were not sufficient for determining the effects of variety or seed treatment on nematode control.

Table 11. Response of soybean varieties to seed treatment for control of soybean cyst nematode (SCN) in 2011.

Variety (SCN reaction - source of resistance)[z]	Treatment and rate/cwt seed: Untreated check	Poncho®/Votivo® 2 fl oz	average[y]
	SCN (no. eggs/100 cc soil)		
Stine® 5420-4 (R - PI 88788)	23.3	18.3	20.8 a[x]
Stine® 5400-4 (S)	20.0	6.7	13.3 a
Pioneer® 95M60 (R - Hartwig)	18.0	20.3	19.2 a
Pioneer® 95M50 (R - PI 88788)	17.6	4.2	10.9 a
Pioneer® 95Y30 (S)	27.3	14.0	20.7 a
Pioneer® 95Y70 (S)	8.3	19.2	13.7 a
average[w]	19.1 a	13.8 a	16.4 a
Treatment LSD (P=0.05)[v]			NS[u]
Variety LSD (P=0.05)			NS

[z] R=resistant and S=susceptible.
[y] Averaged over treatment.
[x] Values in a column or row followed by the same letter are not significantly different at P=0.05.
[w] Averaged over variety.
[v] Fisher's least significant difference.
[u] Treatment effect not significant at P=0.05.

Relationships Between Soil Profile Characteristic and Soybean Yields in 2010

Partners in Progress SOYBEANS

Should this be 2011?

Jason Warren and Chad Godsey
Department of Plant and Soil Sciences

2011 progress made possible through OSB/USB support

- **Depth to limiting layer influences dryland soybean yields.**
- **No single item should be used to delineate management zones, consider use of yield data, soils maps, etc.**

This summary is part of the field-scale variability study initiated in 2010. Various technics may be used to create management zones for precision management of soybean fields. Grid soil sampling, EC measurements and yield maps are good tools that may be used to evaluate field level variability. Soil maps also may be useful but are often criticized for not being accurate enough for the creation of management zones. The purpose of the research presented here was to collect site specific soil profile data to explain some of the variability observed in soybeans that could not be explained by soil maps, grid soil sampling or EC measurement.

Should this be 2011?

Do you mean "technique" instead of "technic"?

What is EC?

Materials and Methods

In January 2011, soil cores were collected to the depth of bed rock or 43 in from soybean fields located in Ottawa, Kay and Washita counties. Fields located in Ottawa and Kay counties were rain fed and the field located in Washita County was irrigated. Soil core collection locations were selected to provide a range in soybean yields, so that profile characteristics could be used to evaluate yield variability. After collection, soil cores were transported back to Stillwater in plastic sleeves. Soil profile descriptions included the depth, texture, clay content, structure, consistency and color of each horizon. This data allows for the determination of the depth to limiting layer, which was defined as the top of the first horizon containing a clay content greater than 35 percent, and redoximorphic features (grey masses intermixed with soil matrix, indicators of poor drainage or perennial water table)(Figure 5) at the Kay and Ottawa county locations. The texture of soils at the Washita County location ranged from sandy loams to sandy clay loams, therefore, it was assumed that clay content and drainage would not limit yield. Because these soils were sandy, it was assumed that whole profile clay content would be positively correlated with yield. The higher clay soils within this field were assumed to have greater water holding capacity and therefore greater yield potential.

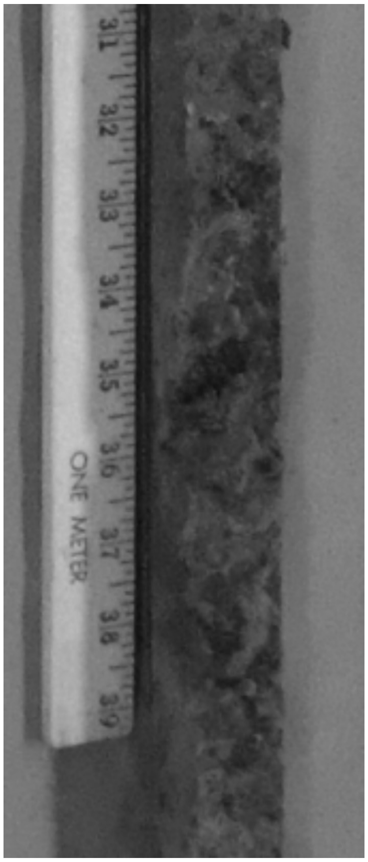

Figure 5: Core showing grey and dark red redoximorphic features

Results and Discussion

The map presented in Figure 6 shows yield, the soil map and core collection location at the Ottawa County field. The whole field is mapped as a Taloka silt loam, therefore the NRCS soil map is not useful to delineate management zones for this field. The yields vary between 11 bu/A and 59 bu/A at this location and were regressed against

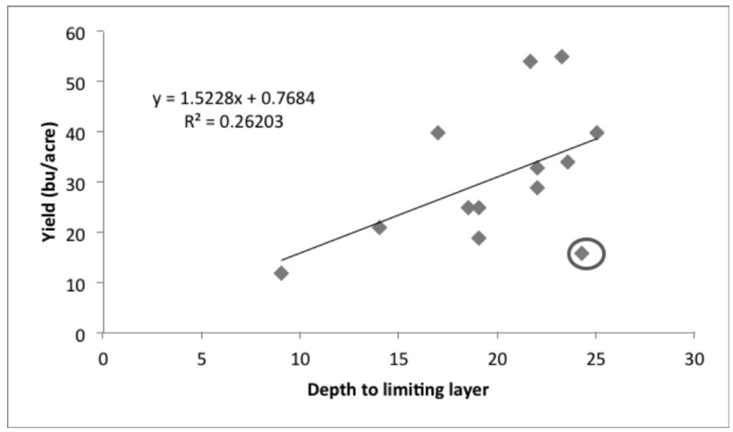

Figure 7: The relationship between soybean yield and depth to limiting layer observed in the field in Ottawa County near Miami.

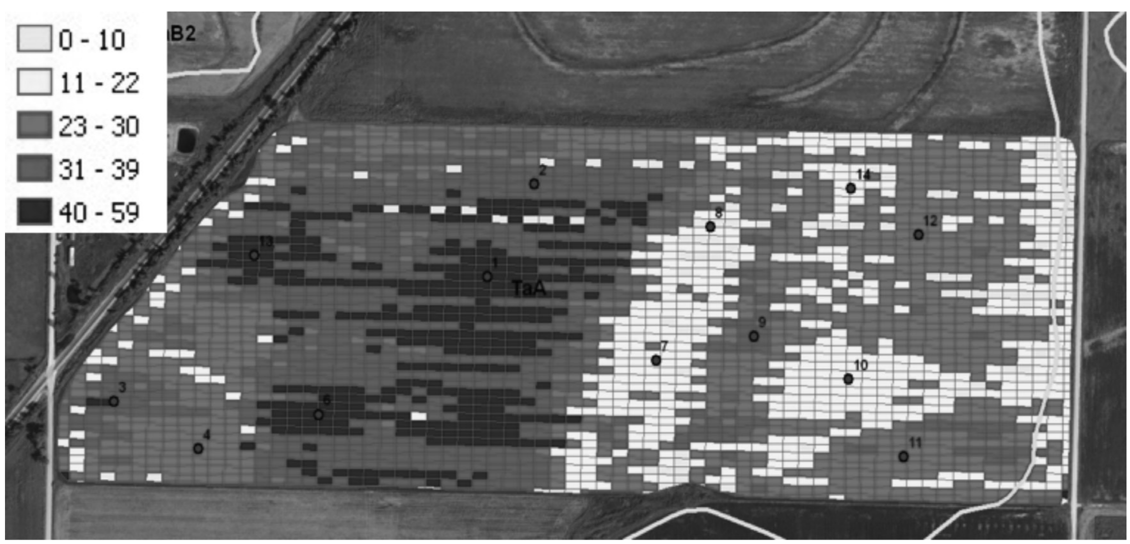

Figure 6: Soybean yields (yields shown in legend are in bu/A), NRCS soil mapping units and the location of soil core collection in Ottawa County near Miami.

the depth to limiting layer in Figure 7. Figure 7 shows that generally the yield is positively related to depth to limiting layer as expected. However, the weak relationship suggests that other variables influence yield. The core represented by the circled point in Figure 7 was collected from a drowned out area on the back side of a terrace. The three points above the cluster points falling on the line were collected from high yielding areas of the field and may result from elevated fertility in these areas.

The map presented in Figure 8shows yield, the soil map and core collection locations at the Kay County field. Visual comparison of yield and the soil map demonstrates that the Port silt loam (Kc, west side of field) is a highly productive soil. This is no surprise as it is a deep, well-draining soil with moderate texture and deep deposits of organic matter resulting from its recent formation in a flood plane. In contrast, Kirkland (KnB) and Tabler (TaA) soils can contain horizons with elevated clay content, which restrict root growth and drainage. Figure 9 shows that depth to limiting layer was correlated with soybean yield. Therefore, in this field, soil profile characteristics play an important role in yield determination. Large differences, such as the differences in yield found on the Port, and the yield found on the Kirkland and Tabler soils, can be delineated with the soil map. However, variation within the soil mapping units also is apparent in its impact on soybean yields.

The map in Figure 10 shows that the soil map provided little or no explanation of the variability in yield at the Washita County location. The low yielding areas (yellow and red) shown in Figure 10 correspond to the access road or terraces such as that observed in the southeast corner and the northwest corner. These areas were avoided during sampling. Therefore, yields presented in Figure 11 range only from 60 bu/A to 80 bu/A. Figure 11 shows only a weak positive relationship between whole profile clay content and soybean yield. Irrigation likely reduces the impact of soil water holding capacity has

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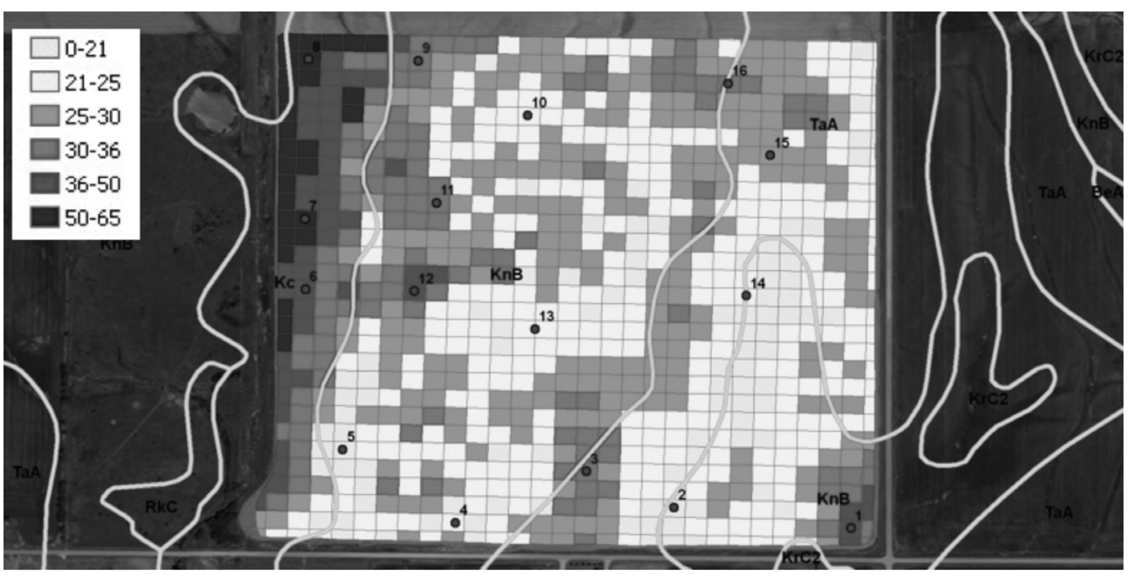

Figure 8: Soybean yields (yields shown in legend are in bu/A), NRCS soil mapping units and the location of soil core collection in Kay County near Ponca City.

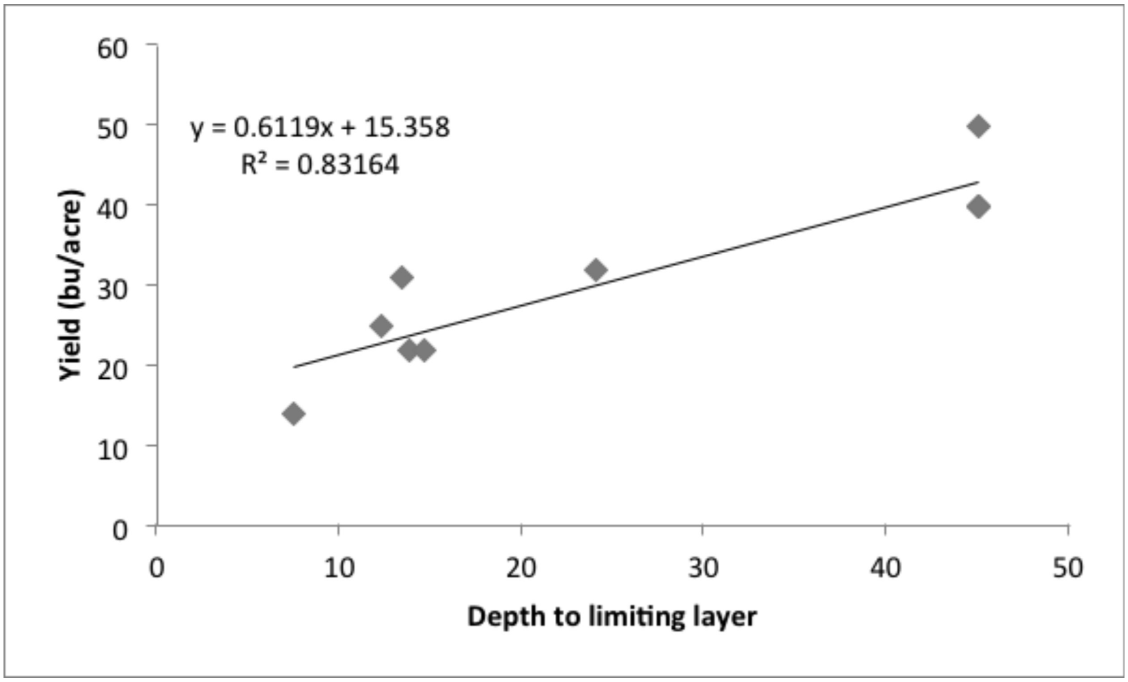

Figure 9: The relationship between soybean yield and depth to limiting layer observed in the field in Kay County near Ponca City.

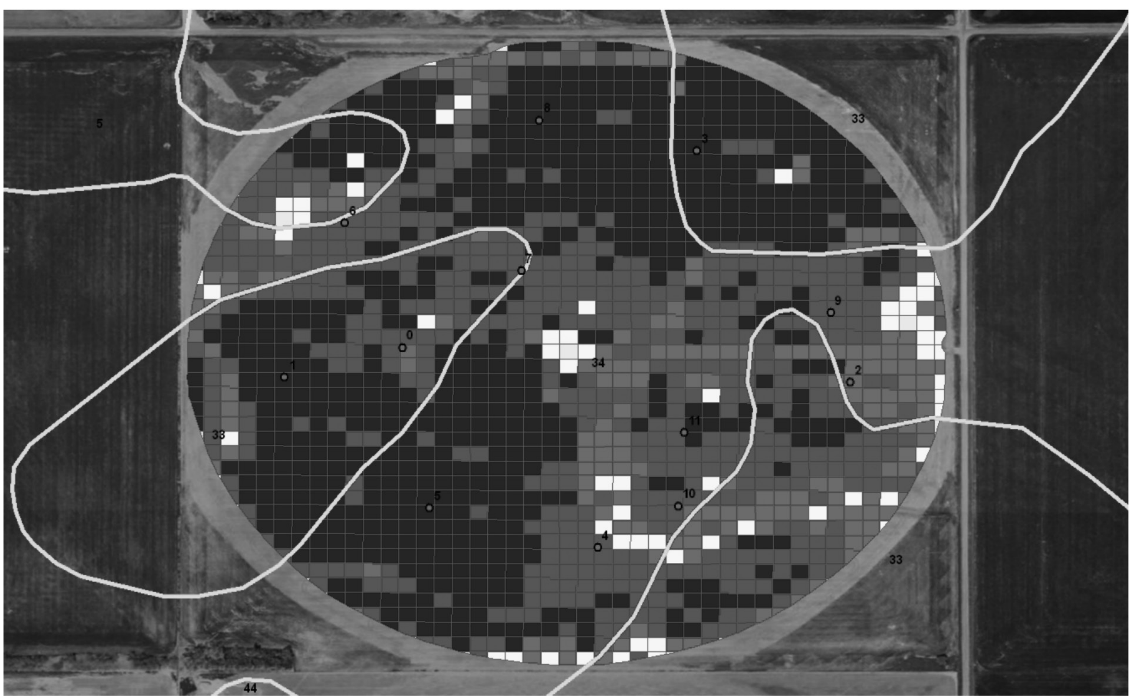

Figure 10: Soybean yields (yields shown in legend are in bu/A), NRCS soil mapping units and the location of soil core collection in southwest Washita County.

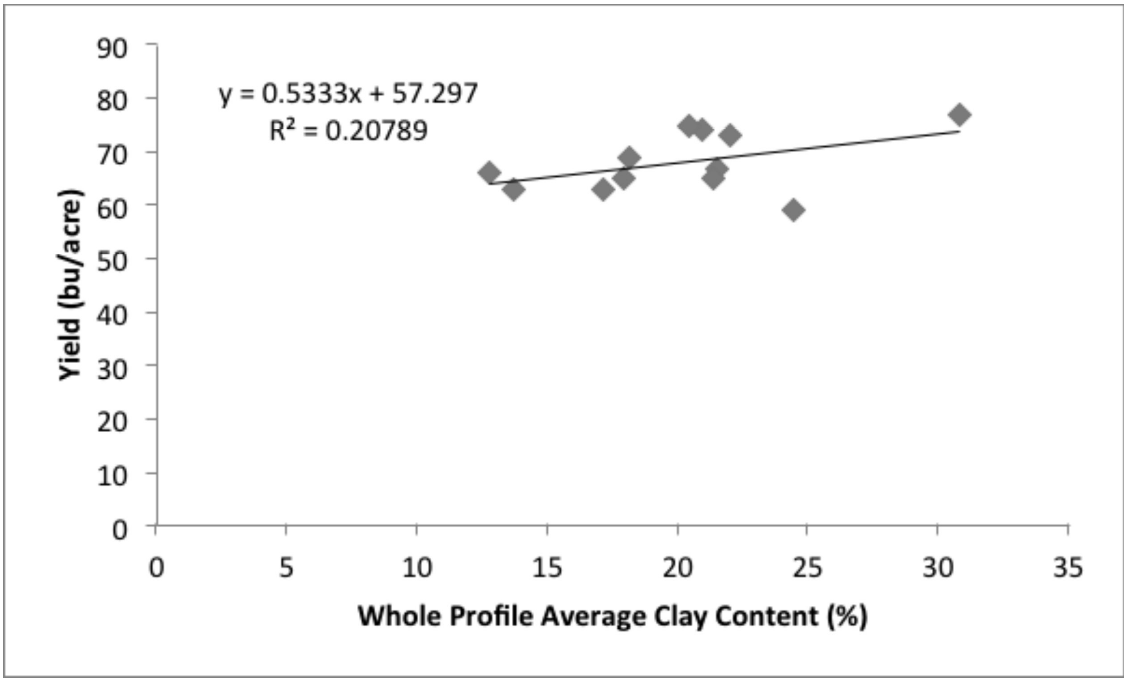

Figure 11: The relationship between soybean yield and the whole profile average clay content in the field in southwest Washita County.

on soybean yields, therefore, yields are generally high and uniform outside the areas of disturbance previously mentioned.

Summary

In summary, depth to limiting layer appears to greatly affect dryland soybean yields in Oklahoma. Depth to limiting layer could be a useful tool in helping to delineate management zones. No single item should be used when creating management zones. Several of the following items should be considered: yield maps, soils map, fertility levels across the field, yield potential, depth to limiting layer across the field, etc.

OKLAHOMA STATE UNIVERSITY

RESEARCH