2010 Research Highlights

Division of Agricultural Sciences and Natural Resources
Oklahoma Panhandle Research and Extension Center
Oklahoma State University
Field & Research Services Unit
Department of Animal Science
Department of Entomology and Plant Pathology
Department of Plant and Soil Sciences
Department of Biosystems and Agricultural Engineering
USDA - ARS
In Sincere Memory of Brent Westerman

Brent Westerman
Senior Director of Field Research Service Units

Robert E. Whitson
DASNR Vice President, Dean & Director

Clarence Watson
Associate Director of the Oklahoma Agricultural Experiment Station

Jonathan Edelson
Assistant Director of the Oklahoma Agricultural Experiment Station
OKLAHOMA PANHANDLE RESEARCH AND EXTENSION CENTER

The Division of Agricultural Sciences and Natural Resources (DASNR) including the Oklahoma Agricultural Experiment Station (OAES) and the Oklahoma Cooperative Extension Service (OCES) at Oklahoma State University (OSU) have a long history of working cooperatively with Oklahoma Panhandle State University (OPSU) to meet the needs of our clientele, the farmers and ranchers of the high plains region. OAES is the research arm of DASNR and continues with the mission to conduct fundamental and applied research for the purpose of developing new knowledge that will lead to technology improvements addressing the needs of the people. The OCES continues to strive to disseminate the research information generated by OAES to the public through field days, workshops, tours, and demonstrations. This has been and will continue to be a major focus of our efforts at the Oklahoma Panhandle Research and Extension Center. Together as a team we have been able to solve many significant problems related to high plains agriculture.

The OPREC is centrally operated within the Field and Research Services Unit (FRSU) of the OAES. The FRSU serves as the backbone for well over 1,000 statewide field and lab based research trials annually. Our unit consists of 18 outlying research stations including the OPREC, the Controlled Environmental Research Lab, the Ridge Road Greenhouse Phase I and Phase II, the Noble Research Center and the Stored Product Research and Extension Center. The FRSU works to provide a central focus for station operations and management with the goal to improve overall efficiency by providing a systematic means for budget management, facility upgrades, consolidation of labor pools, maintenance and repair of equipment and buildings, and other infrastructure needs.

The Oklahoma Panhandle Research and Extension Center at Goodwell is committed to serving the people of the region. Many staff continue to serve our clientele and include; Rick Kochenower Area Agronomy Research and Extension Specialist, Britt Hicks Area Livestock Extension Specialist, and Lawrence Bohl Senior Station Superintendent of OPREC. Other essential OPREC personnel include Donna George Senior Secretary, Craig Chesnut Field Foreman II, Jake Baker Agriculturalist, and several wage payroll and part-time OPSU student laborers. OSU faculty members from numerous Departments continue to utilize OPREC to conduct research and extension efforts in the Panhandle area. Additionally, the OPREC continues to serve as a “hub” for our commodity groups and agriculture industries by hosting several informative agriculture related meetings annually.

The DASNR, OAES, and OCES truly appreciate the support that our clientele, farmers, ranchers, commodity groups, industry, and other agricultural groups have given us over the years. Without your support many of our achievements would not have been possible. We look forward to your continued support in the future and to meeting the needs of the research, extension, and teaching programs in the high plains region.

Clarence Watson
Associate Director
Oklahoma Agricultural Experiment Station
Division of Agricultural Sciences and Natural Resources
Oklahoma State University
The staff at OPREC, OAES F&RSU, Department of Plant and Soil Sciences, Department of Animal Science and Department of Biosystems and Ag Engineering at Oklahoma State University would like to thank the companies and individuals listed below, for providing resources utilized in research projects. Their valuable contributions and support allow researchers to better utilize research dollars. This research is important for producers in the high plains region, not just the Oklahoma panhandle. We would ask that the next time you see these individuals and companies that you say thank you with us.

Archer Daniels Midland Company
BASF
Bayer Crop Sciences
Dow Agro Sciences (Jodie Stockett)
DuPont (Jack Lyons and Robert Rupp)
Farm Credit of Western Oklahoma
Green Country Equipment
Hitch Enterprises
Liquid Control Systems (Tim Nelson)
Midwest Genetics (Bart Arbuthnot)
Monsanto (Ben Mathews, T. K. Baker, Mike Lenz)
National Sorghum Producers
Rick Nelson
GM Northwest Cotton Growers Co-op
Oklahoma Grain Sorghum Commission
Oklahoma Wheat Commission
Oklahoma Wheat Growers
OPSU
Orthman Manufacturing
Pioneer Seed (Ramey Seed)
Sorghum Partners
Hopkins Ag/AIM Agency (J. B. Stewart & Jarrod Stewart)
Syngenta
Texhoma Wheat Growers
Triumph Seed Company
United Sorghum Checkoff Program
Joe Webb
**Oklahoma Panhandle Research and Extension Center**

~ Advisory Board ~

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<th>City, State, Zip</th>
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Annual Precipitation History with 5-year Tendencies
OK-CD1 (Panhandle): 1895-2010

- Light green: Wetter historical periods
- Orange: Drier historical periods
- Black diamond: Individual Annual precipitation value

Long-term Average: 19.32
Climatological data for Oklahoma Panhandle Research and Extension Center, 2010.

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<th>Month</th>
<th>Max</th>
<th>Min</th>
<th>Max. mean</th>
<th>Min. mean</th>
<th>Inches</th>
<th>Long term mean</th>
<th>One day total</th>
<th>AVG mph</th>
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<td>20</td>
<td>1.51</td>
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<td>26</td>
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<td>1.03</td>
<td>0.63</td>
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<td>8</td>
<td>61</td>
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<td>Dec</td>
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<td>2</td>
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<td>22</td>
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<td>0.31</td>
<td>0.23</td>
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<td>Annual total</td>
<td>70.0</td>
<td>40.5</td>
<td>13.03</td>
<td>17.9</td>
<td>NA</td>
<td>NA</td>
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Data from Mesonet Station at OPREC
Yearly Total
Texas        17.89
Cimarron    18.39
Beaver      22.89
BEAVER COUNTY 1948-99

2,987 TOTAL EVENTS

PERCENT OF EVENTS

RAINFALL (inches)

<table>
<thead>
<tr>
<th>Rainfall (inches)</th>
<th>Events</th>
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<td>.01-.24</td>
<td>1767</td>
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<tr>
<td>.25-.49</td>
<td>542</td>
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<tr>
<td>.50-1.0</td>
<td>442</td>
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<tr>
<td>1.0-2.0</td>
<td>185</td>
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<tr>
<td>&gt; 2.0</td>
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CIMARRON COUNTY 1948-99

PERCENT OF EVENTS

RAINFALL (inches)

.01-.24
.25-.49
.50-1.0
1.0-2.0
> 2.0

1874
549
381
159
36

2,999 TOTAL EVENTS
TEXAS COUNTY 1948-99

PERCENT OF EVENTS

RAINFALL (inches)

0.01-0.24: 1835
0.25-0.49: 479
0.50-1.0: 341
1.0-2.0: 176
> 2.0: 25

2,856 TOTAL EVENTS
Crops

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Extension Publications

Oklahoma Corn Performance Trial, 2010
Grain Sorghum Performance Trials in Oklahoma, 2010
Oklahoma Soybean Variety Trial Report 2010
Oklahoma Sunflower Trial Report 2010
Oklahoma Wheat Variety Trials 2009-10
More producers are growing row crops such as grain sorghum (milo) and sunflowers in Northwest Oklahoma. Most of the growers already own a combine that they either use for cutting wheat, beans, or corn. These row crops can be a little more difficult to harvest when compared to the other crops that are normally harvested with the combine and its specific headers. A major difference with these crops is that seeds and in extreme cases full heads can be lost. The loss of seeds is common in all crops but losing heads during harvest can be a significant harvest loss. Specific combine headers perform better than others at preventing both types of losses. There are also special attachments for certain headers that aid in retaining the grain seeds and grain heads.

Our objective was to measure header loss during sunflower and grain sorghum harvest with different combine headers and/or attachments. Header losses were measured by collecting full grain heads and counting the number of seeds left behind from selected areas in the field and quantified to a loss in yield (in lbs/ac).

Methods

A John Deere 6620 combine was used to harvest both crops. Sorghum harvest was performed on November 4, 2010. Four different combine headers were used during this harvest and included a row crop header, a bean header, a conventional wheat header, and the conventional header with milo finger attachments. Sunflowers were harvested on November 17, 2010. Five different headers were used with during the sunflower harvest and included a row crop header, a conventional wheat header, a corn header with sunflower plates, a bean header, and the conventional header with the milo fingers (Figure 1). Header loss collections were performed at six different locations within the field during the harvest performed with each header. The header loss locations were collected using a method shown in Figure 2 to ensure total combine loss was not a factor in the collections.
Figure 1. From top left, clockwise: Row crop head, flex bean header, conventional wheat head with Downer Milo Guards, SunStar sunflower plates for a corn header, corn header with sunflower plates and conventional wheat head (without attachments).
The headers used were four rows wide (30 inch rows), thus the actual designated collection area was ten foot in width by six foot in length for a total of sixty feet squared within the collection area for each collection (Figure 3). This sample area was collected six times per header. Within this collection area the number of heads were counted and collected to be threshed and weighed later. From within the 60 ft² area four one foot square areas were randomly selected to count seeds. Three other 60 ft² areas from each header were selected and collected after harvest to get to get a total combine loss weight.
Heads from both the sunflower and milo harvests were collected from within the 60 ft² area. These heads were threshed and the seeds weighed. The seed weights collected from the heads helped to give a pound per acre loss for heads that did not make it into the combine. The header loss was compared to the total loss.

**Results**

Header loss was calculated for each of the headers based on the individual seed weight and count per the unit area they were collected from. The seeds collected from the heads were counted for a 60 ft² area and the individual seed counts were accounted for the four 1 ft² areas from each collection site. These numbers were then converted to pound per acre yield loss. The results for the sunflowers (Table 1) and the grain sorghum (Table 2) can be viewed below.

### Table 1. Header loss from heads and seeds during sunflower harvest.

<table>
<thead>
<tr>
<th>Header</th>
<th># of Heads</th>
<th>lbs/ac hd loss</th>
<th># of Seeds</th>
<th>lbs/ac sd loss</th>
<th>Total Header Loss</th>
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</thead>
<tbody>
<tr>
<td>Row Crop</td>
<td>2.4</td>
<td>90.7</td>
<td>15.8</td>
<td>72.8</td>
<td>163.4</td>
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<tr>
<td>Wheat</td>
<td>10.8</td>
<td>433.8</td>
<td>9.8</td>
<td>45.3</td>
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<td>Sunflower</td>
<td>4.2</td>
<td>108.4</td>
<td>23.8</td>
<td>109.6</td>
<td>218.1</td>
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<tr>
<td>Bean</td>
<td>4.5</td>
<td>148.5</td>
<td>8.3</td>
<td>38.4</td>
<td>186.8</td>
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<td>Milo</td>
<td>6.6</td>
<td>265.4</td>
<td>9.1</td>
<td>42.0</td>
<td>307.5</td>
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</table>

As shown in Table 1, the row crop header had the lowest header loss followed by the bean header, the sunflower attachments were not very far behind these two. There was a statistical difference in yield loss from each of the headers used. For yield loss from head loss the row crop, sunflower plates and bean header statistically performed the same, while the wheat header and milo fingers were statistically the same. The row crop and sunflower headers performed well below the other three headers when it came to seed loss. More seeds were retained using the grain headers (wheat, bean, and milo fingers). The grain platforms on these headers aided in retaining the higher number of seeds. Total loss followed the same trend as head loss in the performance levels of the headers. A corn header can perform very well with the sunflower plates. However a regular flex header for beans also seemed to work very well for sunflowers during this study. The longer grain platform of the bean header helped to retain a higher number of seeds and heads above the conventional wheat header. Based on this data it is not recommended to use a conventional wheat header or the milo finger attachments for harvesting sunflowers.

### Table 2. Header loss from heads and seeds during Milo harvest.

<table>
<thead>
<tr>
<th>Header</th>
<th># of Heads</th>
<th>lbs/ac hd loss</th>
<th># of Seeds</th>
<th>lbs/ac sd loss</th>
<th>Total Header Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row Crop</td>
<td>0.0</td>
<td>0.0</td>
<td>16.1</td>
<td>54.8</td>
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<tr>
<td>Bean</td>
<td>2.2</td>
<td>72.6</td>
<td>9.7</td>
<td>33.1</td>
<td>105.7</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.5</td>
<td>30.9</td>
<td>9.1</td>
<td>31.0</td>
<td>61.9</td>
</tr>
<tr>
<td>Milo</td>
<td>0.3</td>
<td>5.1</td>
<td>11.2</td>
<td>38.2</td>
<td>43.3</td>
</tr>
</tbody>
</table>
The milo was harvested at about 13% moisture content. It was a very uniform stand and fed into the headers very well. The average total yield was about 130 bushels per acre. As seen in Table 2 the Milo finger attachments for the conventional wheat header performed the best, with the row crop and wheat headers falling right behind. The row crop header had a higher number of seed losses than any of the other heads because of the smaller seeds and header design. However statistically the number of seeds lost between each header was not different. The yield loss due to head losses was statistically the same for the row crop header and the milo attachments. This means that these two headers perform at the same level for retaining heads. As in the sunflower harvest the grain platforms on the bean and wheat headers helped in the reduced seed loss numbers. Even though the total losses of each header was not significantly different the row crop header and the milo finger attachments improved losses. It should be noted that the very uniform high yielding stand of milo helped to keep all headers at a high harvest level.

Conclusions

The data from both studies support very good performance from the row crop head, and if available this header would be a good choice to be used for harvesting these row crops. However depending on what combine headers you have available specialty attachments can make a significant difference in the amount of head and seed loss occurring during harvest. It would be worth the investment to buy the sunflower plates or the milo fingers for their designed crop. In both cases the grain headers performed better on seed loss due to the design of the header grain platform. Even though fewer seeds were lost with the grain headers it must be remembered the significant losses that occur from the loss of complete or partial grain heads. In both studies the row crop header retained the highest number of grain heads. Milo fingers and sunflower plates both have reduced head loss numbers compared to the wheat and bean headers without attachments. Based on the data collected from this study it is shown that the header attachments tested in these trials helped in retaining full heads. It is very important to retain as many heads as possible to prevent large losses thus the attachments are worth using.
OSU joins Texas A&M University/AgriPro in Uniform Testing

The Oklahoma Panhandle Research and Extension Center (OPREC) plays a pivotal role in the final stages of OSU wheat variety development. The 2009-2010 crop season represented our second year of collaborative uniform testing of contemporary varieties and candidate varieties with two other breeding programs in the southern Plains, namely Texas AgriLife and AgriPro. This uniform trial contained the same entries tested across Texas and Oklahoma, including a dryland trial at the OPREC. Along with the usual varieties that would appear in a variety trial such as TAM 111, Jackpot, and Duster, experimental lines under release consideration were evaluated head-to-head. Two such experimental lines from OSU were included in 2010 (Table 1) and have now been officially released by the Oklahoma Agricultural Experiment Station (OAES) as Ruby Lee and Garrison.

Topping the list for statewide performance in Oklahoma were Armour (WestBred), Duster, and the new OAES release, Garrison (Table 1). The statewide yield means included trials at Granite, Enid, Lahoma, and Goodwell dryland. To identify best-variety performance at Goodwell, one must focus strictly on the Goodwell performance data in Table 1. That is because variety means at Lahoma or at Granite were not significantly correlated with variety means at Goodwell ($r = 0.2$ for both pairs of correlations). Hence, a different set of varieties excelled at Goodwell than elsewhere in the state, including TAM 203, the OSU new beardless variety Pete, Jagger, and SY Gold (AgriPro). This lack of yield consistency between downstate locations and the OPREC is not unusual, and we must account for this inconsistency in the OSU wheat improvement program by using the OPREC as a core testing site for line evaluation and selection. The Uniform Variety Trial summarized in Table 1 will be repeated in 2011 with a different lineup of experimental lines.

Testing of Elite Materials from the OSU Wheat Improvement Program

As alluded above, the OPREC is used as one of the three cornerstone testing sites for replicated yield and quality trials in the OSU wheat improvement program. The other two sites include Granite in southwest Oklahoma and Lahoma in north central Oklahoma. Breeding lines in their first year of replicated yield trials, all the way up to those in their fifth year of replicated trials, typically appear at the Center in both dryland and irrigated plots. One such trial contains the most advanced (i.e., elite) breeding lines each year, called the Oklahoma Elite Trial (OET).

Nine of the 30 slots in the 2010 OET were occupied by contemporary check varieties, plus the long-term check variety Chisholm (Table 2). We include varieties which represent the best available commercial genetics for Oklahoma in the HRW market class. Thus each year the panel of checks changes slightly to reflect new improved genetics. This year you will find test results for these outstanding check varieties: Billings, Duster, Endurance, OK Bullet, Centerfield, Fuller, TAM 203, Pete, and Jackpot. The 2010 trial also featured four candidate varieties that were under the careful watch of the OSU Wheat Improvement Team. Two of those candidates were released by the OAES in February 2011 and are currently being considered for licensing.
OK05212 was released as Garrison, and OK05526 was released as Ruby Lee. More information on each of those varieties may be found at the end of this report.

Under further release consideration are the experimental lines OK07209, OK07214, and OK07231, all of which have Duster as one of their parents, with the other parent being different. Of primary interest are the two highest yielding lines in the 2010 OET, OK07209 and OK07214. These lines also performed very well at the OPREC, either irrigated or dryland. Differences between OK07209 and OK07214 have relevance to downstate Oklahoma, such as Hessian fly resistance or tolerance to acidic soils. OK07209 is currently under large-scale foundation seed increase, whereas OK07214 was placed under a limited foundation seed increase, with the intent to undergo a second year of seed multiplication in 2011-2012.

Unlike previous years, the yield results obtained under irrigation were not highly influenced by viruses, the most notable of which in the past have been *Barley yellow dwarf virus* (BYDV), *Wheat streak mosaic virus* (WSMV), and *Triticum mosaic virus*. However, the correlation between yields in the irrigated trial versus the dryland trial was no better than in previous years where differential disease presence biased the comparison ($r=0.62$ in 2010).

Duster, Billings, TAM 203, and Jackpot consistently had higher yields among the checks in both trials. In addition to the two experimental lines already discussed, we have our sights set on a couple other experiments that have performed well over several years of OPREC testing, including OK05511 and OK05312. OK05511 provides much needed insect resistance currently not offered in OSU releases--specifically to greenbug and Hessian fly—and we are evaluating in 2011 a reselection of the original line to purify the insect resistance. OK05312 holds our interest strictly as a High Plains variety, because its yield potential is best expressed in the Oklahoma panhandle, and it confers a high degree of resistance to curl mite, the WSMV vector.

**What is our plan for breeding resistance to WSMV?**

The OSU Wheat Improvement Team has been able to transfer breeding success to OSU stakeholders through the release of varieties with resistance to multiple viruses. Those traits are often stacked in a single variety, with Duster being one example of conferring resistance to *Wheat soilborne mosaic virus* (WSBMV), *Wheat spindle streak mosaic virus* (WSSMV), BYDV, and *High Plains Virus*. However, WSMV has presented a greater challenge to the team, and we do realize the severity of the disease and the yield-limitations it causes in the Oklahoma panhandle. Dr. Hunger, the team’s wheat pathologist, reported in 2004 an average yield loss of 62% when infection occurred in the fall and an average yield loss of 15% when infection occurred in the spring relative to non-infected wheat. Our awareness of WSMV susceptibility was reflected in the priority we placed on this trait when participating in the USDA-CAP grant from 2005 to 2010, where molecular markers were employed across several generations to select directly for WSMV resistance using germplasm developed at the University of Nebraska-Lincoln in partnership with USDA-ARS and at Kansas State University.

The resulting breeding populations are making their way through the breeding program at Oklahoma State University, and purelines are now being developed for statewide testing. Furthermore, we have since expanded our breeding strategy to combine two distinct gene forms of WSMV resistance known as *Wsm1* and *Wsm2* (indeed, they are selected by different molecular markers) with a gene (probably *Cmc4*) that confers resistance to the disease vector (curl mite). This three-pronged approach should uniquely provide the best protection to date for this disease.
One curl-mite resistant experimental has progressed through the program to become a candidate variety, already mentioned as OK05312. We continue to evaluate this line for agronomic and quality traits, and particularly the value of the insect resistance trait to protection from WSMV (in cooperation with Rich Kochenower). Its yielding ability in the High Plains is well established, though performance in the Oklahoma Small Grains Variety Performance Tests in 2010 and in the 2010 OET (Table 2) was compromised by shattering losses.

At Yuma, AZ, 500 head-rows of OK05312 were planted in Fall 2009 to eliminate red-chaff variants and to improve uniformity within the variety. This nursery will provide breeder seed for producing foundation seed in 2011-2012, pending confirmation of reduced yield losses in the presence of WSMV. Scientists at Kansas State University have already confirmed curl mite resistance of OK05312, such that leaf rolling is significantly reduced and fecundity of the curl mite is greatly decreased when plants of OK05312 versus Jagger were infested in a controlled environment (Table 3).

The Wheat Improvement Team will continue to address concerns specific to the High Plains and pertinent to research capabilities at the OPREC. We appreciate the research opportunity afforded by the OPREC and the unique position it places OSU’s Wheat Improvement Team in solving concerns of wheat producers in the panhandle region.

Contributed by Brett F. Carver, OSU Wheat Breeder, on behalf of the Wheat Improvement Team
Table 1. Texas-Oklahoma-AgriPro Uniform Wheat Variety Trial, 2009-2010, conducted at four Oklahoma locations.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Statewide mean</th>
<th>OPREC dryland mean &amp; rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armour</td>
<td>54</td>
<td>67 20</td>
</tr>
<tr>
<td>Duster</td>
<td>52</td>
<td>72 6</td>
</tr>
<tr>
<td>Garrison</td>
<td>52</td>
<td>63 24</td>
</tr>
<tr>
<td>TX06A001263</td>
<td>51</td>
<td>71 9</td>
</tr>
<tr>
<td><strong>Billings</strong></td>
<td><strong>51</strong></td>
<td><strong>69 17</strong></td>
</tr>
<tr>
<td>Jackpot</td>
<td>50</td>
<td>66 21</td>
</tr>
<tr>
<td>TAM 304</td>
<td>49</td>
<td>70 13</td>
</tr>
<tr>
<td>Greer</td>
<td>49</td>
<td>70 12</td>
</tr>
<tr>
<td>TAM 401</td>
<td>48</td>
<td>73 5</td>
</tr>
<tr>
<td>TAM 111</td>
<td>48</td>
<td>71 8</td>
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<tr>
<td><strong>Ruby Lee</strong></td>
<td><strong>48</strong></td>
<td><strong>70 14</strong></td>
</tr>
<tr>
<td>Santa Fe</td>
<td>47</td>
<td>68 18</td>
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<tr>
<td>TAM 113</td>
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<td>71 10</td>
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<td>47</td>
<td>59 30</td>
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<tr>
<td><strong>OK05511</strong></td>
<td><strong>46</strong></td>
<td><strong>70 11</strong></td>
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<tr>
<td>Fannin</td>
<td>46</td>
<td>61 28</td>
</tr>
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<td>46</td>
<td>71 7</td>
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<tr>
<td>Jagger</td>
<td>45</td>
<td>75 2</td>
</tr>
<tr>
<td>SY Gold</td>
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<td>74 4</td>
</tr>
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<td><strong>Pete</strong></td>
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<td><strong>75 3</strong></td>
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<td>77 1</td>
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<td><strong>44</strong></td>
<td><strong>62 27</strong></td>
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<tr>
<td>Shocker</td>
<td>44</td>
<td>62 25</td>
</tr>
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<td>TX05A001822</td>
<td>44</td>
<td>66 22</td>
</tr>
<tr>
<td>Fuller</td>
<td>44</td>
<td>68 19</td>
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<td>Doans</td>
<td>44</td>
<td>56 31</td>
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<td>Art</td>
<td>40</td>
<td>65 23</td>
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<td>39</td>
<td>55 32</td>
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<td>69 16</td>
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<td><strong>60 29</strong></td>
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<td>AP06T3621</td>
<td>36</td>
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<td>C.V.</td>
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<td></td>
</tr>
<tr>
<td>LSD</td>
<td>9</td>
<td></td>
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Table 2. Oklahoma Elite Trial 3 (OET3) conducted at 10 locations in 2009-2010. Entry mean yields and ranks are shown in each column.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Pedigree of experimental line</th>
<th>Statewide</th>
<th>OPREC</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Irrigated</td>
</tr>
<tr>
<td>OK07214</td>
<td>OK93P656-(RMH 3299)/OK99711</td>
<td>54</td>
<td>1</td>
</tr>
<tr>
<td>OK07209</td>
<td>OK93P656-(RMH 3299)/OK99621</td>
<td>53</td>
<td>2</td>
</tr>
<tr>
<td>Duster</td>
<td>Check</td>
<td>52</td>
<td>3</td>
</tr>
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<td>Billings</td>
<td>Check</td>
<td>49</td>
<td>4</td>
</tr>
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<td>OK95616-1/Hickok//Betty</td>
<td>49</td>
<td>5</td>
</tr>
<tr>
<td>Ruby Lee</td>
<td>KS94U275/OK94P549</td>
<td>49</td>
<td>6</td>
</tr>
<tr>
<td>Jackpot</td>
<td>Check</td>
<td>49</td>
<td>7</td>
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<td>OK05204</td>
<td>SWM866442/OK95548</td>
<td>48</td>
<td>8</td>
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<td>OK06332</td>
<td>SWM866442/OK95548/2174</td>
<td>47</td>
<td>9</td>
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<tr>
<td>OK06029C</td>
<td>TXGH12588-120<em>4/FS4//2</em>2174</td>
<td>47</td>
<td>10</td>
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<tr>
<td>TAM 203</td>
<td>TAM 203</td>
<td>47</td>
<td>11</td>
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<td>OK06336</td>
<td>Magvars/2174//Enhancer</td>
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<td>OK05511</td>
<td>TAM 110/2174</td>
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<td>13</td>
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<tr>
<td>OK07231</td>
<td>OK92P577-(RMH 3099)/OK93P656-(RMH 3299)</td>
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<td>14</td>
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<td>TX93V5919/WGRC40//OK94P549/WGRC34</td>
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<td>15</td>
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<tr>
<td>OK06609</td>
<td>SWM866442-7H/2174//OK95548-26C</td>
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<td>OK06822W</td>
<td>OK97G611/Trego</td>
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<td>OK06617</td>
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<td>OK03825-</td>
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<td>5403-6</td>
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<td>G1878/OK98G508W</td>
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<td>OK Bullet</td>
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<td>OK06618</td>
<td>SWM866442/OK94P549//2174</td>
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<td>Chisholm</td>
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<td>OK06528</td>
<td>Vlma/Hickok//Heyne</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>46</td>
<td>71</td>
</tr>
<tr>
<td>C.V.</td>
<td></td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>LSD</td>
<td></td>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>
Table 3. Mean number of wheat curl mites produced and two indicators of feeding damage occurring on OK05312 and Jagger wheat plants infested with a group of curl mites. Data collected 14 days post-infestation, courtesy Kansas State University (M. Marimuthu, P.A. Sotelo, D. Ponnusamy, and C.M. Smith).

<table>
<thead>
<tr>
<th>Entry</th>
<th>No. of wheat curl mites produced</th>
<th>Leaf folding score</th>
<th>Leaf rolling score</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK05312</td>
<td>79 ± 15 b</td>
<td>1.0 ± 0 b</td>
<td>1.9 ± 0.3 b</td>
</tr>
<tr>
<td>Jagger</td>
<td>1573 ± 390a</td>
<td>2.0 ± 0.3a</td>
<td>7.7 ± 0.6 a</td>
</tr>
</tbody>
</table>

Means in a column followed by the same letter not significantly different (α = 0.05)
RELEASE ANNOUNCEMENT
‘Garrison’ Hard Red Winter Wheat

Experimental Designation
OK05212

Pedigree
OK95616-1/Hickok//Betty

Yield Performance

<table>
<thead>
<tr>
<th>OSU Breeding Nurseries (statewide)</th>
<th>2010\textsuperscript{n=30}</th>
<th>2009\textsuperscript{n=30}</th>
<th>2008\textsuperscript{n=15}</th>
<th>2007\textsuperscript{n=30}</th>
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<tr>
<td>Garrison</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Duster</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Endurance</td>
<td>18</td>
<td>6</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

Ranks (highest yielding = ‘1’)

SRPN History (18-20 sites per year)
2010: 10\textsuperscript{th} out of 48 entries; 1\textsuperscript{st} at Lahoma and Wichita; 3\textsuperscript{rd} at Winfield
2009: 7\textsuperscript{th} out of 46 entries; 3\textsuperscript{rd} at Colby, 4\textsuperscript{th} at Lahoma, 5\textsuperscript{th} at Amarillo (irrig.)

Disease Protection

- WSBMV, WSSMV: Highly resistant
- BYDV: Moderately resistant
- High Plains Virus: Moderately resistant
- WSMV: Not known
- Stripe rust: Resistant (to races present in OK in 2005, 2008, & 2010)
- Leaf rust: Intermediate to moderately resistant (late symptoms)
- Powdery mildew: Intermediate to moderately resistant (field tolerance)
- Tan spot: Resistant
- Septoria leaf blotch: Intermediate
- Fusarium head blight: Moderately resistant

Agronomic and Quality Traits:

- Exceptional acid-soil tolerance
- Exceptional spring freeze avoidance or tolerance
- Late FHS arrival, good grazing recovery; Endurance-type maturity
- Moderately good emergence and early vigor
- 2010 test weight: 1-2 lb > Endurance
- 2010 WVT Protein: 13.3\% vs. 11.7\% (Endurance) vs. 12.8\% (Duster)

Weaknesses

- Kernel size (similar to Duster)
- Hessian fly
- Late-season leaf rust
RELEASE ANNOUNCEMENT

‘Ruby Lee’ Hard Red Winter Wheat

Experimental Designation: OK05526, OK05526-RHf

Pedigree: KS94U275/OK94P549

Yield Performance

<table>
<thead>
<tr>
<th>OSU Breeding Nurseries (statewide)</th>
<th>2010 n=30</th>
<th>2009 n=30</th>
<th>2008 n=15</th>
<th>2007 n=30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruby Lee</td>
<td>4 T</td>
<td>16</td>
<td>1 T</td>
<td>3</td>
</tr>
<tr>
<td>Duster</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Endurance</td>
<td>18</td>
<td>6</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

SRPN History
2010: 5th out of 48 entries
1st at Amarillo (irrig.), Chillicothe, Winfield
4th at Wichita

Disease and Insect Protection
- WSBMV, WSSMV: Resistant
- BYDV: Moderately resistant
- High Plains Virus: Moderately resistant
- WSMV: Intermediate
- Leaf rust: Moderately resistant (↓)
- Powdery mildew: Intermediate
- Tan spot: Resistant
- Septoria leaf blotch: Susceptible
- Hessian fly: Resistant

Agronomic and Quality Traits:
- Exceptional top-end yield
- Early maturity
- Above-average test weight with kernel size
- Very good baking quality
- Excellent grazeability (vegetative regeneration, grazing recovery)
- 2010 test weight: 0.5 lb > Garrison
- 2010 WVT Protein: 13.3% vs. 12.4% (Endurance) vs. 12.7% (Duster)

Weaknesses
- Acid soils (similar to Fuller)
- Spring freeze events
EFFECT OF PLANTING DATE ON YIELD AND TEST WEIGHT OF DRY-LAND WHEAT IN THE OKLAHOMA PANHANDLE

Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell
Jeff Edwards, Dept. of Plant and Soil Sciences, Oklahoma State University, Stillwater

Dryland wheat producers in the panhandle region often plant wheat when soil moisture is adequate regardless of calendar date. In the fall of 2004 a study was initiated at OPREC to determine the effect of planting date and variety on dryland wheat grain yield and test weight. Results from these studies can be found in previous highlights books. In the fall of 2009, Duster a variety this known for producing a high number of tillers, was selected for the seeding rate by planting date study. By producing a high number of tillers grain yield maybe increased for planting dates after the optimum period. Planting dates selected were September 1 and 15, October 1 and 15, and November 1 and 15. The selected seeding rates were 45 lb/ac and 90 lb/ac for all dates. Plot size was 5 feet wide by 35 feet long and all plots were planted with a Great Plains no-till plot drill.

Results

Previous research at OPREC has shown the first two weeks of October to be the optimal planting time with the highest yields obtained when planted October 1 (Fig. 1). Recommendations for planting after the optimum date have been to increase seeding rate to potentially increase yield. These recommendations were based on with more seeds planted more tillers and heads would be produced, thus increasing grain yield. Utilizing Duster a variety that will produce a high number of tillers may increase the chance to make up yield with later planting. The results in 2010 were similar to what has been observed in the past, except no difference was observed for the September 15th date when compared to the October dates (Fig. 2). The grain yield was 60 bu/ac or higher for the September 15th to October 15th planting dates. The yields for the September and November 1st planting dates were reduced by 10 bu/ac or more when compared to the optimum period. The November 15th date had the lowest yield at 39 bu/ac. Seeding rate had no effect at any of the selected dates which is most likely due to the high number of tillers produced by Duster.
Figure 1. Grain yields for dry-land wheat on selected planting dates at ORPEC in 2005, 2007, and 2009.

Yields with same letter are not significantly different

Figure 2. Grain yields for Duster planted dry-land at selected dates and seeding rates at OPREC in 2009.

Yields with same later are not significantly different and are for date only
Planting date had a greater effect on test weights than grain yield in 2010, although the November 15th planting date was also affected by seeding rate. As with the yield the optimum planting period was from September 15th to October 15th. Test weights were negatively affected by earlier or later planting compared to the optimum period (Fig 3.). The trend was for higher test weights with higher seeding rates for the last two planting dates. And there was a difference observed for the last planting date with a 1.5 lb/bu higher test weight for the 90 lb/ac seeding rate. This trend has also been observed in earlier seeding rate work and is hard to explain. For 2011 a trial was planted November 15th to compare Duster to another variety at 4 selected seeding rates to determine if it will require a lower seeding rate when planted late.

Figure 3. Test weights for Duster planted dry-land at selected seeding rates and planting dates at OPREC in 2010.

Yields with same letter are not significantly different and are for date only
EFFECTS OF CORN STOVER HARVEST ON SOIL QUALITY INDICATORS AND IRRIGATED CORN YIELD IN THE SOUTHERN GREAT PLAINS
Tyson Ochsner, Plant and Soil Sciences, Oklahoma State University
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell
Jason Warren, Plant and Soil Sciences, Oklahoma State University

Corn fields in Southwest Kansas and the Oklahoma Panhandle have been identified as potential sources of crop residue to serve as cellulosic feedstock for a new cellulosic ethanol plant. Research in other locations has shown that crop residue harvest can have negative impacts on soil quality such as increased erosion, reduced soil nutrient content, and a loss of soil organic carbon. These changes in soil quality can reduce crop productivity and reduce the potential for soil carbon sequestration under no-till management in the region. These detrimental effects of stover harvest might be reduced by partial residue removal and the utilization of cover crops. However, no data are available for the high-yielding, irrigated conditions on the Southern High Plains. Additionally, the impacts of strip-tillage on these soil quality characteristics have not been studied in this region. The impacts of residue removal, strip-tillage, and cover crop utilization may differ from those found in the Midwestern US because the soils, climate, and cropping systems are different. Therefore, the objectives of this study are to evaluate the effects of full and partial corn stover removal and the use of winter cover crops on soil carbon storage in no-till and strip-till management systems.

Materials and Methods
A field experiment was initiated in October 2009 at the Oklahoma Panhandle Research and Extension Center at Goodwell, OK. The treatment structure includes three strip-till treatments that differ only by the amount of residue removed. One has no residue removed and represents the standard irrigated corn production system. All residue is removed from a second strip-till treatment, and 50% of the corn residue is removed from the other treatment. A fourth strip-till treatment has all the residue removed and a cover crop of winter wheat planted after corn harvest. The final treatment is no-till with all residue removed. The experiment is a randomized complete block design with four replications. The plots are 6 corn rows wide and 30 feet long. Ground cover was measured three times in 2010 using downward facing digital photographs taken at a height of 1.2 m and analyzed using SamplePoint software. Saturated hydraulic conductivity and bulk density of the 0-5 cm soil layer were measured using intact 5.0 cm diameter samples collected on 30 October 2010.
Results and Discussion

A primary concern related to corn residue harvest is the increased potential for wind erosion due to inadequate ground cover. Conservation tillage systems may be rendered ineffective for wind erosion prevention by the practice of residue harvest. Typically, a tillage system must maintain <70% bare soil (or >30% residue cover) after planting to qualify as conservation tillage. In 2010, the strip-till treatment with 100% residue removal had 76% bare soil exposed at the surface in May after corn planting (Fig. 1). That level of bare soil exposure would increase the vulnerability to wind erosion. The no-till treatment with 100% removal had 62% bare soil in May and would have offered a marginal level of protection against erosion. Both the strip-till plus cover crop treatment with 100% residue removal and the strip-till treatment with 50% residue removal offered better protection against erosion as indicated by bare soil exposure at the surface remaining below 50% throughout the year.

Fig. 1. Percent bare soil during March, May, and October 2010 for strip-till (ST) with 0%, 50%, and 100% residue removal, for no-till (NT) with 100% residue removal, and for strip-till with 100% residue removal and a winter wheat cover crop. Corn was planted in all treatments in April and harvested in September. Vertical bars represent ± one standard deviation from the mean.

Soil samples collected on 30 October 2010 show highest saturated hydraulic conductivity and lowest bulk density under the strip-till plus cover crop treatment (Fig. 2). These data suggest that the wheat cover crop helped to alleviate short-term degradation of soil physical properties under 100% residue removal. More data will be needed to determine if the treatment effects are statistically significant and if they persistent from year to year.
Fig. 2. Saturated hydraulic conductivity and bulk density for the 0-5 cm soil depth under strip-till (ST) with 0%, 50%, and 100% residue removal, for no-till (NT) with 100% residue removal, and for strip-till with 100% residue removal and a winter wheat cover crop. Corn was planted in all treatments in April and harvested in September. Soil samples collected in 30 October 2010.

Corn yields were low and variable across all treatments in 2010 (Table 1). Lowest average yields occurred in the no-till and strip-till plus cover crop treatments with 100% residue removal. More data are needed to determine how these treatments will affect the yield of the subsequent corn crop.

Table 1. Corn yields in 2010 after one year of residue removal treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST 0% removal</td>
<td>104</td>
<td>55</td>
</tr>
<tr>
<td>ST 100% removal</td>
<td>100</td>
<td>37</td>
</tr>
<tr>
<td>NT 100% removal</td>
<td>87</td>
<td>32</td>
</tr>
<tr>
<td>ST 100% removal + cover crop</td>
<td>84</td>
<td>36</td>
</tr>
<tr>
<td>ST 50% removal</td>
<td>92</td>
<td>42</td>
</tr>
</tbody>
</table>
The GreenSeeker™ sensor plots were established to demonstrate the use of the sensor and N-Rich strip in the high yield production system of the Oklahoma Panhandle. The trials consisted of three nitrogen (N) rates replicated four times. The N treatments were 0, 100 and 200 lbs N ac\(^{-1}\) applied at planting. On June 14th the plots were sensed with the GreenSeeker™ handheld sensor and Normalized Difference Vegetative Index (NDVI) reading recorded. Those readings were used to predict final grain yield and side-dress N rates. No side-dress fertilizer was applied because the plots needed to go to final grain yield without additional N to evaluate the ability of the sensor to predict yield. Final grain yield ranged from 107 to 195 bu ac\(^{-1}\), Table 1 show the treatment averages. You can see in Figure 1, that yield was likely maximized with just a little more than 100 lbs of N. The optical sensor did predict higher yields than what was recorded however this is expected as Predicted Yield (YP0) should be considered as a maximum yield potential and as often the case something will occur between sensing and harvest that will reduce yield potential. Figure2 illustrates the relationship between NDVI and final yield, in which there is a strong correlation. The purpose of using the sensor is to collect the data needed for the Sensor Based Nitrogen Rate Calculator (SBNRC) that is looked on the [www.NUE.okstate.edu](http://www.NUE.okstate.edu) website. Table 1 has the SBNRC side-dress N rate recommendation (N-Rec) and the theoretical N need (N-Need) of each treatment. The theoretical N-Need is calculated as total Grain N of the plot subtracted from total Grain N of highest yielding plot divided by an expected N fertilizer use efficiency of 50%. On the treatment average the SBNRC underestimated N at the 0 and 100 lbs rate and over estimated at the 200 lbs rate. However if we average every plot the SBNRC underestimated the N need by 9 lbs N ac\(^{-1}\). This is actually a very impressive value as we often expect soil test N recommendations to be off by 20 to 30 lbs. This trial demonstrated the potential of the technology and an expanded trial is planned for the 2011 crop year.

Table 1. Treatment averages across the three nitrogen (N) rates. Yield, predicted yield (YP0), NDVI, SBNRC N rate recommendation (N-Rec), and theoretical N needs based on a grain N concentration of 0.75 and fertilizer use efficiency of 50% (N-Need).

<table>
<thead>
<tr>
<th>N rate lbs ac(^{-1})</th>
<th>Yld bu ac(^{-1})</th>
<th>YP0 bu ac(^{-1})</th>
<th>NDVI</th>
<th>N-Rec lbs ac(^{-1})</th>
<th>N-Need* lbs ac(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>129</td>
<td>175</td>
<td>0.70</td>
<td>71</td>
<td>98</td>
</tr>
<tr>
<td>100</td>
<td>177</td>
<td>210</td>
<td>0.76</td>
<td>19</td>
<td>27</td>
</tr>
<tr>
<td>200</td>
<td>185</td>
<td>208</td>
<td>0.76</td>
<td>23</td>
<td>15</td>
</tr>
</tbody>
</table>

*N-Need calculated as total Grain N of the plot subtracted from total Grain N of highest yielding plot divided by an expected N fertilizer use efficiency of 50%.
Figure 1. Nitrogen rate and final yield from the GreenSeeker™ corn trial. Grain yield was maximized between 100 and 200 lbs N ac\(^{-1}\).

Figure 2. Normalized Difference Vegetative Index (NDVI) recorded from the plots on June 18\(^{th}\) 2010 and final grain yield (bu ac\(^{-1}\)).
Nitrogen Fertilizer Management using Subsurface Drip Application of Swine Effluent
Jason Warren, Dept. of Plant and Soil Sciences, Oklahoma State University
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell
Jeff Hattey, Dept. of Plant and Soil Sciences, Oklahoma State University

In traditional center pivot applications as much as 50% of the total N applied in swine effluent can easily be lost to volatilization. In addition, diurnal variations in the amount of N lost to volatilization after application causes variation in the availability of N across the irrigated corn field. This variability is generally overcome using supplemental application of commercial fertilizer at rates sufficient to ensure optimum yields in the most N limited areas of the field. This results in very inefficient utilization of swine effluent N.

Swine effluent application through subsurface drip irrigation eliminates ammonia volatilization, thereby optimizing the potential use efficiency of swine effluent N. The cost savings resulting from reduced supplemental commercial N requirements can offset some of the cost of implementing subsurface irrigation. Elimination of ammonia volatilization after swine effluent application also provides environmental benefit. The N is no longer transported off the intended cropland and therefore cannot be deposited in sensitive ecosystems.

Despite these obvious benefits of subsurface swine effluent applications, research is needed to optimize its use in the context of current corn management practices. Specifically, there is currently no research data available to evaluate subsurface irrigation in combination with strip-tillage pre-plant N applications.

Therefore a study was initiated in 2010 in which the treatments in Table 1 were imposed in a corn/soybean rotation. This study will allow us to determine if supplementation with 40 lbs of commercial fertilizer applied pre-plant with a strip-till unit will influence nitrogen use efficiency when N is applied as commercial fertilizer or swine effluent periodically throughout the growing season.

Table 1: N source, tillage and N rate treatments imposed on subsurface drip irrigated (SDI) corn within a corn/soybean rotation located at the OPREC, Goodwell, OK

<table>
<thead>
<tr>
<th>TRT#</th>
<th>N application strategy*</th>
<th>Tillage</th>
<th>N rate</th>
<th>First N application Fertigation schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Nitrogen Control</td>
<td>no-till</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>No Nitrogen Control</td>
<td>strip-till</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>3</td>
<td>Effluent only through SDI</td>
<td>no-till</td>
<td>180</td>
<td>initiate at 4 leaf</td>
</tr>
<tr>
<td>4</td>
<td>Effluent only through SDI</td>
<td>strip-till</td>
<td>180</td>
<td>40 lbs in Strip</td>
</tr>
<tr>
<td>5</td>
<td>UAN through SDI</td>
<td>no-till</td>
<td>180</td>
<td>initiate at 4 leaf</td>
</tr>
<tr>
<td>6</td>
<td>UAN through SDI</td>
<td>strip-till</td>
<td>180</td>
<td>40 lbs in Strip</td>
</tr>
</tbody>
</table>

*all treatments will receive 5 gals of 10-34-0 at corn planting and all treatments except the No-N control will receive a additional target application of 180 lbs of total N. Corn and Soybeans will be rotated on plots with 4 replicates for three years at which time the treatment structure and objectives will be assessed.
Expected Results:

We expect that strip-tillage application of commercial fertilizer may increase NUE because the N is placed above the irrigation drip line. This will allow early season water applications to carry this supplemental fertilizer to the root zone with the wetting front. In contrast, early season fertigation can result in portion of the fertilizer N be leached to below the drip line thereby moving it farther from the root zone. This research will help to make informed decision about the N management strategies when utilizing strip-till and subsurface drip irrigation.
INTRODUCTION

It is estimated that roughly 2.4 million pigs are located in the Oklahoma panhandle and surrounding counties. In the geographic region of the Ogallala Aquifer, which is the prime non-renewable water resource. The Ogallala Aquifer supplies the water used to irrigate approximately one fifth of U.S. cropland. Looking for sustainability, farmers and producers search for alternatives to current water sources. With the influx of animal waste increments from swine production facilities, numerous farmers and producers apply effluent to adjoining property as a liquid fertilizer for irrigation. Nevertheless, continuous applications have lead to the buildup of macro and micro-nutrients in the soil which makes them more vulnerable to leaching. For water or soil issues, subsurface drip irrigation (SDI) provides several advantages including water use efficiency by reducing soil evaporation, surface runoff, or deep percolation while improving infiltration and water storage. The purpose of this study is to evaluate the nutrient distributions that occur after various seasonal applications of swine effluent through a subsurface drip irrigation system. Swine effluent was placed through two subsurface drip irrigation systems, one with an emitter rate of 2.38 L h⁻¹ and the other with a slower emitter rate of 0.72 L h⁻¹. After 10 years of application, an extensive soil sampling regime was implemented and the samples were taken to the lab for analysis. Nutrient distribution maps were determined for the following: NO₃, NH₄, P, Ortho-P, K, Mg, SO₄, Ca, Zn, Cu, Mn, Fe, and B. The data indicates that concentrations between the lower and the higher emitter rate were significantly different at all depths and distances. However, the lower emitter rate on the SDI system can help use swine manure as a sustainable water and nutrient rich resource for agricultural purposes. The lower emitter rate allows for the nutrients to be distributed more evenly throughout the profile. This project will play a significant role in the future of agriculture, water efficiency, and animal waste management as water resources become a more prevalent issue.

PROCEDURE

Research plots were established in 2001 at the Oklahoma Panhandle Research and Extension Center (OPREC) in Goodwell, OK and fitted with the SDI system. The 18.29 m X 182.88 m (60 by 600 ft.) plots were put on a corn-soybean rotation with two flow rates range from the highest flow rate for plots 49-50 to 2.38 L h⁻¹ (0.63 gal h⁻¹) and the lowest flow rate of 0.72 L h⁻¹ (0.19 gal h⁻¹) for the field designated 53. Swine effluent was applied in 2010: May 21st, June 5th, July 2nd, and July 23rd. Approximately 18,927.06 L (5000 gallons) were applied to each plot during each application. Plots are also irrigated with groundwater on a revolving schedule. In the fall of 2010, an extensive soil sampling regime was put into place. Sampling layout had small difference between plots because, irrigation tape lines with an emitter rate of 2.38 L h⁻¹ emitters were placed 60 cm apart and irrigation tape lines with an emitter rate of 0.72 L h⁻¹ emitters were spaced 46 cm apart (Figure 1). As a control plot, soil samples were taken in surround soil to examine original nutrient distributions prior to swine effluent amendments.
Figure 1. Soil Sampling Schematic. Each circle with an "X" indicates a soil core with a depth from 0-90 centimeters (cm) which were not randomly assigned for each rep. Black dots represent emitters along drip tape line. Top right emitter exemplifies emitter in question.

RESULTS

ANOVA was used to determine if there was significance in the nutrient distributions between the high and low flow emitter rates. Table 1 shows below that for all mobile nutrients, there was only a significant difference at the 15-30, 30-45, and 45-60 cm depths.

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Mobile Nutrients</th>
<th>Immobile Nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO3  B  SO4  P  K  Mg  Ca  Zn  Cu  Fe</td>
<td></td>
</tr>
<tr>
<td>0-15</td>
<td>NS   NS  NS  *  *  *  *  NS  NS  NS</td>
<td></td>
</tr>
<tr>
<td>15-30</td>
<td>*    *   *  *  *  *  *  NS  NS  NS</td>
<td></td>
</tr>
<tr>
<td>30-45</td>
<td>*    *   *  *  *  *  *  NS  NS  NS</td>
<td></td>
</tr>
<tr>
<td>45-60</td>
<td>*    *   *  *  *  *  *  NS  NS  NS</td>
<td></td>
</tr>
<tr>
<td>60-75</td>
<td>NS   NS  NS  *  *  *  NS  NS  NS  NS</td>
<td></td>
</tr>
<tr>
<td>75-90</td>
<td>NS   NS  NS  *  *  *  NS  NS  NS  NS</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. NS, * Not significant or significantly different at 0.05 respectively
**Figure 2.** Data shows that NO$_3^-$ concentrations directly at emitter are higher for the Low Flow. This build up of nutrients in the low flow emitter is due to the low amount of pressure used to exert the nutrients away from the emitter and into the surrounding soil. Boron and SO$_4^{2-}$ distributions were similar to the nitrate distributions as stated in Table 1.

**Figure 3.** High flow (left) vs. Low right (right) NO$_3^-$ concentrations between emitters at the 45 cm depth. Emitters are represented by black square boxes. The data suggest that there is a “starving” effect occurring between emitters in the low flow while the contours within the high flow are not at steep and there is an overall evening of nutrients throughout the profile.
Figure 4. Data shows that Phosphorus concentrations directly at emitter are higher for the Low Flow. This is due to the low amount of pressure used to exert the nutrients away from the emitter and into the surrounding soil. Potassium, Magnesium and Calcium distributions were similar.

Figure 5. High flow (left) vs. Low right (right) Phosphorus concentrations between emitters at the 45 cm depth. Emitters are represented by black square boxes. Nutrient distributions for Phosphorus show that the high flow has a more even distribution while the low flow has steeper contour changes.
Figure 6. Data shows that Zinc concentrations directly at emitter are higher for the Low Flow. This is due to the low amount of pressure used to exert the nutrients away from the emitter and into the surrounding soil. Copper and Iron distributions were similar.

Figure 7. High flow clay % between emitters at the 45 cm depth. Emitters are represented by black square boxes. Clay percentages can be seen to being exerted by emitters and moved towards the center of the profile. This would also cause a sand percentage increase right at the emitters.
CONCLUSIONS

Nitrate-N concentrations are significantly correlated with depth and distance at the 30, 45, and 60 cm depths. Zinc, Copper, and Iron were not significantly correlated with depth or distance, and Phosphorus and Potassium were significantly correlated at all depths and distances.

The data indicates that concentrations between the lower and the higher emitter rate were significantly different at all depths and distances only for the nutrients of Phosphorus, Potassium, and Magnesium. However, the lower emitter rate on the SDI system can help use swine manure as sustainable water and nutrient rich resource for agricultural purposes. The lower emitter rate allows for the nutrients to be distributed more evenly throughout the profile. This project will play a significant role in the future of agriculture, water efficiency, and animal waste management as water resources become a more prevalent issue.
Comparison of bleacher herbicides for use in corn
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell
Joe Armstrong, Dept. of Plant and Soil Sciences, Oklahoma State University

Introduction
In 2010, a study was conducted at the OSU Panhandle Research Station to compare various “bleacher” herbicides for weed control and yield in corn. The bleacher herbicides, also known as HPPD inhibitors, have been shown to provide excellent control of many difficult-to-control weeds, including broadleaf weeds that have developed resistance to other herbicides. Many of the bleacher herbicides can be used as either preemergence or postemergence treatments and are usually tank-mixed with atrazine to further improve weed control. Additionally, the herbicide Integrity® was also evaluated. Integrity is a pre-mix of Sharpen® and Outlook® and is used as a preemergence treatment for grass and broadleaf weed control. Sharpen is typically used with glyphosate to improve control of weeds in burndown applications prior to planting in no-till situations, but can also be used a preemergence treatment ahead of corn to provide soil residual weed control.

Results
All of the treatments evaluated provided good to excellent control of pigweed and sunflower at 21 days after application. The preemergence only treatments, Trt 1 Corvus and Trt 2 Balance Flexx, were effective at controlling pigweed and sunflower during the evaluation period, but would likely not provide season-long weed control. Capreno, Trts 5 and 6, provided 100% control when applied as a “delayed preemergence” treatment at V2-V4 corn. When combined with Roundup or Ignite, Capreno can control any weeds that are present and provide soil activity into the growing season, often requiring only a single application. Integrity also provided excellent control of pigweed and sunflower at 21 days after application. No crop injury was observed with any of the treatments that were evaluated.

To effectively prevent or delay the development of herbicide-resistant weeds, it is necessary to use multiple herbicides and modes of action. Over-reliance on a single herbicide is the quickest way to select for herbicide-resistant weeds. The bleacher herbicides provide excellent weed control and allow use of a new herbicide mode of action. Bleacher herbicides are also available for use in other crops, such as Huskie® in grain sorghum and wheat, and Callisto® and Callisto-containing products in grain sorghum. As always, read the product labels to determine appropriate application timings and use rates.
Table 1. Weed control and grain yields for various bleacher herbicides used in corn.

<table>
<thead>
<tr>
<th>Trt</th>
<th>Herbicides</th>
<th>Rate/acre</th>
<th>Application timing</th>
<th>% Weed control 21 d after treatment</th>
<th>Grain yield bu/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pigweed</td>
<td>Sunflower</td>
</tr>
<tr>
<td>1</td>
<td>Corvus + Aatrex</td>
<td>5 fl oz + 2 pt</td>
<td>PRE</td>
<td>98</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Balance Flexx + Aatrex</td>
<td>5 fl oz + 2 pt</td>
<td>PRE</td>
<td>95</td>
<td>88</td>
</tr>
<tr>
<td>3</td>
<td>Corvus + Aatrex + Laudis + Aatrex</td>
<td>3 fl oz + 2 pt</td>
<td>PRE V5-V6</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Balance Flexx + Aatrex + Laudis + Aatrex</td>
<td>3 fl oz + 2 pt</td>
<td>PRE V5-V6</td>
<td>100</td>
<td>99</td>
</tr>
<tr>
<td>5</td>
<td>Capreno + Ignite + Aatrex</td>
<td>3 fl oz + 22 fl oz + 2 pt</td>
<td>V2-V4</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>Capreno + Roundup + Aatrex</td>
<td>3 fl oz + 22 fl oz + 2 pt</td>
<td>V2-V4</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>Lumax Roundup</td>
<td>2.5 qt 22 fl oz</td>
<td>PRE V5-V6</td>
<td>98</td>
<td>95</td>
</tr>
<tr>
<td>8</td>
<td>Bicep II Magnum Callisto + Aatrex</td>
<td>1.6 qt 3 fl oz + 1 pt</td>
<td>PRE V5-V6</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>9</td>
<td>Prequel Roundup</td>
<td>1.66 oz 22 fl oz</td>
<td>PRE V5-V6</td>
<td>99</td>
<td>95</td>
</tr>
<tr>
<td>10</td>
<td>Integrity Roundup</td>
<td>10 fl oz 22 fl oz</td>
<td>PRE V5-V6</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>11</td>
<td>Integrity Roundup</td>
<td>16 fl oz 22 fl oz</td>
<td>PRE V5-V6</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>12</td>
<td>Untreated</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSD</td>
<td></td>
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</tr>
</tbody>
</table>
Post Emergent Broadleaf Control in Grain Sorghum  
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell

In 2010 in a study was initiated to evaluate Huskie, a broadleaf herbicide currently labeled for use in wheat, for its effectiveness in controlling pigweed and velvetleaf in grain sorghum (it is expected to get registration for use in grain sorghum in September of 2011). Huskie is a pre-mix combination of Buctril and pyrasulfotole, a bleacher herbicide. Applications were made at the V-5 growth stage, or 15 inch tall grain sorghum, with 6 treatments at each stage, a sequential treatment, and one preemergent treatment (Table 1.)

Table 1. List of treatment for post emergent broadleaf control in grain sorghum at OPREC, in 2010

<table>
<thead>
<tr>
<th>Treatment Number</th>
<th>Herbicide</th>
<th>Rate</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>2</td>
<td>Sharpen</td>
<td>2 oz/ac</td>
<td>Preemergent</td>
</tr>
<tr>
<td>3 and 10</td>
<td>Huskie</td>
<td>13 oz/ac</td>
<td>V-5 and 15 inch sorghum</td>
</tr>
<tr>
<td></td>
<td>Atrazine</td>
<td>Pt/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ammonium Sulfate</td>
<td>Lb/ac</td>
<td></td>
</tr>
<tr>
<td>4 and 11</td>
<td>Huskie</td>
<td>16 oz/ac</td>
<td>V-5 and 15 inch sorghum</td>
</tr>
<tr>
<td></td>
<td>Atrazine</td>
<td>Pt/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ammonium Sulfate</td>
<td>Lb/ac</td>
<td></td>
</tr>
<tr>
<td>5 and 12</td>
<td>Huskie</td>
<td>16 oz/ac</td>
<td>V-5 and 15 inch sorghum</td>
</tr>
<tr>
<td></td>
<td>Atrazine</td>
<td>Pt/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,4-D Ester</td>
<td>4 oz/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ammonium Sulfate</td>
<td>Lb/ac</td>
<td></td>
</tr>
<tr>
<td>6 and 13</td>
<td>Huskie</td>
<td>16 oz/ac</td>
<td>V-5 and 15 inch sorghum</td>
</tr>
<tr>
<td></td>
<td>Atrazine</td>
<td>Pt/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Banvel</td>
<td>4 oz/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ammonium Sulfate</td>
<td>Lb/ac</td>
<td></td>
</tr>
<tr>
<td>7 and 14</td>
<td>Atrazine</td>
<td>Pt/ac</td>
<td>V-5 and 15 inch sorghum</td>
</tr>
<tr>
<td></td>
<td>Buctril 2EC</td>
<td>Pt/ac</td>
<td></td>
</tr>
<tr>
<td>8 and 15</td>
<td>Aim EC</td>
<td>.50 oz/ac</td>
<td>V-5 and 15 inch sorghum</td>
</tr>
<tr>
<td></td>
<td>2,4-D</td>
<td>8 oz/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NIS</td>
<td>.3 pt/ac</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Huskie</td>
<td>13 oz/ac</td>
<td>V-5 + 15 inch sorghum</td>
</tr>
<tr>
<td></td>
<td>Atrazine</td>
<td>Pt/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ammonium Sulfate</td>
<td>Lb/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Huskie</td>
<td>13 oz/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Atrazine</td>
<td>Pt/ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ammonium Sulfate</td>
<td>Lb/ac</td>
<td></td>
</tr>
</tbody>
</table>
Ratings for crop tolerance and weed control were taken on selected dates (Table 2.) Since velvet leaf was the major weed species in all plots it was only one rated. Pigweed was only found in 3 plots therefore no comparisons could be made. Grain was also harvested and yields reported.

Table 2. Ratings for crop tolerance and velvet leaf control at selected dates, also grain yield for Huskie post emergent control at OPREC, 2010.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Injury %</td>
<td>Velvet Leaf control %</td>
<td>Injury %</td>
<td>Velvet Leaf control %</td>
<td>Injury %</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>92</td>
<td>0</td>
<td>97</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>100</td>
<td>0</td>
<td>87</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>97</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>100</td>
<td>0</td>
<td>93</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>100</td>
<td>0</td>
<td>93</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>88</td>
<td>0</td>
<td>87</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>40</td>
<td>100</td>
<td>13</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>13</td>
<td>100</td>
<td>47</td>
<td>100</td>
<td>37</td>
</tr>
<tr>
<td>10</td>
<td>----</td>
<td>----</td>
<td>27</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td>11</td>
<td>----</td>
<td>----</td>
<td>37</td>
<td>90</td>
<td>23</td>
</tr>
<tr>
<td>12</td>
<td>----</td>
<td>----</td>
<td>10</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td>----</td>
<td>----</td>
<td>3</td>
<td>90</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td>----</td>
<td>----</td>
<td>0</td>
<td>63</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>----</td>
<td>----</td>
<td>70</td>
<td>80</td>
<td>63</td>
</tr>
</tbody>
</table>

mean 128
CV% 20.8
L.S.D. 44

Results

The crop tolerance for Huskie is good, as can be seen by grain yields (Table 2). Although leaf blotching is observed, it grows out of it and it doesn’t affect yields. As always recommended it is better to control weeds early as possible. Plots sprayed at the V-5 stage had 28 bu/ac yield increase when compared to plots sprayed at 15 inch sorghum height. A large part of the yield difference may be attributed to the reduced weed control for the Atrazine/Buctril treatment at the 15 inch stage, but all yields were lower for later applications. Larger weeds are generally more difficult to control with all herbicides. Although the Huskie shows excellent control of velvet leaf at a later application, the highest yields were obtained when applications were made at the V-5 stage.
Post Emergent Grass Control in Grain Sorghum
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell
Joe Armstrong, Dept. of Plant and Soil Sciences, Oklahoma State University

In 2010 in conjunction with DuPont chemical company two grain sorghum inbred lines were planted that were tolerant to post emergent grass control herbicides. One inbred was tolerant to ALS inhibitor herbicides and will have the trade name Inzen Z™. The other inbred is tolerant to “fop” herbicides from the ACCase herbicides inhibitor mode of action, such as Assure II (active ingredient: quizalofop) and will have the trade name Inzen AII™. These resistance traits were breed into sorghum from wild relatives at Kansas State University, making them non-genetically modified organisms (non-GMO). Since the resistance came from wild relatives and could potentially move from the grain sorghum back to johnsongrass and shattercane, best management practices will be CRITICAL for the long-term viability of the technology. The present timetable for release for Inzen AII is a limited supply of seed in 2011 with adequate seed supplies in 2012. The Inzen Z launch date has been delayed until 2015.

In 2010 both inbreds were planted to evaluate and demonstrate tolerance to the herbicides. The Inzen Z herbicide formulation has not been determined as of yet, but we can report that the inbred is tolerant to the grass control herbicide. The Inzen AII rate most likely will be 8 oz/ac of Assure II and, as with the Inzen Z trait the inbred is tolerant to Assure II. The inbred is not tolerant to the “dim” herbicides of the ACCase inhibitor mode of action such as Select Max (active ingredient clethodim). In addition to excellent tolerance in the inbred lines, control of grass weeds was very good with the postemergence herbicide treatments.
TIMING OF DRY-LAND STRIP-TILLAGE FOR GRAIN SORGHUM PRODUCTION IN THE HIGH PLAINS
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell

With the growing interest in strip-till throughout the high plains, a study was initiated in the fall of 2003 to determine if timing of strip-till would affect yield of dry-land grain sorghum. After three years it appeared that strip-till reduced grain yields when compared to no-till. But one question that was not answered in the previous study was would strip-tilling just before planting reduce yields. Therefore in the summer of 2007 a new study with four dates of strip-tilling was initiated. The dates were immediately after wheat harvest, fall, spring, and on the same day as planting. The immediately after harvest date was selected for two reasons. It is generally a good time for producers to have time do tillage and the chance to receive rainfall and replenish the tilled strips with moisture. The fall date was selected due to data from the previous study, in 2005 yield for fall strip-till was same as no-till (Table 1). This can be explained by the strip-tillage having been done before a significant rainfall event in November of 2004. With the amount of rainfall received (3.51 inches) the tillage strips were replenished with moisture before planting, therefore no reduction in grain yields was observed. The spring date was selected because again it is time when producers can do tillage work. One of the concerns many producers have with no-till is that nitrogen (N) is tied-up in the crop residue when surface applied or volatilized. Nitrogen tie-up and volatilization is greatly reduced with strip-till due to the N being placed below (generally 3 – 8 inches) seeding depth. Many irrigated producers in the region are doing strip-till from late fall to early spring. This original study was designed to determine what the affect of strip-till (no fertilizer applied) at different dates would have on grain sorghum yield. In the new study all fertilizer in the strip-till treatments is applied with the strip-till unit, and only the no-till fertilizer is applied on the surface. Grain sorghum was selected as the crop to be grown, because it is the most widely grown summer row crop in the region. Plots were four rows wide by 50 foot long and strip-tilled with an Orthman four-row one-tripper at a depth of 7 inches.
Table 1. Grain sorghum yield (bu/ac) for selected years from a timing of dry-land strip-till experiment at OPREC.

<table>
<thead>
<tr>
<th>Timing</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>Two-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-till</td>
<td>62.5 a†</td>
<td>81.7 a</td>
<td>80.1 a</td>
<td>74.8 a</td>
</tr>
<tr>
<td>March (spring)</td>
<td>47.6 b</td>
<td>77.6 a</td>
<td>54.1 b</td>
<td>59.1 b</td>
</tr>
<tr>
<td>September (fall)</td>
<td>45.5 b</td>
<td>66.9 a</td>
<td>56.6 b</td>
<td>57.9 b</td>
</tr>
<tr>
<td>January</td>
<td>42.1 b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>37.9 b</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

†Yields with same letter not significantly different

Results
No data was collected in 2009 due to late planting.

Climate conditions varied between 2008 and 2010 as seen by the difference in yields (Table 2). The late winter and spring of 2010 had higher than normal rainfall. The 6.39 inches of precipitation received was 3.04 inches more than the long-term average. This higher precipitation may have accounted for no difference in yields between treatments in 2010. Although no differences were observed, yields for strip-till after the preceding wheat harvest and at planting are the highest when looking at two-year data. No difference in test weight has been observed in either year (data not reported). Future work will look more at N rates of strip-till compared to no-till. Planting date may also be affected, therefore strip-till and no-till will be compared looking at a very late April planting date.

Table 2. Grain sorghum yield (bu/ac) for 2008 timing of dry-land strip-till experiment at OPREC.

<table>
<thead>
<tr>
<th>Strip-till Timing</th>
<th>2008</th>
<th>2010</th>
<th>Two-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>After harvest</td>
<td>48.1 a</td>
<td>78 a</td>
<td>63 a</td>
</tr>
<tr>
<td>At planting</td>
<td>50.7 a</td>
<td>74 a</td>
<td>63 a</td>
</tr>
<tr>
<td>No-till</td>
<td>44.2 a</td>
<td>77 a</td>
<td>60 a</td>
</tr>
<tr>
<td>Fall</td>
<td>45.4 a</td>
<td>70 a</td>
<td>58 a</td>
</tr>
<tr>
<td>Spring</td>
<td>31.8 b</td>
<td>77 a</td>
<td>55 a</td>
</tr>
</tbody>
</table>

Yields with same letter not significantly different
NO-TILL VS MINIMUM-TILL DRY-LAND CROP ROTATIONS
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell

A study was initiated in 1999 to evaluate four different dry-land cropping rotations and two tillage systems for their long-term productivity in the panhandle region. Rotations evaluated include Wheat-Sorghum-Fallow (WSF), Wheat-Corn-Fallow (WCF), Wheat-Soybean-Fallow (WBF), and Continuous Sorghum (CS). Soybean and corn were not successful in the first five years of the study; therefore in 2004 cotton replaced soybean and sunflower replaced corn in the rotation, also continuous sorghum was replaced with a grain sorghum-sunflower (SF) rotation. Starting in 2010 the study was changed again and only sorghum was grown. Tillage systems include no-till and minimum tillage. Two maturity classifications were used with all summer crops in the rotations until 2001, at which time all summer crops were planted with single maturity hybrids or varieties. Most dry-land producers in the panhandle region utilize the WSF rotation. Other rotations would allow producers flexibility in planting, weed management, insect management, and marketing.

Results
Climate

Due to climate condition and other factors obtaining results from the rotations other than the WSF has been difficult, therefore only the WSF will be reported.

Precipitation since 1999 has been erratic for the panhandle region with yearly totals ranging from a low of 12.0 inches in 2007 to a high of 20.31 in 2004. Even in 2008 the yearly total of 18.27 inches was above the long-term mean of 17.89 inches, although most of the rainfall 14.81 inches was received after July 1. The mean rainfall for the last eleven summer growing seasons (June, July, and August) of 6.55 is 1.17 inches below the long term mean (Table 1). Four of the nine years have been 3 inches or more below the long term mean therefore grain sorghum yields have been affected. Between drought and hail storms three wheat crops have failed in the duration of the study. In 2002 rainfall was not received in time to activate the preemergent herbicide and no sorghum was harvested, this was the only time it has happened.
Table 1. Summer growing season precipitation at OPREC

<table>
<thead>
<tr>
<th>Month</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Long-term mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>June</td>
<td>2.29</td>
<td>0.61</td>
<td>1.32</td>
<td>5.26</td>
<td>3.82</td>
<td>2.01</td>
<td>2.34</td>
<td>1.62</td>
<td>1.51</td>
<td>1.74</td>
<td>3.16</td>
<td>2.86</td>
</tr>
<tr>
<td>July</td>
<td>0.76</td>
<td>0.00</td>
<td>2.52</td>
<td>1.87</td>
<td>2.43</td>
<td>1.40</td>
<td>2.05</td>
<td>2.00</td>
<td>3.77</td>
<td>2.58</td>
<td>1.22</td>
<td>2.58</td>
</tr>
<tr>
<td>August</td>
<td>1.09</td>
<td>0.66</td>
<td>0.27</td>
<td>1.19</td>
<td>2.87</td>
<td>3.21</td>
<td>4.06</td>
<td>0.26</td>
<td>5.64</td>
<td>1.36</td>
<td>5.42</td>
<td>2.28</td>
</tr>
<tr>
<td>Total</td>
<td>4.14</td>
<td>1.27</td>
<td>4.11</td>
<td>8.32</td>
<td>9.12</td>
<td>6.62</td>
<td>8.45</td>
<td>3.88</td>
<td>10.7</td>
<td>5.68</td>
<td>9.80</td>
<td>7.72</td>
</tr>
</tbody>
</table>

Wheat

No wheat was harvested in 2002 and 2008 due to drought, and 2006 due to a hail storm.

This report will focus on wheat yields following grain sorghum, because in some years other crops never emerged or were lost to other factors.

Fig. 1. Wheat grain yields (bu/ac) from WSF in dry-land tillage and crop rotation study at OPREC.

Neither tillage system produced, or will produce grain when drought occurs and no crops are harvested as in 2002 and 2008 (Figure 1). In three of the seven years that wheat was harvested grain yields were significantly higher for no-till (Fig. 1) with an average increase of 14 bu/ac. In 2010 yields for conventional tillage were significantly higher than no-till for the first time. In years that no difference was observed yields have been the same. In research conducted by
Kansas State University, they have shown a constituent increase in grain yield for no-till that hasn’t yet been observed in this study.

**Grain Sorghum**

As with wheat when no precipitation is received one tillage system makes no difference as in 2002 when no sorghum was harvested (Fig. 2).

Figure 2. Grain yields of grain sorghum (bu/ac) for dry-land tillage and crop rotation study at OPREC.

Since 2004, grain sorghum yields have been significantly higher for no-till than conventional tillage (Table 3). This increase in sorghum grain yields was in year 6 or the third time through the rotation. This yield difference was also observed and reported by researchers at Kansas State University at the Tribune location. In 2004, 2006, and 2007 no-till grain yields were double of those for minimum tillage. Part of the higher grain yield in 2006 can be attributed to higher test weights for no-till (Table 4). The delayed maturity of minimum till grain sorghum adversely affected the test weights. In 2008 with delayed planting, maturity selection was too long for the year with the cooler conditions that existed. The mean high temperatures in 2008 for July and August were 3 and 9 F° cooler than in 2007 at 90 and 87 F° respectively. These cooler temperatures didn’t allow for maturity of the grain sorghum and reduced yields. In hybrid
performance trial near this study the highest yields 75 bu/ac were obtained with shorter season hybrids than was planted in this study. Again in 2009 planting was delayed until late June due to lack of soil moisture, and with the lower than normal rainfall test weights were affected although not significantly. In all other years no difference in test weight was observed between tillage treatments, although yields for no-till were higher than minimum till. Planting was delayed in 2004 due to a lack of soil moisture; therefore, an early maturity sorghum was utilized instead of the normal medium maturity. Although test weights are not significantly different for each year, when all years are considered no-till is has a significantly higher test weight than doe’s minimum tillage.

Table 3. Yields of grain sorghum (bu/ac) for dry-land tillage and crop rotation study at OPREC.

<table>
<thead>
<tr>
<th>Tillage</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Seven-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-till</td>
<td>54.8</td>
<td>53.9</td>
<td>73.7</td>
<td>41.5</td>
<td>34.5</td>
<td>86.4</td>
<td>86.3</td>
<td>61.6</td>
</tr>
<tr>
<td>Minimum till</td>
<td>28.0</td>
<td>38.3</td>
<td>35.6</td>
<td>17.4</td>
<td>22.3</td>
<td>69.0</td>
<td>67.0</td>
<td>40.8</td>
</tr>
<tr>
<td>Mean</td>
<td>42.3</td>
<td>46.2</td>
<td>53.5</td>
<td>29.5</td>
<td>28.4</td>
<td>77.7</td>
<td>76.7</td>
<td>51.2</td>
</tr>
<tr>
<td>CV %</td>
<td>6.4</td>
<td>13.6</td>
<td>19.0</td>
<td>8.0</td>
<td>55.3</td>
<td>1.2</td>
<td>4.1</td>
<td>17.9</td>
</tr>
<tr>
<td>L.S.D.</td>
<td>6.1</td>
<td>NS</td>
<td>24.2</td>
<td>8.3</td>
<td>NS</td>
<td>10.9</td>
<td>10.9</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Table 4. Test weight of grain sorghum (lb/bu) for dry-land tillage and crop rotation study at OPREC.

<table>
<thead>
<tr>
<th>Tillage</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Seven-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-till</td>
<td>56.5</td>
<td>57.8</td>
<td>56.8</td>
<td>57.9</td>
<td>50.9</td>
<td>57.4</td>
<td>59.7</td>
<td>56.7</td>
</tr>
<tr>
<td>Minimum till</td>
<td>55.8</td>
<td>56.9</td>
<td>49.6</td>
<td>57.9</td>
<td>49.5</td>
<td>55.4</td>
<td>58.1</td>
<td>54.8</td>
</tr>
<tr>
<td>Mean</td>
<td>56.3</td>
<td>57.2</td>
<td>53.1</td>
<td>57.9</td>
<td>50.2</td>
<td>56.4</td>
<td>58.9</td>
<td>55.8</td>
</tr>
<tr>
<td>CV %</td>
<td>0.8</td>
<td>1.6</td>
<td>4.2</td>
<td>0.4</td>
<td>2.3</td>
<td>3.0</td>
<td>1.9</td>
<td>3.6</td>
</tr>
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<td>L.S.D.</td>
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<td>NS</td>
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</table>
**DRY-LAND NO-TILL CROPPING INTENSITY STUDY**
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell

In the fall of 2010 a study was initiated to determine if increasing cropping intensity for rainfed no-till rotations is possible. Previous work at OPREC has shown significantly higher yields for no-till grain sorghum in the wheat-sorghum-fallow rotation (WSF) when compared to minimum tillage. Grain yields for wheat have been inconsistent with no-till and minimum tillage each having significantly higher yields in some years. With no-till generally showing an increase in yields it was determined to see if cropping intensity would affect the yield of grain sorghum. The intensity and timing of selected crops will alter fallow periods from short fallow periods during the winter (when evaporation is least) to the long term standard of approximately 14 months. Shifting the fallow period may allow more intense rotations without affecting yields of grain sorghum. The rotations are wheat-fallow-wheat (WFW) long term standard, wheat-grain sorghum-fallow (WSF) present standard, wheat-double crop millet-grain sorghum-safflower-wheat (WMSSa) most intense rotation, wheat-double crop sesame-sorghum-millet-wheat (WSeSMW), wheat-double crop millet-sorghum-wheat (WMSW), wheat-sorghum-safflower-wheat (WSSaW), and continuous wheat (CW). Plots are 30 ft X 30 ft and will be planted with appropriate equipment and harvested with Massey 8XP plot combine.

Crops were selected to increase intensity based on when they could be planted and harvested. Proso millet was selected because it could be planted from mid May till late July. So it could be used early or as a double crop. Sesame was selected because it would work as a double crop following wheat, and is a crop that is drought tolerant and flowers best when temperatures are warm. Safflower was selected because it could be planted in late March and harvested in early August, therefore wheat could be planted following harvest. Also Safflower is a broadleaf crop which may help with weed control. There are other crops that would work as either hay crops or as a cover crop, these were selected because grain could be harvested and yields established.

**Results**

The rotations are just being established, it will take a couple of years to collect any data.
Expanding Production Area and Alternative Energy Crop Market of Proso Millet for Water Deficient Lands

Kevin Larson and Jeffrey Tranel, Plainsman Research Center, Walsh
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell

Proso millet is a low water-use, low input crop. It is an ideal crop for water deficient lands, such as contract-expired CRP lands. Expanding the production area of proso millet will require development of a new end-use market. Currently, proso millet is used almost exclusively for birdseed. The birdseed market is limited and expansion is improbable. The feed grain market with recent exponential growth is ethanol. Most ethanol production in the United States is from corn. If proso millet replaces some of the corn as an ethanol feedstock, expansion of proso millet production would occur. The purpose of this study is two-fold: 1) to determine if proso millet is viable crop outside of its traditional production area and 2) to determine if proso millet is a viable ethanol crop. If our objectives for proso millet are successful, production area expansion (into new dryland areas) and market expansion (as a new ethanol feedstock) will be realized.

Material and Methods for 2009

We planted proso millet at two sites, the Plainsman Research Center at Walsh, Colorado and the Oklahoma Panhandle Research and Extension Center at Goodwell, Oklahoma. We planted four proso millet cultivars at four incremental planting dates throughout July 2009. Three of the cultivars were standard starch cultivars: Huntsman, Sunrise, and Horizon. The fourth cultivar was a waxy starch cultivar, Plateau. The four planting dates at Walsh were: PD1, July 1; PD2, July 10; PD3, July 20; and PD4, July 31, 2009. The four planting dates at Goodwell were: PD1, July 7; PD2, July 14; PD3, July 21; and PD4, July 28, 2009. The experimental designs were split-plots with planting dates as the main plot and cultivars as the subplots with four replications. The plot size at Walsh was 10 ft. by 50 ft. (harvested 10 ft. by 44 ft.). The plot size at Goodwell was 5 ft. by 35 ft. (harvested 5 ft. by 30 ft.). Both sites were irrigated to assure seed germination. All cultivars and planting dates were seeded at 15 lb/a. Nitrogen was the only fertilizer applied, 50 lb/a at Walsh and 100 lb/a at Goodwell. For weed control at Walsh, the entire site had a preplant application of glyphosate 24 oz/a and 2,4-D ester 0.5 lb/a, and a post emergence application of dicamba 4 oz/a and 2,4-D amine 0.38 lb/a. For weed control at Goodwell, the entire site had a preplant application of atrazine 1.0 lb/a, and no post emergence herbicides were applied. Both sites were harvested with a self-propelled combines equipped with conventional grain heads. For both sites at harvest, we recorded grain yield, test weight, and seed moisture. The harvest dates at Walsh were: PD1, September 29; PD2, October 16; PD3 and PD4, October 17. The harvest dates at Goodwell were: PD1, September 14 and PD3 October 19. At Goodwell, the July 14 planting date (PD2) did not establish an adequate stand and was eliminated from the study, and the July 28 planting date (PD4) was not harvested because of excessive rainfall.

To determine ethanol production, grain samples (7 lb of cleaned seed) were milled three times with a grain mill set at 0.008 in. The milled grain was diluted with water (20 gal/bu). The mash was boiled and alpha amylase was added to liquefy it. The mash was cooled and alpha amylase was again added to breakdown the starches into dextrins. The mash was further cooled and gluco amylase was added to convert the dextrins into sugars. The temperature of the mash
was further lowered, yeast was added, and the mash was allowed to ferment for five days in an airlocked container. After fermentation was completed, the beer in the mash was pressed out with a fruit press. To extract the remaining beer, water was added and the dilute beer was pressed (this step was repeated twice). The remaining wet distillers grain was oven dried. The alcohol in the beer was distilled with a stainless steel still with a refractation column.

**Material and Methods for 2010**

All cultural practices in 2010 were similar to the cultural practices we used in 2009, except we planted the proso millet cultivars at four monthly planting dates from May to August. The four planting dates at Walsh were: PD1, May 12; PD2, June 3; PD3, July 2; and PD4, August 2, 2010. The four planting dates at Goodwell were in early May, June, July, and the August planting date was not planted due to bird damage in the previous planting dates. The Goodwell site was not harvested because of severe bird damage. Grain yield, test weight, seed moisture, plant height, and seed shattering measurements were recorded at harvest for Walsh. The harvest dates at Walsh were: PD1, August 30; PD2, August 30; PD3, September 21; and PD4, November 5.

**Results for 2009**

The first planting dates at both sites produced the highest average grain yield, 1645 lb/a at Walsh and 1450 lb/a at Goodwell (Tables 1 and 2). The planting date ranking for grain yield at Walsh was: PD1>>PD2>PD3=PD4 (Table 3). The planting date ranking at Goodwell was PD1>PD3 (Table 4). Huntsman produced the highest yield at all harvested planting dates at both sites, although Huntsman was not significantly different than Sunrise at Walsh, and Huntsman only significantly out yielded Plateau at Goodwell. Grain yield ranking of the four cultivars was consistent for all four planting dates at Walsh: Huntsman=Sunrise>Horizon>Plateau (Table 3 and Figure 1). The relative ranking of the four cultivars for the two harvested planting dates at Goodwell was: Huntsman>Sunrise=Horizon>Plateau, although the only significant difference was between Huntsman and Plateau (Table 4 and Figure 3).

At both sites, the first planting date produced the highest ethanol production, 59.5 gal/a for Walsh and 50.0 gal/a for Goodwell (Tables 3 and 4). The ethanol production rankings for the planting dates were: PD1>>PD2>PD3=PD4 at Walsh, and PD1>PD3 at Goodwell. These planting date ethanol production rankings have the same order and magnitude as the grain yield rankings. At both sites, Huntsman had the highest ethanol production at each planting date (Tables 1 and 2) and highest overall production, 36.6 gal/a for Walsh and 56.8 gal/a for Goodwell. Plateau produced the highest per bushel ethanol yield for each planting date at Walsh. Horizon had the highest overall ethanol yield at Goodwell with 1.98 gal/bu, and Plateau had the highest overall ethanol yield at Walsh with 2.11 gal/bu.

Test weights significantly decreased with later planting dates at Walsh (Table 3 and Figure 2), but increased, although not significantly, between the two harvested planting dates (PD1 and PD3) at Goodwell (Table 4 and Figure 3). Huntsman had the highest overall test weight at both sites, 56.9 lb/bu at Goodwell and 54.6 lb/bu at Walsh.

Plant height consistently decreased with later planting dates at Walsh (Table 1). The plant height ranking from tallest to shortest was: Huntsman, Sunrise, Horizon, and Plateau.

At Walsh, date to 50% heading averaged 33 days after planting (DAP) for all planting dates and cultivars (Table 1). With later planting dates, date of 50% heading became increasingly earlier for all cultivars, except Plateau. Plateau was the earliest maturing cultivar
tested and its date to 50% heading remained at 30 to 31 DAP for the first three planting dates then dropped to 29 DAP at the last planting date. Date to 80% maturity, when the crop was ready for swathing, averaged 61 DAP for all planting dates and cultivars. Like heading, date to 80% maturity was earlier with later planting dates for all cultivars, except Plateau. Date of maturity of Plateau remained 58 to 59 DAP for all four planting dates.

Results for 2010

All the yield results for 2010 are from the Walsh site only, because the Goodwell site was lost to bird damage. At Walsh, the June planting date had the highest grain yield of 1891 lb/a, but it was not significantly higher than the July planting date with 1783 lb/a (Table 6 and Fig. 4). The May and June plantings dates were significantly higher than the July planting date, and the July planting date was significantly higher than the August planting date. The grain yield ranking for the planting dates was PD2=PD1>>PD3>>PD4. Huntsman had the single highest yield of 2170 lb/a with the June planting date, although it was not significantly different from Sunrise, which had the second highest yield of 2045 lb/a with the May planting date (Table 5). Huntsman and Sunrise produced significantly higher yield than Plateau and Horizon. The yield ranking for the cultivars was Huntsman=Sunrise>Plateau=Horizon.

The average test weight for the July planting was significantly higher than May and August planting dates, but it was not significantly higher than the June planting date (Table 6 and Fig. 5). The test weight ranking for the planting dates was PD3=PD2>PD4>PD1. Test weight for PD4 was based solely on Huntsman because there was insufficient plot yield from the other three cultivars for test weight measurements. The highest test weight of 56.4 lb/bu occurred with Huntsman at the July planting date, and the lowest test weight was 50.9 lb/bu with Plateau at the May planting date (Table 5). Huntsman had the highest test weight, 55.7 lb/bu. The test weight of Huntsman was significantly higher than Sunrise and Horizon, which were significantly higher than Plateau. The test weight ranking for the cultivars was Huntsman>Sunrise=Horizon>Plateau.

Plant height remained relatively constant at about 25 in. for the first three planting date, but it was only half as high for the last planting date (Table 5). Huntsman was the tallest cultivar; it was an inch taller than the second tallest cultivar, Sunrise, in three of the four planting dates.

It took an average of 5 to 8 days longer for the cultivars planted in May to reach 50% heading and 80% maturity than the other three planting dates (Table 5). The cultivars in the July planting date had the fewest days to heading and maturity. Huntsman required an average of an extra day more than Sunrise to reach 50% heading and 80% maturity.

We have not yet performed the fermentations and distillations on the 2010 crop needed for ethanol analyses. Ethanol analysis for the 2010 crop will be conducted later this winter. For later reports, we will include ethanol yield and ethanol production after we perform the necessary fermentations and distillations.

Discussion

In 2009, we evaluated only July planting dates for proso millet production. The first planting dates (July 1 for Walsh and July 7 for Goodwell) produced the highest grain yield and ethanol production (Tables 3 and 4). There was a significant yield decrease between the July 1 and July 10 planting dates at Walsh (990 lb/a yield drop), and the yield difference between the two harvested planting dates (July 7 and July 21) at Goodwell of 267 lb/a was also significant.
This suggests that, when planting in July, early July planting is critical for high yields at Walsh and Goodwell, but with the small yield decrease, the planting window maybe longer at Goodwell. Highest ethanol production corresponded with highest grain yield. Huntsman planted in early July had the highest grain yield and ethanol production at both Walsh and Goodland (Tables 1 and 2). Test weights decreased significantly with later planting dates at Walsh, but they actually increased at Goodwell, although the test weight increase was not significant. Moreover, at Walsh, Plateau consistently had the lowest test weight for all four planting dates; however, Plateau had the highest per bushel ethanol yield. Delayed planting, past early July, did not appear to have the severe yield and test weight penalty at Goodwell as it did at Walsh. Nonetheless, the highest grain yield and ethanol production averages were from the first planting dates at both sites.

The 2010 yield results were only from the Walsh site. Huntsman at the June 3 planting date had the single highest yield of 2170 lb/a (Table 5). The optimum planting date for Huntsman was late May (Fig. 4). We have yet to perform ethanol analysis on grain samples harvested in 2010, but ethanol analysis from 2009 indicates that high ethanol production corresponded with high grain yield. Therefore, Huntsman planted in late May/early June may produce the highest ethanol production. After we identify the optimum ethanol production window for the highest ethanol producing cultivar, we will develop crop enterprise budgets for proso millet as an ethanol crop and compare it to proso millet as a birdseed crop.
Table 1.--Proso Millet: Planting Dates and Cultivars, Walsh, CO, 2009.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Seed Yield</th>
<th>Test Weight</th>
<th>Ethanol Yield</th>
<th>Total Production</th>
<th>Plant Height</th>
<th>50% Heading</th>
<th>80% Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lb/a</td>
<td>lb/bu</td>
<td>gal/bu</td>
<td>gal/a</td>
<td>in</td>
<td>DAP</td>
<td>DAP</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>2137</td>
<td>56.5</td>
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<td>77.8</td>
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<td>66</td>
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<tr>
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<td>1.96</td>
<td>68.5</td>
<td>26</td>
<td>38</td>
<td>65</td>
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<td>24</td>
<td>36</td>
<td>64</td>
</tr>
<tr>
<td>Plateau</td>
<td>1076</td>
<td>53.5</td>
<td>2.10</td>
<td>40.4</td>
<td>21</td>
<td>30</td>
<td>58</td>
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<tr>
<td><strong>PD1 Average</strong></td>
<td><strong>1645</strong></td>
<td><strong>55.6</strong></td>
<td><strong>2.03</strong></td>
<td><strong>59.5</strong></td>
<td><strong>25</strong></td>
<td><strong>36</strong></td>
<td><strong>63</strong></td>
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<td>21</td>
<td>36</td>
<td>63</td>
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<td>2.07</td>
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<td>19</td>
<td>34</td>
<td>61</td>
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<tr>
<td>Plateau</td>
<td>208</td>
<td>54.1</td>
<td>2.10</td>
<td>7.8</td>
<td>16</td>
<td>30</td>
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<tr>
<td><strong>PD2 Average</strong></td>
<td><strong>655</strong></td>
<td><strong>54.7</strong></td>
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<td><strong>24.0</strong></td>
<td><strong>19</strong></td>
<td><strong>34</strong></td>
<td><strong>61</strong></td>
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<tr>
<td><strong>PD3 - July 20</strong></td>
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<td></td>
<td></td>
<td></td>
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</tr>
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<td>Huntsman</td>
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<td>34</td>
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<td>33</td>
<td>61</td>
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<tr>
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<td>13</td>
<td>31</td>
<td>59</td>
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<tr>
<td><strong>PD3 Average</strong></td>
<td><strong>280</strong></td>
<td><strong>54.1</strong></td>
<td><strong>2.09</strong></td>
<td><strong>10.3</strong></td>
<td><strong>16</strong></td>
<td><strong>33</strong></td>
<td><strong>61</strong></td>
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<tr>
<td><strong>PD4 - July 31</strong></td>
<td></td>
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<tr>
<td>Huntsman</td>
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<td>Sunrise</td>
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<tr>
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<tr>
<td><strong>PD4 Average</strong></td>
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<td><strong>51.4</strong></td>
<td><strong>2.02</strong></td>
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<td><strong>31</strong></td>
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</table>

DAP is days after planting.
Seed yields adjusted to 13% seed moisture content.
Ethanol Production is 100% ethanol.
Table 2.-Proso Millet Planting Dates and Cultivars, Seed Yield and Ethanol Yield at Goodwell, OK, 2009.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Seed Yield</th>
<th>Test Weight</th>
<th>Ethanol Yield</th>
<th>Total Ethanol Prod.</th>
<th>Seed Yield</th>
<th>Test Weight</th>
<th>Ethanol Yield</th>
<th>Total Ethanol Prod.</th>
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<td>gal/bu</td>
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<tr>
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<td>873</td>
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Mean 1450 54.8 1.93 50.0 1183 56.3 1.99 42.0

LSD 0.05 NS NS NS NS
CV % 23 3 27 3

Seed Yield is adjusted to 13.0% seed moisture content.
Ethanol Production is 100% ethanol.
Table 3.--Proso Millet Planting Dates and Cultivar Summary at Walsh, 2009.

<table>
<thead>
<tr>
<th>Planting Date</th>
<th>Total Ethanol Production</th>
<th>Seed Yield</th>
<th>Ethanol Yield</th>
<th>Test Seed Weight</th>
<th>Seed Moisture</th>
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<td>lb/a</td>
<td>gal/bu</td>
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<td>%</td>
</tr>
<tr>
<td>PD1 - July 1</td>
<td>59.5</td>
<td>1645 a</td>
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<tr>
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<td>53.9 c</td>
<td>14.7 b</td>
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<td>PD4 - July 31</td>
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<td>278 c</td>
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<td>51.3 d</td>
<td>17.0 c</td>
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<tr>
<td>Cultivar</td>
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</tr>
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<td>Huntsman</td>
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<td>978 a</td>
<td>2.04</td>
<td>54.6 a</td>
<td>14.8 a</td>
</tr>
<tr>
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<td>903 a</td>
<td>1.99</td>
<td>54.0 b</td>
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<td>14.7 a</td>
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<td>14.8</td>
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</tbody>
</table>

Seed Yield is adjusted to 13% seed moisture content.
Ethanol is adjusted to 100% alcohol.
Table 4.--Proso Millet Planting Dates and Cultivar Summary at Goodwell, 2009

<table>
<thead>
<tr>
<th></th>
<th>Total Ethanol Production</th>
<th>Seed Yield</th>
<th>Ethanol Yield</th>
<th>Test Weight</th>
<th>Seed Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gal/a</td>
<td>lb/a</td>
<td>gal/bu</td>
<td>lb/bu</td>
<td>%</td>
</tr>
<tr>
<td><strong>Planting Date</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD1 - July 7</td>
<td>50.0</td>
<td>1450 a</td>
<td>1.93</td>
<td>54.7 b</td>
<td>13.8 a</td>
</tr>
<tr>
<td>PD3 - July 21</td>
<td>42.0</td>
<td>1183 b</td>
<td>1.99</td>
<td>56.3 a</td>
<td>12.9 a</td>
</tr>
<tr>
<td>PD LSD 0.05</td>
<td>91.2</td>
<td></td>
<td>2.31</td>
<td>2.33</td>
<td></td>
</tr>
<tr>
<td><strong>Cultivar</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huntsman</td>
<td>56.8</td>
<td>1622 a</td>
<td>1.96</td>
<td>56.9 a</td>
<td>13.8 a</td>
</tr>
<tr>
<td>Sunrise</td>
<td>44.5</td>
<td>1282 ab</td>
<td>1.96</td>
<td>56.3 a</td>
<td>13.5 a</td>
</tr>
<tr>
<td>Horizon</td>
<td>47.3</td>
<td>1342 ab</td>
<td>1.98</td>
<td>55.4 ab</td>
<td>13.3 a</td>
</tr>
<tr>
<td>Plateau</td>
<td>35.4</td>
<td>1021 b</td>
<td>1.95</td>
<td>53.5 b</td>
<td>12.8 a</td>
</tr>
<tr>
<td>Cultivar LSD 0.05</td>
<td>354.0</td>
<td></td>
<td>1.97</td>
<td>1.88</td>
<td></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>46.0</td>
<td>1317</td>
<td>1.96</td>
<td>55.5</td>
<td>13.4</td>
</tr>
</tbody>
</table>

Seed Yield is adjusted to 13% seed moisture content.
Fig. 1. Seed yield of proso millet planting dates and cultivars for ethanol production study at Walsh, CO, 2009. The planting dates were: PD1, July 1; PD2, July 10; PD3, July 20; and PD4, July 31. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, September 29; PD2, October 16; PD3 and PD4, October 17.
Fig. 2. Test weight of proso millet planting dates and cultivars for ethanol production study at Walsh, CO, 2009. The planting dates were: PD1, July 1; PD2, July 10; PD3, July 20; and PD4, July 31. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, September 29; PD2, October 16; PD3 and PD4, October 17.
Fig. 3. Seed yield and test weight of proso millet planting dates and cultivars for ethanol production study at Goodwell, OK, 2009. The harvested planting dates were: PD1, July 7; and PD3, July 21, 2009. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, September 14; and PD3, October 19. Seed yield is adjusted to 13.0% seed moisture content.
Table 5.--Proso Millet: Planting Dates and Cultivars, Walsh, CO, 2010.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Seed Yield</th>
<th>Test Weight</th>
<th>Moisture %</th>
<th>Shattering %</th>
<th>Plant Height</th>
<th>50% Heading</th>
<th>80% Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lb/a</td>
<td>lb/bu</td>
<td></td>
<td></td>
<td>DAP</td>
<td>DAP</td>
<td></td>
</tr>
<tr>
<td><strong>PD1 - May 12</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huntsman</td>
<td>2101</td>
<td>54.9</td>
<td>14.0</td>
<td>15.0</td>
<td>26</td>
<td>54</td>
<td>87</td>
</tr>
<tr>
<td>Sunrise</td>
<td>2045</td>
<td>54.4</td>
<td>13.7</td>
<td>12.5</td>
<td>25</td>
<td>53</td>
<td>86</td>
</tr>
<tr>
<td>Horizon</td>
<td>1466</td>
<td>53.7</td>
<td>14.3</td>
<td>12.5</td>
<td>22</td>
<td>51</td>
<td>84</td>
</tr>
<tr>
<td>Plateau</td>
<td>1519</td>
<td>50.9</td>
<td>14.4</td>
<td>9.0</td>
<td>22</td>
<td>47</td>
<td>80</td>
</tr>
<tr>
<td><strong>PD1 Average</strong></td>
<td>1783</td>
<td>53.5</td>
<td>14.1</td>
<td>12.3</td>
<td>24</td>
<td>51</td>
<td>84</td>
</tr>
<tr>
<td><strong>PD2 - June 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huntsman</td>
<td>2170</td>
<td>56.0</td>
<td>16.6</td>
<td>5.0</td>
<td>29</td>
<td>47</td>
<td>78</td>
</tr>
<tr>
<td>Sunrise</td>
<td>1985</td>
<td>55.1</td>
<td>16.4</td>
<td>3.5</td>
<td>28</td>
<td>46</td>
<td>77</td>
</tr>
<tr>
<td>Horizon</td>
<td>1717</td>
<td>55.5</td>
<td>14.9</td>
<td>5.5</td>
<td>25</td>
<td>44</td>
<td>75</td>
</tr>
<tr>
<td>Plateau</td>
<td>1692</td>
<td>51.9</td>
<td>14.6</td>
<td>4.0</td>
<td>23</td>
<td>40</td>
<td>73</td>
</tr>
<tr>
<td><strong>PD2 Average</strong></td>
<td>1891</td>
<td>54.6</td>
<td>15.6</td>
<td>4.5</td>
<td>26</td>
<td>44</td>
<td>76</td>
</tr>
<tr>
<td><strong>PD3 - July 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huntsman</td>
<td>1126</td>
<td>56.4</td>
<td>13.6</td>
<td>4.0</td>
<td>26</td>
<td>38</td>
<td>66</td>
</tr>
<tr>
<td>Sunrise</td>
<td>1143</td>
<td>55.4</td>
<td>14.0</td>
<td>3.0</td>
<td>25</td>
<td>38</td>
<td>65</td>
</tr>
<tr>
<td>Horizon</td>
<td>766</td>
<td>55.1</td>
<td>14.2</td>
<td>1.5</td>
<td>22</td>
<td>36</td>
<td>62</td>
</tr>
<tr>
<td>Plateau</td>
<td>926</td>
<td>53.5</td>
<td>13.9</td>
<td>3.0</td>
<td>21</td>
<td>32</td>
<td>62</td>
</tr>
<tr>
<td><strong>PD3 Average</strong></td>
<td>990</td>
<td>55.1</td>
<td>13.9</td>
<td>2.9</td>
<td>24</td>
<td>36</td>
<td>64</td>
</tr>
<tr>
<td><strong>PD4 - Aug. 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huntsman</td>
<td>79</td>
<td>54.3</td>
<td>13.7</td>
<td>0.0</td>
<td>12</td>
<td>49</td>
<td>77</td>
</tr>
<tr>
<td>Sunrise</td>
<td>40</td>
<td>--</td>
<td>--</td>
<td>0.0</td>
<td>13</td>
<td>48</td>
<td>76</td>
</tr>
<tr>
<td>Horizon</td>
<td>17</td>
<td>--</td>
<td>--</td>
<td>0.0</td>
<td>11</td>
<td>45</td>
<td>76</td>
</tr>
<tr>
<td>Plateau</td>
<td>30</td>
<td>--</td>
<td>--</td>
<td>0.0</td>
<td>11</td>
<td>43</td>
<td>75</td>
</tr>
<tr>
<td><strong>PD4 Average</strong></td>
<td>42</td>
<td>54.3</td>
<td>13.7</td>
<td>0.0</td>
<td>12</td>
<td>46</td>
<td>76</td>
</tr>
</tbody>
</table>

|          | 1177       | 54.4        | 14.3       | 4.9          | 22           | 44           | 75           |
| LSD 0.05 | 221.1      | 0.86        | 0.44       | 2.12         |              |              |              |

Harvested: PD1, Aug. 30; PD2, Aug. 30; PD3, Sep. 21; PD4, Nov. 5, 2010.
DAP is days after planting.
Seed yields adjusted to 13% seed moisture content.
Table 6.--Proso Millet Planting Dates and Cultivar Summary at Walsh, 2010.

<table>
<thead>
<tr>
<th></th>
<th>Seed Yield</th>
<th>Test Weight</th>
<th>Seed Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planting Date</td>
<td>ppm lb/a</td>
<td>lb/bu</td>
<td>%</td>
</tr>
<tr>
<td>PD1 - May 12</td>
<td>1783 a</td>
<td>53.5 c</td>
<td>14.1 b</td>
</tr>
<tr>
<td>PD2 - June 3</td>
<td>1891 a</td>
<td>54.6 ab</td>
<td>15.6 a</td>
</tr>
<tr>
<td>PD3 - July 2</td>
<td>990 b</td>
<td>55.1 a</td>
<td>13.9 bc</td>
</tr>
<tr>
<td>PD4 - August 2</td>
<td>42 c</td>
<td>54.3 b</td>
<td>13.7 c</td>
</tr>
<tr>
<td>PD LSD 0.05</td>
<td>134.6</td>
<td>0.71</td>
<td>0.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Seed Yield</th>
<th>Test Weight</th>
<th>Seed Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huntsman</td>
<td>1369 a</td>
<td>55.7 a</td>
<td>14.7 a</td>
</tr>
<tr>
<td>Sunrise</td>
<td>1303 a</td>
<td>55.0 b</td>
<td>14.7 a</td>
</tr>
<tr>
<td>Horizon</td>
<td>991 b</td>
<td>54.8 b</td>
<td>14.5 ab</td>
</tr>
<tr>
<td>Plateau</td>
<td>1042 b</td>
<td>52.1 c</td>
<td>14.3 b</td>
</tr>
<tr>
<td>Cultivar LSD 0.05</td>
<td>113.5</td>
<td>0.45</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Average 1177 54.4 14.3

Seed Yield is adjusted to 13% seed moisture content. PD4 test weight and seed moisture of Huntsman only.
Fig. 4. Seed yield of proso millet planting dates and cultivars for ethanol production study at Walsh, CO, 2010. The planting dates were: PD1, May 12; PD2, June 3; PD3, July 2; and PD4, August 2. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, August 30; PD2, August 30; PD3, September 21; and PD4, November 5.
Fig. 5. Test weight of proso millet planting dates and cultivars for ethanol production study at Walsh, CO, 2010. The planting dates were: PD1, May 12; PD2, June 3; PD3, July 2; and PD4, August 2. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, August 30; PD2, August 30; PD3, September 21; and PD4, November 5.
INTRODUCTION

In recent years, the number of confined animal feeding operations (CAFOs) has increased within the United States to a level where CAFOs now produce approximately 40% of U.S. livestock. The reduction of costs in feed, facility management, transportation and labor has caused animal production facilities to favor this scheme of management. However, residents in communities that are in close proximity to CAFOs are concerned about their health, as well as the environment, due to the quantity of malodorous compounds, bacteria, fungi, and endotoxins that these facilities release. The Environmental Protection Agency (EPA) and United States Department of Agriculture are dedicated to regulating animal feeding operations and the pollutants they emit. As CAFOs operators attempt to decrease their emissions effectively and efficiently, the use of biofiltration in these facilities has been under research. Biofiltration systems contain biologically active media that react with volatile organic compounds and inorganic air toxins while relying on microbial catabolic reactions for waste compounds degradation to improve exflow air quality.

The greatest concentration of swine raised in CAFOs is in Oklahoma, Arkansas, North Carolina, northern Iowa and southern Minnesota (Copeland, 2007). The high concentration of animals in a small geographic area has resulted in noticeable emissions of airborne pollutants; these airborne emissions in large enough quantity can have a detrimental effect on the environment and human health, and can lead to decreased production and increased costs. To protect the surrounding population as well as the swine, the well known biofiltration technology was applied to mitigate and remediate emissions from hazardous concentrations from livestock (pig) buildings. However, little is known about what processes the biofilter technology actually uses to reduce hazardous gas concentrations. There are three major processes that biofilters use: chemical, physical, and biological. The objective of this study was to determine the pathways and processes involved in the biofiltration of the two main hazardous waste that arise from swine production: NH3 (ammonia) and H2S (hydrogen sulfide) at concentrations of 5 ppm and 25 respectively. This research was based on the hypothesis that physical characteristics such as surface area and pore size would have a greater effect on biofilter performance for both gases than would pH or biological species. The purpose of this study was to determine if the reactions occurring during the process of filtering these gasses was related to biological, chemical or physical factors.

Keywords: biofilter, swine, animal waste, pig housing, production, CAFOs.
Materials and Methods

This experiment was performed at Oklahoma State University at the Swine Research Farm. Fifteen Drierite polycarbonate gas purifiers (Stock # 26800, W. A. Hammond Drierite Co. LTD, Xenia, OH) with a volume of 1.009*10^-3 m^3 were used as replicates of a biofilter. The Drierite columns were packed with one of each of the fifteen treatments (Table 1). As the biofilter received inlet gas concentrations from the swine barn, the outlet end was attached to both a Thermo Scientific Hydrogen Sulfide Analyzer (pulsed fluorescence gas analyzer) and a Fourier transform infrared (FTIR) spectrometer made by California Analytical Instruments.

| Table 1. The various treatments used as media to approve and/or disprove the hypothesis. |
|------------------------------------------|----------------|----------------|
| Compost 20% Moisture                    | Wood Chips     | 50:50 Cationic/Anionic Resin Mix |
| Autoclaved Compost                      | 50:50 Compost/Cationic Resin Mix | 50:50 Compost Anionic Resin Mix |
| 50:50 Compost/Wood Chip Mix             | 50:50 Autoclaved Compost/Anionic Resin Mix | 50:50 Autoclaved Compost/Cationic Resin Mix |
| 50:50 Autoclaved Compost/Wood Chip Mix  | 50:50 Autoclaved Compost/Anionic Resin Mix | 50:50 Autoclaved Compost/Cationic Resin Mix |

Swanson and Loehr (1997) summarized characteristics that a filtering material should possess:

- Optimal microbial environment – nutrients, moisture, pH, carbon supply should not be limiting
- Large specific surface area – maximizes attachment area, sorption capacity, and number of reaction sites per unit of medium volume
- Structural integrity – necessary to resist medium compaction which increases pressure drops and lowers gas retention times
- High moisture retention – moisture is critical in maintaining active microorganisms
- High porosity – keeps retention times high and backpressure low
- Low bulk density – reduces medium compaction potential

Most current biofilter technology uses either a straw/compost or woodchip/compost mixture as the media. The compost media and wood chip mixtures were from the Oklahoma Botanical Garden in Stillwater, OK. The initial moisture content of the compost and wood chip medias were determined by drying from more than 8 hrs at 105 C in a drying oven (Yani et al., 1998). Deionized water was then added to bring the final moisture content to 20%, 40%, and 70 % dry mass basis. These moistures contents were selected based on Nicolai and Janni (1997) to assess microbial growth during the biofiltration process. Moisture content was recorded at the beginning and the end of a 40 min sampling period.

Samples were run at an ambient temperature range of 4 – 40°C with a residence time of .504 to .336 min (1.008 L / (2 – 3 L min^-3) = .504 - .336 min). Also, because an acclimation period is needed for certain bacteria and organisms that biodegrade NH3 and H2S, the compost mixtures were placed into a biofilter at the Swine Research Farm two weeks prior to the experiment. To determine how strong pH has an effect on biofilter performance inert cationic and anionic resins were used.

Results and Discussion

Ammonia levels were determined by California Analytical Instrument’s CAI 600 FTIR Analyzer. Hydrogen Sulfide concentrations were determined simultaneously with a Thermo Scientific Model 450i was used because it utilizes pulsed fluorescence technology to analyze
H$_2$S gas compounds. All results were analyzed using PROC GLM and PROC MIXED using SAS 9.1 statistical software (SAS Institute, Raleigh, NC).

**Hydrogen Sulfide**

Data suggests that the most effective media in mitigating H$_2$S is a 50:50 Compost/Anionic Resin Mix. The table below shows that hydrogen sulfide does rely on pore space, bacteria, and a particular pH range to achieve high reduction percentages (Table 1).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of Observations</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>120</td>
<td>2.68</td>
<td>3.88</td>
</tr>
<tr>
<td>Anionic Resin</td>
<td>120</td>
<td>41.72</td>
<td>6.27</td>
</tr>
<tr>
<td>Cationic Resin</td>
<td>120</td>
<td>97.54</td>
<td>4.37</td>
</tr>
<tr>
<td>50:50 Anionic/Cationic Resin Mix</td>
<td>120</td>
<td>49.16</td>
<td>9.99</td>
</tr>
<tr>
<td>Autoclaved Compost</td>
<td>120</td>
<td>79.54</td>
<td>5.77</td>
</tr>
<tr>
<td>50:50 Compost/Anionic Resin Mix</td>
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<td>69.58</td>
<td>8.61</td>
</tr>
<tr>
<td>50:50 Compost/Cationic Resin Mix</td>
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<td>8.58</td>
</tr>
<tr>
<td>50:50 Autoclaved Compost/Anionic Resin Mix</td>
<td>120</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>50:50 Autoclaved Compost/Cationic Resin Mix</td>
<td>120</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Wood Chip</td>
<td>120</td>
<td>72.35</td>
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<td>77.60</td>
<td>5.97</td>
</tr>
<tr>
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<td>72.92</td>
<td>8.59</td>
</tr>
<tr>
<td>Compost 20% moisture</td>
<td>120</td>
<td>81.37</td>
<td>6.42</td>
</tr>
<tr>
<td>Compost 40% moisture</td>
<td>120</td>
<td>81.94</td>
<td>6.19</td>
</tr>
<tr>
<td>Compost 70% moisture</td>
<td>120</td>
<td>6.19</td>
<td>6.67</td>
</tr>
</tbody>
</table>

**Ammonia**

Preliminary data suggests that surface area places the largest role in mitigating NH$_3$. The 40% and 70% moisture levels were not significantly different (Table 2).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of Observations</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
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<td>3.12</td>
<td>3.10</td>
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<td>Anionic Resin</td>
<td>120</td>
<td>83.13</td>
<td>7.26</td>
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<td>Cationic Resin</td>
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<td>30.30</td>
<td>12.01</td>
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<td>50:50 Anionic/Cationic Resin Mix</td>
<td>120</td>
<td>54.93</td>
<td>22.68</td>
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<td>Autoclaved Compost</td>
<td>120</td>
<td>50.00</td>
<td>22.68</td>
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<td>50:50 Compost/Anionic Resin Mix</td>
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<td>100.00</td>
<td>0.00</td>
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<tr>
<td>50:50 Compost/Cationic Resin Mix</td>
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<td>10.19</td>
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<td>82.92</td>
<td>6.99</td>
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<td>6.03</td>
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<td>15.90</td>
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<tr>
<td>Compost 20% moisture</td>
<td>120</td>
<td>72.67</td>
<td>4.54</td>
</tr>
<tr>
<td>Compost 40% moisture</td>
<td>120</td>
<td>84.95</td>
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<td>Compost 70% moisture</td>
<td>120</td>
<td>80.23</td>
<td>15.00</td>
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</table>
**Other Results**

These results are based off of reduction percentages

- Anionic Resin, because of its pH of 7.69, was not effective at filtering NH₃, nor H₂S.
- Cationic Resin was effective at filtering NH₃ and did even better at filtering H₂S.
- H₂S filtration appeared to be primarily due to a biochemical process or as a result of small pore spaces.
- Cationic and Anionic Resin had an additive effect on NH₃ and H₂S.
- Autoclaved Compost was less effective at filtering NH₃ than Cationic Resin, but somewhat effective at removing H₂S.
- Compost was effective at removing both H₂S and NH₃, possibly because of microbial activity, numerous micro pores, and large surface area.
- Compost/Wood Chip mixture was effective at removing both H₂S and NH₃, but less effective than Compost alone.
- Moisture level played an important part in the reduction of H₂S. Popular belief is currently that biofilters need to maintain a moisture percentage of 70% to keep sulfur reducing bacteria healthy, and this research backs up that belief.

**CONCLUSION**

- The factors that affect the biofiltration process:
  - NH₃
    - Biological, little requirements
    - Chemical, pH has small effect
    - Physical, requires media to have a large surface and low bulk density
  - H₂S
    - Biological, requires sulfur reducing bacteria
    - Chemical, requires pH of 2.5-5.0
    - Physical, requires media to have a large surface area and low bulk density

Biofilters would be more effective with different design and operating parameters in order to function more efficiently for longer periods of time. There is a need for a two-stage biofilter; this could be accomplished with a top and a bottom layer. Since preliminary data suggest that the biofiltration process would work better for longer periods of time if the NH₃ was captured before the H₂S, the first (bottom) layer should contain a porous media to capture NH₃ and the second (top) layer should have porous media with a low pH in order to capture H₂S.

**Acknowledgements**

This work was supported in part by USDA-CSREES proposal number 2008-03357.
REFERENCES
TRIAL OBJECTIVES AND PROCEDURES

Each year the Oklahoma Cooperative Extension Service conducts corn performance trials in Oklahoma. These trials provide producers, extension educators, industry representatives, and researchers with information on corn hybrids marketed in Oklahoma. Company participation was voluntary, so some hybrids marketed in Oklahoma were not included in the test. Company or brand name, entry designation, plant characteristics, and maturity information, were provided by the companies and were not validated by OSU; therefore, we strongly recommend consulting company representatives for more detailed information regarding these traits and disease resistance ratings (Tables 3 and 4).

Irrigated test plots were established at the Oklahoma Panhandle Research and Extension Center (OPREC) near Goodwell and the Joe Webb farm near Guymon. Fertility levels, herbicide use, and soil series (when available) are listed with data. Individual plots were two 25-foot rows seeded at a target population of 32,000 plants/ac. Plots were trimmed to 20 feet prior to being harvested to determine grain yield. The ensilage trial was seeded the same as the grain trial with 10 feet of one row harvested to determine yield. Experimental design for all locations was a randomized complete block with four replications. Grain yield is reported consistent with U.S. No. 1 grade corn (56 lbs/bu and adjusted to moisture content of 15.5%). Corn ensilage was harvested at the early dent stage with average moisture content of 69% and production is reported as tons/ac adjusted to 65% moisture.

GROWING CONDITIONS

Corn planting started in early April but was delayed until mid April from rainfall. Most planting resumed April 28th and was not delayed again until mid May by which time most corn had been planted. Conditions for germination and emergence were good. Most corn acres required no pre-irrigation prior to planting, due to the 4.51 inches of precipitation received during the January through March time period. Temperatures during the growing season were near normal with no 100°F recorded during May, June had 3, July had 4, and August had 10 days of 100°F or greater. The number of days in August may have reduced yields on the later planted corn in 2010. Mean high temperatures for the period were near the long-term averages. The mean high temperature for May was 77°F which is 2 degrees below the long term mean. For June, July and August the mean high temperatures were normal or slightly above, June 91°F compared to 88°F, July 93°F which is the long term mean, and August 93°F compared to 91°F. The number of 100°F and higher than normal temperatures may have affected grain fill on the later planted corn. Rainfall for the period was above the long-term mean, but 38% was received in mid to late August (Table 1). Therefore irrigation scheduling was critical during most of the growing season. The harvest period had no major delays to weather and most producers reporting yields ranging from 200 bu/ac to over 250 bu/ac.
RESULTS

Grain yield, test weight, harvest moisture, and plant populations for OPREC and Webb trials are presented (Tables 3 and 4). Least Significant Differences (L.S.D.) are shown at the bottom of each table. Unless two entries differ by at least the L.S.D. shown, little confidence can be placed in one being superior to another. The coefficient of variation (C.V.) is provided as an estimate of the precision of the data with respect to the mean. To provide some indication of yield stability, 2-year means are also provided in tables producers interested in comparing hybrids for consistency of yield should consult these.

The following people have contributed to this report by assisting in crop production, data collection, and publication; Roger Gribble, Jeff Bedwell, Tommy Puffinbarger, Donna George, Lawrence Bohl, Matt Lamar, Eddie Pickard, Wilson Henry, Cameron Murley, and Craig Chesnut. Their efforts are greatly appreciated.

Table 1. Rainfall and irrigation for irrigated corn performance trial locations in Texas County.

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<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
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* Plant Characteristics: SV - Seedling Vigor; SS - stalk strength; SG - stay green; EP - ear placement (Low, Medium, High)
Rating scale for above characteristics except ear placement 1 = excellent - 9 = poor
<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac</th>
<th>Test Weight Lb/bu</th>
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Cooperator: Joe Webb  
Soil Series: Richfield Clay Loam  
Strip-Till: Following wheat in 2009  
Fertilizer: N: 230 lbs/ac  P: 50 lbs P2O5/ac  K: 0 and 5 gal 10-34-0 in row with planter  
Herbicide: 1.5qt/ac Harness Extra (Pre-emergence) + 3/4 oz/ac Balance  
Planting Date: April 14, 2010  
Harvest Date: September 21, 2010
Table 4. Ensilage Yields and Quality Panhandle Corn Performance Trial, 2010.

<table>
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<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Yield Tons/ac</th>
<th>Plant Population plants/ac</th>
<th>Harvest Moisture %</th>
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<td>27,600</td>
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</table>

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<th></th>
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<th>CV %</th>
<th>L.S.D.</th>
</tr>
</thead>
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<td>NS</td>
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<tr>
<td>Plant Population plants/ac</td>
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<tr>
<td>Harvest Moisture %</td>
<td>53.1</td>
<td>5.3</td>
<td>4.6</td>
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</tbody>
</table>

Cooperator: OPREC
Soil Series: Richfield Clay Loam
Strip-till: wheat double crop sunflower in 2009
Fertilizer: N: 230 lbs/ac  P: 50 lbs/ac P₂O₅  K: 0 and 5 gal 10-34-0 in row with planter
Herbicide: 2 qt/ac Cinch ATZ Lite (Preemergence) + .75 oz Balance Flex
Planting Date: April 29, 2010
Harvest Date: September 11, 2010
TRIAL OBJECTIVES AND PROCEDURES

Each year, performance trials for hybrid grain sorghum are conducted by the Oklahoma Cooperative Extension Service. These trials provide producers, extension educators, industry representatives, and researchers with information for hybrid grain sorghums marketed in Oklahoma.

Performance trials are conducted at ten locations in Oklahoma: Apache, Alva, Blackwell, Cherokee, Enid, Goodwell, Homestead, Keyes, Gate, and Tipton. Dry-land trials are conducted at all locations, with an additional limited irrigation trial at Goodwell. The Cherokee, Homestead, and Gate locations are uniquely designed trials to evaluate certain hybrids (generally early and medium maturity) for planting in late April. In 2010 trials were continued at Enid and Alva to evaluate hybrids for use as a double crop.

Grain sorghum hybrids entered (Table 1) were assigned by companies to their respective maturity groups (early, medium, and late) and trial locations, therefore, all hybrids were not entered at all locations. Hybrids tested at the Cherokee, Homestead, Enid, Alva, and Slapout locations were determined by Oklahoma State University. Companies submitted all hybrid characteristics presented in Table 1. This information was not determined or verified by Oklahoma State University. Company participation was voluntary, therefore some hybrids marketed in Oklahoma were not included in the test. Each maturity group was tested in a randomized complete block design with four replications. Plots were two 30-inch rows by 25 feet. Plots were trimmed to 20 feet prior to harvest. Tractor powered cone planters were used to plant all trials with seeding rates adjusted for trial location. Trials were harvested with a Massey-Ferguson model, 8 plot combine.

Target populations, cooperating producers, fertilization, cultural practices, soil series, and herbicide use on all trials are listed individually in the results tables. Rainfall data from the nearest Mesonet site are also listed. Some trials are long distances from the nearest Mesonet site; therefore rainfall could be greater or less than reported.

Highlights
The highlight in 2010 was the high yields at all locations. The highest dry-land yield at all locations was Cherokee with 129 bu/ac trial mean. There was also an area from Enid to Blackwell that yields were adversely affected by fusarium stalk rot. The rot was a function of the year, with high rainfall and temperatures. Double crops yields were good for most producers but the area between Fairview and Okeene was drier than surrounding areas. New in 2010 are short notes about each trial location accompanying the result tables.
GROWING CONDITIONS

Soil moisture conditions were excellent for planting at the April planted trials. Soil temperatures were also higher than in 2009. Therefore, better plant emergence was observed in 2010. The planting period in April did not have any major delays. Panhandle dry-land planting was delayed until moisture from rainfall in mid June. Rainfall in 2010 was plentiful for the northwest area of the state, with trial locations receiving average or above precipitation. In other regions rainfall was near the long-term average and was timely, resulting in outstanding yields. Planting was delayed for double crop sorghum due to rainfall. An extended warm fall allowed all hybrids in double crop trials to mature, although an area east of Enid experienced a frost in early October that affected yields and test weights.

Insects were not a major concern in 2010, but due to late harvest many producers reported some bird damage.

RESULTS

Grain yields in 2010 were higher than 2009, and producers reported the highest yields obtained were on late May and early June plantings.

Grain yields are reported bushel per acre of threshed grain, adjusted to a moisture content of 14.0% (Tables 2-11). Test weight, plant population, and the number of heads per acre at harvest are reported.

Bird damage and lodging are also reported when present at a location. Different plant populations at each location prevent accurate comparison between locations. Also comparisons across maturity groups were not conducted. Producers should note that late maturing hybrids will generally yield more than early and medium maturity hybrids. However, the availability of moisture at critical crop development periods often influences yield more than the yield differences associated with maturity groups.

When choosing a maturity group, the type of cropping system, planting date, planting rate and potential moisture should be taken into consideration. For more information consult Fact Sheet No. 2034 Grain Sorghum Planting Rates and Dates, and Fact Sheet No. 2113 Grain Sorghum Production Calendar.

Least Significant Difference (L.S.D.) is a statistical test of yield differences and is shown at the bottom of each table. Unless two hybrids differ by at least the L.S.D. shown, little confidence can be placed in one hybrid being superior to another and the difference is probably not real.

The coefficient of variation (C.V.) is provided as an estimate of the precision of the data with respect to the mean for that location and maturity group. To provide some indication of yield stability, 2-year and 3-year means for yield and test weight are provided where trials have been conducted for more than one year with more than three entries per maturity group. Producers interested in comparing hybrids for consistency of yield in a specific area should consult these tables.

The following people have contributed to this report by assisting in crop production, data collection, and publication: Donna George, Lawrence Bohl, Rocky Thacker, Eddie Pickard, Jeff Bedwell, Jimmy Rhodes, Tommy Puffinbarger, Todd Trennepohl, Cori Woelk, Jacob Baker, Cameron Murley, and Wilson Henry. Their efforts are greatly appreciated. Also would like to thank the Oklahoma Grain Sorghum Commission and The United Sorghum Checkoff Program for their financial support.
Table 1. Seed source and hybrid characteristics of grain sorghums in the Oklahoma Grain Sorghum Performance Trials, 2010. All hybrids are susceptible to birds and are single cross.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Seed Color</th>
<th>Endosperm</th>
<th>Days to Mid-bloom</th>
<th>Greenbug Resistance</th>
<th>Trial Location</th>
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Trial locations: 1 – all; 2 – panhandle only; 3 – (Altus, Tipton, Blackwell); 4 – irrigated only (OPREC)

Seed Color: Br – Brown; W – White; Y – Yellow; Bz – Bronze; R – Red; C – Cream
Endosperm: HW – hetero-waxy; W – waxy; HY – Hetero-yellow; Y – Yellow; N – Non-waxy
Greenbug Resistance: Biotypes hybrid is resistance too
### Table 2. Results from Apache grain sorghum performance trial, 2010.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
<th>Deer Damage %</th>
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60 to 69 days to mid-bloom

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<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
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<th>Deer Damage %</th>
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<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
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<td>37,000</td>
<td>1.28</td>
<td>34</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK 7633</td>
<td>69</td>
<td>55.3</td>
<td>11.3</td>
<td>27,200</td>
<td>1.57</td>
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</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 05631</td>
<td>57</td>
<td>51.1</td>
<td>12.1</td>
<td>26,700</td>
<td>1.40</td>
<td>0</td>
</tr>
<tr>
<td>Mean</td>
<td>73</td>
<td>54.8</td>
<td>11.6</td>
<td>32,600</td>
<td>1.39</td>
<td>---</td>
<td>-----</td>
</tr>
<tr>
<td>C.V.%</td>
<td>12</td>
<td>1.4</td>
<td>2.1</td>
<td>8.0</td>
<td>8.9</td>
<td>---</td>
<td>-----</td>
</tr>
<tr>
<td>L.S.D.</td>
<td>17</td>
<td>1.4</td>
<td>0.5</td>
<td>4,900</td>
<td>NS</td>
<td>---</td>
<td>-----</td>
</tr>
</tbody>
</table>

Cooperator: Alan Mindemann
No-till Practices: Sprayed and killed wheat in early April of 2010
Fertilizer: N: 80 lbs/ac + 5 gal/ac 10-34-0 with planter
Planting Date: April 26, 2010
Seeding rate 56,000 seeds/ac
Herbicide: 2 qt/ac Cinch ATZ Lite (Preemergence)

Monthly Rainfall (in.)

<table>
<thead>
<tr>
<th></th>
<th>Apr.</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010:</td>
<td>2.66</td>
<td>1.68</td>
<td>4.01</td>
<td>5.72</td>
<td>0.93</td>
<td><strong>15.00</strong></td>
</tr>
<tr>
<td>Long term mean:</td>
<td>2.99</td>
<td>4.79</td>
<td>3.83</td>
<td>2.23</td>
<td>2.55</td>
<td><strong>16.39</strong></td>
</tr>
</tbody>
</table>

Notes:
Stands were reduced due to the short interval between wheat being sprayed and planting date.
Table 3. Results from Blackwell grain sorghum performance trial, 2010.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Lodging %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeKalb</td>
<td>DKS 28-05</td>
<td>87</td>
<td>57.3</td>
<td>13.0</td>
<td>41,600</td>
<td>8</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 37-07</td>
<td>83</td>
<td>57.6</td>
<td>13.2</td>
<td>42,000</td>
<td>38</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-207</td>
<td>77</td>
<td>55.5</td>
<td>13.2</td>
<td>43,300</td>
<td>5</td>
</tr>
<tr>
<td>DeKalb</td>
<td>Pulsar</td>
<td>69</td>
<td>55.9</td>
<td>13.5</td>
<td>25,900</td>
<td>5</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 29-28</td>
<td>39</td>
<td>57.7</td>
<td>13.5</td>
<td>43,200</td>
<td>0</td>
</tr>
</tbody>
</table>

Mean 71 56.2 13.3 39,200 ----
C.V.% 10.7 3.7 3.0 10.1 ----
L.S.D. 12 NS NS 6,100 ----

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Lodging %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeKalb</td>
<td>DKS 44-20</td>
<td>92</td>
<td>58.2</td>
<td>14.1</td>
<td>45,200</td>
<td>0</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>H-486</td>
<td>89</td>
<td>56.6</td>
<td>13.5</td>
<td>43,800</td>
<td>10</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>KS 585</td>
<td>89</td>
<td>59.0</td>
<td>13.3</td>
<td>36,300</td>
<td>0</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK5418</td>
<td>88</td>
<td>56.8</td>
<td>13.3</td>
<td>37,100</td>
<td>0</td>
</tr>
<tr>
<td>Channel Bio LLC</td>
<td>5B90</td>
<td>87</td>
<td>58.8</td>
<td>13.2</td>
<td>40,000</td>
<td>0</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>87P06</td>
<td>85</td>
<td>57.2</td>
<td>12.9</td>
<td>42,500</td>
<td>0</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>85G01</td>
<td>83</td>
<td>57.6</td>
<td>12.7</td>
<td>47,200</td>
<td>60</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>86G32</td>
<td>83</td>
<td>55.5</td>
<td>13.1</td>
<td>34,400</td>
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<tr>
<td>Syngenta Seeds</td>
<td>5745</td>
<td>83</td>
<td>55.9</td>
<td>13.5</td>
<td>40,200</td>
<td>13</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>X449</td>
<td>81</td>
<td>57.6</td>
<td>13.5</td>
<td>45,300</td>
<td>25</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>5613</td>
<td>80</td>
<td>56.0</td>
<td>13.1</td>
<td>40,100</td>
<td>40</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TR 452</td>
<td>78</td>
<td>57.8</td>
<td>13.4</td>
<td>39,900</td>
<td>5</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 84732</td>
<td>77</td>
<td>56.1</td>
<td>15.8</td>
<td>26,500</td>
<td>5</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-524</td>
<td>76</td>
<td>55.4</td>
<td>13.1</td>
<td>31,000</td>
<td>10</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-222</td>
<td>75</td>
<td>56.7</td>
<td>13.8</td>
<td>40,000</td>
<td>23</td>
</tr>
<tr>
<td>Channel Bio LLC</td>
<td>7B11</td>
<td>75</td>
<td>58.2</td>
<td>14.3</td>
<td>30,300</td>
<td>3</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-056</td>
<td>74</td>
<td>56.8</td>
<td>12.9</td>
<td>44,300</td>
<td>30</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>5464</td>
<td>74</td>
<td>57.2</td>
<td>15.0</td>
<td>22,300</td>
<td>5</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>5556</td>
<td>72</td>
<td>57.3</td>
<td>13.1</td>
<td>44,900</td>
<td>30</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 36-06</td>
<td>70</td>
<td>57.9</td>
<td>13.1</td>
<td>35,900</td>
<td>48</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-012</td>
<td>69</td>
<td>56.2</td>
<td>12.8</td>
<td>30,500</td>
<td>33</td>
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</table>

Mean 80 57.1 13.5 38,000 -----  
C.V.% 12.4 1.5 4.3 17.5 -----   
L.S.D. 14.0 1.2 0.8 9,400 -----
### Table 3. Continued.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Lodging %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK 7633</td>
<td>82</td>
<td>55.7</td>
<td>14.6</td>
<td>30,500</td>
<td>0</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK6638</td>
<td>63</td>
<td>55.4</td>
<td>12.2</td>
<td>39,600</td>
<td>63</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 05631</td>
<td>63</td>
<td>55.0</td>
<td>12.2</td>
<td>36,700</td>
<td>65</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 49-45</td>
<td>59</td>
<td>55.2</td>
<td>12.4</td>
<td>39,800</td>
<td>83</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>85Y40</td>
<td>54</td>
<td>56.1</td>
<td>11.9</td>
<td>38,800</td>
<td>93</td>
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<tr>
<td>Mean</td>
<td></td>
<td>64</td>
<td>55.5</td>
<td>12.6</td>
<td>37,100</td>
<td>-----</td>
</tr>
<tr>
<td>C.V.%</td>
<td></td>
<td>14.3</td>
<td>3.0</td>
<td>5.9</td>
<td>15.4</td>
<td>-----</td>
</tr>
<tr>
<td>L.S.D.</td>
<td></td>
<td>14.2</td>
<td>NS</td>
<td>1.2</td>
<td>NS</td>
<td>-----</td>
</tr>
</tbody>
</table>

70 days and greater to mid-bloom

Cooperator: Bill and Louise Rigdon
No-till Practices: Followed Soybean in 2009
Fertilizer: N: 120 lbs/ac + 5 gal/ac 10-34-0 with planter
Planting Date: April 27, 2010
Seeding rate 56,000 seeds/ac
Herbicide: 2 qt/ac Cinch ATZ Lite (Preemergence)

### Monthly Rainfall (in.)

<table>
<thead>
<tr>
<th></th>
<th>Apr.</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>3.42</td>
<td>6.83</td>
<td>7.41</td>
<td>3.00</td>
<td>3.96</td>
<td>24.62</td>
</tr>
<tr>
<td>Long term mean:</td>
<td>3.28</td>
<td>5.83</td>
<td>4.05</td>
<td>2.68</td>
<td>3.19</td>
<td>19.03</td>
</tr>
</tbody>
</table>

### Notes:

Yields were significantly reduced by heavy fusarium stalk rot infestation charcoal rot was also found but was minimal. The fusarium is the reason for the unusually high incidence of lodging.
## Table 4. Results from Cherokee grain sorghum performance trial, 2010.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield bu/ac</th>
<th>Test weight lb/bu</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>85G03</td>
<td>150</td>
<td>122</td>
<td>57.9</td>
<td>57.8</td>
<td>12.5</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>KS 585</td>
<td>156</td>
<td>117</td>
<td>59.9</td>
<td>60.0</td>
<td>9.3</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>5613</td>
<td>157</td>
<td>112</td>
<td>57.7</td>
<td>57.5</td>
<td>12.7</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>H-486</td>
<td>142</td>
<td>109</td>
<td>57.2</td>
<td>57.4</td>
<td>12.4</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-222</td>
<td>145</td>
<td>108</td>
<td>58.7</td>
<td>57.4</td>
<td>12.0</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 37-07</td>
<td>134</td>
<td>105</td>
<td>60.0</td>
<td>59.1</td>
<td>12.6</td>
</tr>
<tr>
<td>NC+ Hybrids</td>
<td>5B90</td>
<td>124</td>
<td>105</td>
<td>59.6</td>
<td>59.3</td>
<td>12.4</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-056</td>
<td>134</td>
<td>104</td>
<td>57.9</td>
<td>57.9</td>
<td>12.3</td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 36-06</td>
<td>133</td>
<td>103</td>
<td>59.7</td>
<td>58.7</td>
<td>12.3</td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 44-20</td>
<td>119</td>
<td>97</td>
<td>59.3</td>
<td>59.0</td>
<td>13.7</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TR 452</td>
<td>113</td>
<td>92</td>
<td>57.5</td>
<td>57.7</td>
<td>12.7</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK6638</td>
<td>109</td>
<td>89</td>
<td>58.6</td>
<td>57.8</td>
<td>12.2</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>87P06</td>
<td>116</td>
<td>89</td>
<td>57.7</td>
<td>57.0</td>
<td>12.8</td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 28-05</td>
<td>112</td>
<td>87</td>
<td>57.2</td>
<td>57.1</td>
<td>12.5</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-207</td>
<td>88</td>
<td>65</td>
<td>55.0</td>
<td>55.4</td>
<td>11.9</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>X 449</td>
<td>144</td>
<td>-----</td>
<td>59.6</td>
<td>-----</td>
<td>12.5</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 84732</td>
<td>125</td>
<td>-----</td>
<td>57.7</td>
<td>-----</td>
<td>13.3</td>
</tr>
<tr>
<td>Mean</td>
<td>129</td>
<td>100</td>
<td>58.3</td>
<td>57.9</td>
<td>12.1</td>
<td>38,200</td>
</tr>
<tr>
<td>C.V.%</td>
<td>12.1</td>
<td>13.6</td>
<td>1.8</td>
<td>1.9</td>
<td>7.1</td>
<td>8.8</td>
</tr>
<tr>
<td>L.S.D.</td>
<td>22</td>
<td>14</td>
<td>1.5</td>
<td>1.1</td>
<td>NS</td>
<td>4,800</td>
</tr>
</tbody>
</table>

Cooperator: Doug McMurtrey  
No-till Practices: Followed soybean in 2009  
Fertilizer: N: 118 lbs N/ac + 5 gal/ac 10-34-0 with planter  
Planting Date: April 27, 2010  
Seeding rate 56,000 seeds/ac  
Herbicide 2.5 qt/ac Degree Extra  
Soil Series: Kay Silt Loam  
Soil Test: N: 17  P: 110  K: 500  pH: 5.8  
First hybrid headed out June 23  
Harvest Date: August 30, 2010  
Target Population 45,000 plants/ac

### Monthly Rainfall (in.)

<table>
<thead>
<tr>
<th></th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1.99</td>
<td>8.16</td>
<td>2.89</td>
<td>4.42</td>
<td>6.44</td>
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</tr>
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<td>5.83</td>
<td>4.05</td>
<td>2.68</td>
<td>3.19</td>
<td><strong>19.03</strong></td>
</tr>
</tbody>
</table>

**Notes:**
Best yield in dry-land test plots in last 12 years.
Table 5. Results from Enid double crop grain sorghum performance trial, 2010.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield bu/ac</th>
<th>Test weight lb/bu</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-056</td>
<td>2010 Two-year</td>
<td>2010 Two-year</td>
<td>18.5</td>
<td>25,000</td>
<td>1.62</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TR 452</td>
<td>111</td>
<td>59.3</td>
<td>17.4</td>
<td>24,700</td>
<td>1.50</td>
</tr>
<tr>
<td>Channel Bio LLC</td>
<td>5B90</td>
<td>108</td>
<td>59.7</td>
<td>17.3</td>
<td>19,300</td>
<td>2.27</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 44-20</td>
<td>94</td>
<td>60.3</td>
<td>17.5</td>
<td>24,300</td>
<td>1.46</td>
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<td>58.7</td>
<td>18.4</td>
<td>20,700</td>
<td>1.42</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK5418</td>
<td>87</td>
<td>59.2</td>
<td>17.4</td>
<td>19,500</td>
<td>2.07</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 37-07</td>
<td>93</td>
<td>59.3</td>
<td>17.5</td>
<td>23,300</td>
<td>1.59</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>H-486</td>
<td>81</td>
<td>58.0</td>
<td>17.6</td>
<td>19,100</td>
<td>1.61</td>
</tr>
<tr>
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<td>89</td>
<td>58.4</td>
<td>17.0</td>
<td>16,100</td>
<td>2.45</td>
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<td>58.9</td>
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<td>13,900</td>
<td>1.53</td>
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<tr>
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<td>34</td>
<td>56.6</td>
<td>17.4</td>
<td>14,700</td>
<td>1.94</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>X449</td>
<td>117</td>
<td>60.1</td>
<td>17.8</td>
<td>21,900</td>
<td>1.78</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>85G01</td>
<td>108</td>
<td>58.5</td>
<td>17.7</td>
<td>21,800</td>
<td>1.94</td>
</tr>
<tr>
<td>Channel Bio LLC</td>
<td>7B11</td>
<td>106</td>
<td>59.2</td>
<td>19.0</td>
<td>17,600</td>
<td>1.93</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 28-05</td>
<td>94</td>
<td>57.9</td>
<td>16.6</td>
<td>19,700</td>
<td>2.49</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 84732</td>
<td>94</td>
<td>55.8</td>
<td>21.3</td>
<td>16,000</td>
<td>2.22</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK4420</td>
<td>78</td>
<td>59.9</td>
<td>17.4</td>
<td>20,900</td>
<td>1.88</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-012</td>
<td>75</td>
<td>58.8</td>
<td>17.0</td>
<td>18,000</td>
<td>1.66</td>
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<tr>
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<td>58.2</td>
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<td>1.61</td>
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<tr>
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<td>72</td>
<td>58.7</td>
<td>17.8</td>
<td>19,600</td>
<td>1.84</td>
</tr>
<tr>
<td>C.V.%</td>
<td>12.1</td>
<td>20.3</td>
<td>1.5</td>
<td>2.4</td>
<td>20.1</td>
<td>17.5</td>
</tr>
<tr>
<td>L.S.D.</td>
<td>16</td>
<td>16</td>
<td>1.2</td>
<td>0.6</td>
<td>5,600</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Cooperator: James and Richard Wuerflein
No-till Practices: Fallowing wheat in 2010
Fertilizer: N: 100 lbs N/ac + 5 gal/ac 10-34-0 with planter
Planting Date: June 23, 2010
Seeding rate 56,000 seeds/ac

Monthly Rainfall (in.)

<table>
<thead>
<tr>
<th></th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>010</td>
<td>3.71</td>
<td>6.56</td>
<td>3.58</td>
<td>3.37</td>
<td>1.45</td>
<td><strong>18.67</strong></td>
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<tr>
<td>Long term mean:</td>
<td>4.26</td>
<td>2.89</td>
<td>3.35</td>
<td>3.39</td>
<td>3.17</td>
<td><strong>17.06</strong></td>
</tr>
</tbody>
</table>

Notes:
- Stand was reduced due to heavy rainfall after planting and some injury due to atrazine was observed when counting plants.
- Pioneer 87P06 yield was reduced due to heavy deer damage, was only one with significant damage.
Table 6. Results from Gate grain sorghum performance trial, 2010.

<table>
<thead>
<tr>
<th>Company</th>
<th>Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
<th>Bird Damage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorghum Partners Inc</td>
<td>KS 585</td>
<td>71</td>
<td>60.1</td>
<td>13.7</td>
<td>19,200</td>
<td>2.28</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-056</td>
<td>62</td>
<td>56.7</td>
<td>16.0</td>
<td>21,900</td>
<td>1.86</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>85G03</td>
<td>60</td>
<td>56.8</td>
<td>14.2</td>
<td>22,100</td>
<td>2.00</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-222</td>
<td>60</td>
<td>58.7</td>
<td>13.6</td>
<td>23,400</td>
<td>1.70</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>NC+ Hybrids</td>
<td>SB90</td>
<td>59</td>
<td>57.1</td>
<td>15.0</td>
<td>18,100</td>
<td>2.46</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>87P06</td>
<td>58</td>
<td>57.3</td>
<td>11.7</td>
<td>18,400</td>
<td>2.56</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 28-05</td>
<td>57</td>
<td>56.2</td>
<td>11.8</td>
<td>21,900</td>
<td>2.26</td>
<td>30</td>
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</tr>
<tr>
<td>DEKALB</td>
<td>DKS 44-20</td>
<td>57</td>
<td>58.3</td>
<td>13.6</td>
<td>28,600</td>
<td>1.58</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 37-07</td>
<td>54</td>
<td>58.5</td>
<td>17.8</td>
<td>23,400</td>
<td>1.91</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>X 449</td>
<td>54</td>
<td>57.1</td>
<td>18.9</td>
<td>21,600</td>
<td>1.90</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 84732</td>
<td>49</td>
<td>55.2</td>
<td>18.7</td>
<td>11,900</td>
<td>2.57</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-207</td>
<td>48</td>
<td>56.3</td>
<td>13.4</td>
<td>18,300</td>
<td>1.81</td>
<td>25</td>
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</tr>
<tr>
<td>Syngenta Seeds</td>
<td>H-486</td>
<td>47</td>
<td>54.2</td>
<td>18.4</td>
<td>20,300</td>
<td>1.63</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>5613</td>
<td>41</td>
<td>56.6</td>
<td>13.6</td>
<td>20,200</td>
<td>1.69</td>
<td>50</td>
<td></td>
</tr>
<tr>
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<td>NK6638</td>
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<td>54.8</td>
<td>19.0</td>
<td>17,400</td>
<td>1.90</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TR 452</td>
<td>37</td>
<td>55.7</td>
<td>15.6</td>
<td>18,700</td>
<td>1.83</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 36-06</td>
<td>32</td>
<td>54.5</td>
<td>16.2</td>
<td>17,000</td>
<td>2.28</td>
<td>75</td>
<td></td>
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</tbody>
</table>

Mean 52 56.7 15.0 20,100 2.01 ----
C.V.% 15.6 2.7 7.7 9.9 7.3 ----
L.S.D. 17.2 3.2 2.5 4,200 0.31 ----

Cooperator: Gary Graves
No-till Practices: Followed grazed volunteer wheat
Fertilizer: N: 120 lbs/ac + 5 gal/ac 10-34-0 with planter
Planting Date: April 27, 2010
Seeding rate 47,000 seeds/ac
Herbicide: 2 qt/ac Cinch ATZ Lite (Preemergence)

Monthly Rainfall (in.)

<table>
<thead>
<tr>
<th></th>
<th>Apr.</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010:</td>
<td>2.00</td>
<td>2.83</td>
<td>4.51</td>
<td>4.51</td>
<td>2.37</td>
<td>14.26</td>
</tr>
<tr>
<td>Long term mean:</td>
<td>1.91</td>
<td>3.19</td>
<td>3.00</td>
<td>2.66</td>
<td>2.56</td>
<td>13.32</td>
</tr>
</tbody>
</table>

Notes:
First year of trial, with the trial being only early planted sorghum in the area, bird damage affected yields significantly.
Table 7. Results from Homestead grain sorghum performance trial, 2010.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorghum Partners Inc</td>
<td>X 449</td>
<td>110</td>
<td>59.0</td>
<td>11.9</td>
<td>35,000</td>
<td>1.43</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>85G03</td>
<td>110</td>
<td>57.6</td>
<td>11.7</td>
<td>29,000</td>
<td>2.02</td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 44-20</td>
<td>109</td>
<td>59.1</td>
<td>11.8</td>
<td>39,000</td>
<td>1.36</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-222</td>
<td>107</td>
<td>58.0</td>
<td>11.7</td>
<td>28,700</td>
<td>1.51</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>5613</td>
<td>102</td>
<td>57.3</td>
<td>11.7</td>
<td>31,700</td>
<td>1.41</td>
</tr>
<tr>
<td>Sorghum Partners Inc NK6638</td>
<td>98</td>
<td>57.8</td>
<td>11.4</td>
<td>22,300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TR 452</td>
<td>93</td>
<td>58.6</td>
<td>11.6</td>
<td>26,500</td>
<td>1.51</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 37-07</td>
<td>92</td>
<td>58.5</td>
<td>11.8</td>
<td>26,400</td>
<td>1.68</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
<td>H-486</td>
<td>91</td>
<td>58.1</td>
<td>11.7</td>
<td>32,700</td>
<td>1.23</td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 36-06</td>
<td>91</td>
<td>58.8</td>
<td>11.8</td>
<td>23,800</td>
<td>1.67</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>87P06</td>
<td>89</td>
<td>56.9</td>
<td>11.9</td>
<td>27,600</td>
<td>2.20</td>
</tr>
<tr>
<td>NC+ Hybrids</td>
<td>5B90</td>
<td>86</td>
<td>58.2</td>
<td>11.5</td>
<td>27,100</td>
<td>1.66</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 84732</td>
<td>85</td>
<td>57.5</td>
<td>11.7</td>
<td>18,200</td>
<td>2.06</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-056</td>
<td>84</td>
<td>57.3</td>
<td>11.6</td>
<td>34,500</td>
<td>1.32</td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 28-05</td>
<td>83</td>
<td>53.9</td>
<td>12.5</td>
<td>26,800</td>
<td>1.99</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
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<td>80</td>
<td>59.1</td>
<td>11.6</td>
<td>22,100</td>
<td>1.62</td>
</tr>
<tr>
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<td>JS-207</td>
<td>74</td>
<td>56.0</td>
<td>11.1</td>
<td>29,600</td>
<td>1.49</td>
</tr>
</tbody>
</table>

|               |        |                        |                        |                  |                            |                            |
| Mean          |        | 93                     | 57.7                   | 11.7             | 28,300                     | 1.64                       |
| C.V.%         |        | 8.6                    | 1.7                    | 3.8              | 11.3                       | 18.5                       |
| L.S.D.        |        | 11                     | 1.4                    | NS               | 4,600                      | 0.43                       |

Cooperator: Brook Strader  
Min-till tillage Practices: Grain sorghum in 2009  
Fertilizer: N: 130 lbs N + 5 gal/ac 10-34-0 with planter  
Seeding rate 56,000 plants/acre  
Planting Date: April 26, 2010  
Herbicide: Cinch ATZ Lite 2.0 qts/acre (Preemergence)

Soil Series: Canadian Fine Sandy Loam  
First hybrid headed out June 20  
Target Population 45,000 plants/acre  
Harvest Date: August 30, 2010

Monthly Rainfall (in.)

<table>
<thead>
<tr>
<th></th>
<th>Apr.</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010:</td>
<td>3.96</td>
<td>5.05</td>
<td>2.05</td>
<td>3.78</td>
<td>0.63</td>
<td><strong>15.47</strong></td>
</tr>
<tr>
<td>Long term mean:</td>
<td>2.50</td>
<td>4.20</td>
<td>3.20</td>
<td>2.70</td>
<td>2.80</td>
<td><strong>15.40</strong></td>
</tr>
</tbody>
</table>

Notes:

Stands were reduced due to heavy rainfall just prior to emergence.
Table 8. Results from Keyes grain sorghum performance trial, 2010.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 60 days to mid-bloom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 37-07</td>
<td>132</td>
<td>59.7</td>
<td>12.4</td>
<td>16,700</td>
<td>3.02</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 28-05</td>
<td>128</td>
<td>56.7</td>
<td>11.5</td>
<td>18,300</td>
<td>3.44</td>
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<td>103</td>
<td>57.8</td>
<td>11.8</td>
<td>13,200</td>
<td>3.58</td>
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<td>Pulsar</td>
<td>97</td>
<td>58.2</td>
<td>12.4</td>
<td>12,600</td>
<td>3.32</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 29-28</td>
<td>93</td>
<td>58.1</td>
<td>11.6</td>
<td>17,600</td>
<td>3.25</td>
</tr>
<tr>
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<td>SP3303</td>
<td>74</td>
<td>58.9</td>
<td>11.8</td>
<td>8,400</td>
<td>3.59</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>105</td>
<td>58.2</td>
<td>11.9</td>
<td>14,400</td>
<td>3.37</td>
</tr>
<tr>
<td>C.V.%</td>
<td></td>
<td>17.2</td>
<td>1.0</td>
<td>2.9</td>
<td>23.0</td>
<td>18.7</td>
</tr>
<tr>
<td>L.S.D.</td>
<td></td>
<td>27</td>
<td>0.9</td>
<td>0.5</td>
<td>5,000 NS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
<th>Lodging %</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 to 69 days to mid-bloom</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-222</td>
<td>128</td>
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<td>12.9</td>
<td>17,900</td>
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<td>DKS 36-06</td>
<td>122</td>
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<td>12.7</td>
<td>15,600</td>
<td>2.76</td>
<td>0</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TR 452</td>
<td>120</td>
<td>59.0</td>
<td>12.0</td>
<td>13,700</td>
<td>2.98</td>
<td>0</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 44-20</td>
<td>119</td>
<td>59.6</td>
<td>12.5</td>
<td>20,000</td>
<td>2.22</td>
<td>0</td>
</tr>
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<td>Sorghum Partners Inc</td>
<td>KS 585</td>
<td>116</td>
<td>59.6</td>
<td>12.6</td>
<td>13,400</td>
<td>3.25</td>
<td>0</td>
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<tr>
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<td>JS-524</td>
<td>112</td>
<td>58.0</td>
<td>12.2</td>
<td>12,600</td>
<td>3.28</td>
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<td>58.3</td>
<td>12.6</td>
<td>15,700</td>
<td>2.70</td>
<td>0</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>85G01</td>
<td>111</td>
<td>58.7</td>
<td>11.8</td>
<td>18,300</td>
<td>2.29</td>
<td>15</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>X449</td>
<td>110</td>
<td>59.7</td>
<td>12.8</td>
<td>16,700</td>
<td>2.95</td>
<td>5</td>
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<td>14,000</td>
<td>3.59</td>
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<tr>
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<td>109</td>
<td>59.0</td>
<td>12.1</td>
<td>14,200</td>
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<tr>
<td>Syngenta Seeds</td>
<td>H-486</td>
<td>109</td>
<td>58.0</td>
<td>13.3</td>
<td>15,700</td>
<td>3.01</td>
<td>0</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 84732</td>
<td>105</td>
<td>59.0</td>
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<td>10,800</td>
<td>3.56</td>
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</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK5418</td>
<td>103</td>
<td>58.9</td>
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<td>3.27</td>
<td>15</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
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<td>59.3</td>
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<tr>
<td>Syngenta Seeds</td>
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<td>99</td>
<td>58.9</td>
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<td>13,600</td>
<td>2.87</td>
<td>5</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK4420</td>
<td>87</td>
<td>58.9</td>
<td>12.3</td>
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<td>8</td>
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<td>Syngenta Seeds</td>
<td>5745</td>
<td>82</td>
<td>57.1</td>
<td>11.5</td>
<td>15,000</td>
<td>2.75</td>
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<td>Pioneer Hi-Bred Int.</td>
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<td>80</td>
<td>57.5</td>
<td>11.4</td>
<td>13,000</td>
<td>3.47</td>
<td>5</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>107</td>
<td>58.7</td>
<td>12.3</td>
<td>14,900</td>
<td>2.91</td>
<td>-----</td>
</tr>
<tr>
<td>C.V.%</td>
<td></td>
<td>18.2</td>
<td>1.3</td>
<td>3.6</td>
<td>18.2</td>
<td>18.2</td>
<td>-----</td>
</tr>
<tr>
<td>L.S.D.</td>
<td></td>
<td>28</td>
<td>1.1</td>
<td>0.6</td>
<td>3,800</td>
<td>0.78</td>
<td>-----</td>
</tr>
</tbody>
</table>
Table 8. Continued.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK6638</td>
<td>131</td>
<td>59.1</td>
<td>12.9</td>
<td>14,700</td>
<td>3.06</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 05631</td>
<td>116</td>
<td>58.2</td>
<td>12.3</td>
<td>10,500</td>
<td>2.82</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 49-45</td>
<td>130</td>
<td>59.1</td>
<td>13.3</td>
<td>13,700</td>
<td>3.23</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK 7633</td>
<td>118</td>
<td>59.2</td>
<td>13.7</td>
<td>12,000</td>
<td>3.14</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>85Y40</td>
<td>133</td>
<td>59.6</td>
<td>12.6</td>
<td>14,700</td>
<td>3.31</td>
</tr>
<tr>
<td>Mean</td>
<td>126</td>
<td>59.0</td>
<td>12.9</td>
<td>13,100</td>
<td>3.11</td>
<td></td>
</tr>
<tr>
<td>C.V.%</td>
<td>10.9</td>
<td>0.8</td>
<td>2.0</td>
<td>20.5</td>
<td>11.4</td>
<td></td>
</tr>
<tr>
<td>L.S.D.</td>
<td>21</td>
<td>0.7</td>
<td>0.4</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

70 days and greater to mid-bloom

Cooperator: JB Stewart
Min-till tillage Practices: Wheat in 2009
Fertilizer: N: 50 lbs N + 5 gal/ac 10-34-0 with planter
Seeding rate 27,400 plants/ac
Planting Date: April 26, 2010
Herbicide: Cinch ATZ Lite 2.0 qts/ac (Preemergence)

Monthly Rainfall (in.)

<table>
<thead>
<tr>
<th>2010:</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug.</th>
<th>Sep.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.87</td>
<td>1.90</td>
<td>3.99</td>
<td>3.51</td>
<td>0.47</td>
<td><strong>10.74</strong></td>
</tr>
</tbody>
</table>

Long term mean: 2.76 2.92 2.85 2.55 1.97 **13.05**

Notes:

Rainfall was higher at trial location than reported at the Mesonet site near Boise City. Lodging in plots may have been due to areas of soil compaction. The trial was planted into marginal moisture which accounts for reduced stands.
Table 9. Results from OPREC limited irrigation grain sorghum performance trial, 2010.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield bu/ac</th>
<th>Test weight lb/bu</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2010</td>
<td>Two-year</td>
<td>2010</td>
<td>Two-year</td>
<td></td>
</tr>
<tr>
<td><strong>Less than 60 days to mid-bloom</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 37-07</td>
<td>161</td>
<td>160</td>
<td>60.0</td>
<td>59.8</td>
<td>12.4</td>
</tr>
<tr>
<td>DeKalb</td>
<td>Pulsar</td>
<td>148</td>
<td>148</td>
<td>58.4</td>
<td>58.1</td>
<td>12.4</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 28-05</td>
<td>144</td>
<td>143</td>
<td>56.9</td>
<td>57.2</td>
<td>11.6</td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-207</td>
<td>138</td>
<td>142</td>
<td>56.3</td>
<td>56.4</td>
<td>11.6</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 29-28</td>
<td>127</td>
<td>126</td>
<td>56.4</td>
<td>56.8</td>
<td>11.8</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>SP3303</td>
<td>119</td>
<td>-----</td>
<td>58.4</td>
<td>-----</td>
<td>11.9</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>140</td>
<td>144</td>
<td>57.7</td>
<td>57.7</td>
<td>11.9</td>
</tr>
<tr>
<td>C.V.%</td>
<td></td>
<td>5.3</td>
<td>5.4</td>
<td>1.3</td>
<td>1.6</td>
<td>1.3</td>
</tr>
<tr>
<td>L.S.D.</td>
<td></td>
<td>11</td>
<td>8</td>
<td>1.1</td>
<td>1.0</td>
<td>0.2</td>
</tr>
</tbody>
</table>

<p>| <strong>60 to 69 days to mid-bloom</strong> |              |      |          |      |          |                          |                            |
| Sorghum Partners Inc | KS 585       | 145  | 158      | 60.3  | 59.4    | 12.5                       | 40,900                     | 1.45                       |
| DeKalb             | DKS 44-20    | 157  | 156      | 60.8  | 59.6    | 12.4                       | 64,100                     | 1.11                       |
| Johnston Seed Co.  | JS-222       | 157  | 156      | 59.5  | 58.9    | 12.4                       | 56,100                     | 1.01                       |
| Syngenta Seeds     | 5464         | 154  | 153      | 59.2  | 59.3    | 12.5                       | 42,900                     | 1.27                       |
| Syngenta Seeds     | 5556         | 141  | 151      | 58.7  | 58.3    | 12.3                       | 48,900                     | 1.17                       |
| Johnston Seed Co.  | JS-056       | 139  | 151      | 58.9  | 58.9    | 12.2                       | 55,200                     | 1.11                       |
| Pioneer Hi-Bred Int. | 86G32       | 138  | 150      | 58.1  | 58.0    | 12.0                       | 45,800                     | 1.30                       |
| DeKalb             | DKS 36-06    | 152  | 148      | 58.1  | 58.3    | 12.8                       | 49,400                     | 1.14                       |
| Triumph Seed       | TR 452       | 145  | 148      | 59.0  | 58.7    | 12.2                       | 47,200                     | 1.12                       |
| Syngenta Seeds     | 5613         | 137  | 146      | 58.8  | 58.7    | 12.0                       | 51,000                     | 1.11                       |
| Johnston Seed Co.  | JS-524       | 133  | 146      | 57.3  | 56.8    | 12.2                       | 45,500                     | 1.22                       |
| Sorghum Partners Inc | NK5418      | 142  | 145      | 58.5  | 57.7    | 12.2                       | 49,800                     | 1.30                       |
| Syngenta Seeds     | H-486        | 140  | 138      | 58.2  | 57.8    | 12.5                       | 44,800                     | 1.16                       |
| Johnston Seed Co.  | JS-012       | 131  | 137      | 58.0  | 57.8    | 11.9                       | 39,400                     | 1.30                       |
| Pioneer Hi-Bred Int. | 87P06       | 121  | 130      | 57.7  | 58.2    | 11.9                       | 49,400                     | 1.46                       |
| Triumph Seed       | TRX 84732    | 155  | -----    | 58.8  | -----   | 13.0                       | 39,400                     | 1.48                       |
| Sorghum Partners Inc | X449        | 151  | -----    | 60.5  | -----   | 12.9                       | 52,300                     | 1.17                       |
| Pioneer Hi-Bred Int. | 85G01       | 142  | -----    | 59.5  | -----   | 11.8                       | 54,200                     | 1.08                       |
| Sorghum Partners Inc | NK4420      | 139  | -----    | 58.3  | -----   | 12.6                       | 55,300                     | 1.19                       |
| Syngenta Seeds     | 5745         | 138  | -----    | 57.2  | -----   | 12.2                       | 48,400                     | 1.22                       |
| Mean               |              | 143  | 148      | 58.7  | 58.4    | 12.3                       | 49,000                     | 1.22                       |
| C.V.%              |              | 5.8  | 6.9      | 1.2   | 2.2     | 1.9                        | 9.5                        | 11.40                      |
| L.S.D.             |              | 12   | 10       | 1.0   | 1.3     | 0.3                        | 6,600                      | 0.20                       |</p>
<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield</th>
<th>Test weight</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2010</td>
<td>Two-year</td>
<td>Three-year</td>
<td>2010</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>70 days and greater to mid-bloom</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 53-67</td>
<td>147</td>
<td>150</td>
<td>141</td>
<td>58.4</td>
<td>59.2</td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 54-03</td>
<td>152</td>
<td>150</td>
<td>140</td>
<td>57.4</td>
<td>57.3</td>
</tr>
<tr>
<td>DEKALB</td>
<td>DKS 54-00</td>
<td>145</td>
<td>144</td>
<td>133</td>
<td>56.3</td>
<td>57.5</td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK6638</td>
<td>136</td>
<td>137</td>
<td>128</td>
<td>57.8</td>
<td>58.2</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>84G62</td>
<td>159</td>
<td>156</td>
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<td>58.7</td>
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<td>138</td>
<td>-----</td>
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<td>58.1</td>
</tr>
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<td>DKS 49-45</td>
<td>150</td>
<td>-----</td>
<td>-----</td>
<td>57.7</td>
<td>-----</td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>85Y40</td>
<td>147</td>
<td>-----</td>
<td>-----</td>
<td>59.1</td>
<td>-----</td>
</tr>
<tr>
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<td>NK 7633</td>
<td>145</td>
<td>-----</td>
<td>-----</td>
<td>57.6</td>
<td>-----</td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 05631</td>
<td>132</td>
<td>-----</td>
<td>-----</td>
<td>55.2</td>
<td>-----</td>
</tr>
<tr>
<td>Mean</td>
<td>145</td>
<td>146</td>
<td>135</td>
<td>57.6</td>
<td>58.2</td>
<td>57.5</td>
</tr>
<tr>
<td>C.V.%</td>
<td>6.9</td>
<td>6.5</td>
<td>7.2</td>
<td>1.7</td>
<td>2.4</td>
<td>2.7</td>
</tr>
<tr>
<td>L.S.D.</td>
<td>14</td>
<td>10</td>
<td>8</td>
<td>1.5</td>
<td>NS</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Cooperator: OPREC
Strip-till following wheat and double crop sunflower in 2009
Herbicide: Cinch ATZ Lite 2 qts/ac (Preemergence)
Seeding rate 64,500 plants/ac
Planting Date: June 7, 2010

Monthly Rainfall (in.)

<table>
<thead>
<tr>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sep</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.64</td>
<td>3.16</td>
<td>1.22</td>
<td>5.42</td>
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</table>

Long term mean:

<table>
<thead>
<tr>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
</tr>
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<tbody>
<tr>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>2.6</td>
<td>1.3</td>
</tr>
</tbody>
</table>

**Notes:**

Rainfall was received in very timely manner when irrigation was not scheduled. There was a 68 bu/ac yield difference between hybrids entered in both dry-land and irrigated which equals 8.7 bushels per inch of irrigation.
<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield bu/ac</th>
<th>Test weight lb/bu</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/acre</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2010 Two-year 2010 Two-year</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 37-07</td>
<td>86  89  55.9  57.1</td>
<td>12.9  26,700</td>
<td>1.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 28-05</td>
<td>71  80  56.4  56.9</td>
<td>11.4  24,100</td>
<td>1.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 29-28</td>
<td>73  76  56.3  56.4</td>
<td>12.2  26,700</td>
<td>1.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>Pulsar</td>
<td>72  75  56.2  56.4</td>
<td>12.3  21,400</td>
<td>1.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-207</td>
<td>74  71  54.9  55.9</td>
<td>11.8  22,400</td>
<td>1.77</td>
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<td></td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>SP3303</td>
<td>56  -----  55.6  -----</td>
<td>11.5  23,200</td>
<td>1.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>72  78  55.8  56.5</td>
<td>12.0  24,100</td>
<td>1.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C.V.%</td>
<td>14.3 12.5  2.2  3.4</td>
<td>3.3  4.9</td>
<td>9.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L.S.D.</td>
<td>16  10 NS  NS</td>
<td>0.6  1,800</td>
<td>0.23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Less than 60 days to mid-bloom

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield bu/ac</th>
<th>Test weight lb/bu</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/acre</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2010 Two-year 2010 Two-year</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 44-20</td>
<td>96  89  57.8  58.0</td>
<td>12.7  23,400</td>
<td>1.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 36-06</td>
<td>78  81  57.3  56.8</td>
<td>12.0  22,700</td>
<td>1.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>87P06</td>
<td>73  78  56.4  56.6</td>
<td>12.0  23,000</td>
<td>1.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Johnston Seed Co.</td>
<td>JS-524</td>
<td>75  76  56.7  56.3</td>
<td>12.5  27,200</td>
<td>1.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK5418</td>
<td>64  76  58.1  57.7</td>
<td>11.2  20,000</td>
<td>1.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pioneer Hi-Bred Int.</td>
<td>86G32</td>
<td>70  75  57.0  57.1</td>
<td>12.2  18,700</td>
<td>1.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>KS 585</td>
<td>72  75  57.8  57.9</td>
<td>12.5  23,000</td>
<td>1.44</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>1.42</td>
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<td></td>
</tr>
<tr>
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<td></td>
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<tr>
<td>Syngenta Seeds</td>
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<td>12.0  23,100</td>
<td>1.40</td>
<td></td>
<td></td>
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<tr>
<td>Triumph Seed</td>
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<td>60  -----  56.7  -----</td>
<td>12.4  24,000</td>
<td>1.32</td>
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<tr>
<td></td>
<td>Mean</td>
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<td>12.1  22,300</td>
<td>1.51</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>C.V.%</td>
<td>15.3 13.2  2.3  2.8</td>
<td>8.3  12.1</td>
<td>17.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L.S.D.</td>
<td>15  9.7 NS  1.6</td>
<td>NS  3,800</td>
<td>0.37</td>
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</table>
Table 10. Continued.

<table>
<thead>
<tr>
<th>Company</th>
<th>Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pioneer Hi-Bred Int.</td>
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<td>89</td>
<td>58.2</td>
<td>11.7</td>
<td>19,500</td>
<td>1.54</td>
<td></td>
</tr>
<tr>
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<td>DKS 49-45</td>
<td>88</td>
<td>57.1</td>
<td>11.3</td>
<td>16,500</td>
<td>1.86</td>
<td></td>
</tr>
<tr>
<td>Triumph Seed</td>
<td>TRX 05631</td>
<td>83</td>
<td>58.5</td>
<td>11.6</td>
<td>20,000</td>
<td>1.59</td>
<td></td>
</tr>
<tr>
<td>Sorghum Partners Inc</td>
<td>NK 7633</td>
<td>82</td>
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<td>11.3</td>
<td>18,700</td>
<td>1.62</td>
<td></td>
</tr>
<tr>
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<td>NK6638</td>
<td>76</td>
<td>56.5</td>
<td>11.9</td>
<td>17,800</td>
<td>1.86</td>
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<tr>
<td>Mean</td>
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<td>84</td>
<td>57.3</td>
<td>11.5</td>
<td>18,500</td>
<td>1.69</td>
<td></td>
</tr>
<tr>
<td>C.V.%</td>
<td></td>
<td>10.8</td>
<td>3.5</td>
<td>3.2</td>
<td>13.6</td>
<td>19.9</td>
<td></td>
</tr>
<tr>
<td>L.S.D.</td>
<td></td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

70 days and greater to mid-bloom

Cooperator: 0PREC
No-till tillage Practices: Wheat in 2009
Fertilizer: N: 50 lbs N + 5 gal/ac 10-34-0 with planter
Seeding rate 27,400 plants/ac
Planting Date: June 2, 2010
Herbicide: Cinch ATZ Lite 2.0 qts/ac (Preemergence)

Soil Series: Richfield Clay Loam
Target Population 25,000 plants/ac
Harvest Date: October 29, 2010

Monthly Rainfall (in.)   May  June  July  Aug.  Sep.  Total
2010:                    2.64  3.16  1.22  5.42  0.20  **12.64**
Long term mean:          3.25  2.86  2.58  2.28  1.77  **12.74**

Notes:
Due to planter error the early hybrids were replanted 2 weeks after the date above.
Table 11. Results from Tipton grain sorghum performance trial, 2010.

<table>
<thead>
<tr>
<th>Company Brand Name</th>
<th>Hybrid</th>
<th>Grain Yield Bu/ac 2010</th>
<th>Test weight Lb/bu 2010</th>
<th>Harvest Moisture</th>
<th>Plant Population plants/ac</th>
<th>Head Population heads/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bu/ac</td>
<td>Lb/bu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2010</td>
<td>2010</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Less than 60 days to mid-bloom</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>DeKalb</td>
<td>Pulsar</td>
<td>91</td>
<td>57.8</td>
<td>12.5</td>
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<td>1.89</td>
</tr>
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<td>12.5</td>
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<tr>
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<td>55.1</td>
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</tr>
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<td>54.4</td>
<td>11.8</td>
<td>42,000</td>
<td>1.86</td>
</tr>
<tr>
<td>DeKalb</td>
<td>DKS 29-28</td>
<td>69</td>
<td>55.1</td>
<td>11.5</td>
<td>45,300</td>
<td>1.58</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>81</td>
<td>56.3</td>
<td>12.0</td>
<td>44,600</td>
<td>1.69</td>
</tr>
<tr>
<td>C.V.%</td>
<td></td>
<td>6.7</td>
<td>1.2</td>
<td>3.2</td>
<td>8.2</td>
<td>11.1</td>
</tr>
<tr>
<td>L.S.D.</td>
<td></td>
<td>10</td>
<td>0.7</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td><strong>60 to 69 days to mid-bloom</strong></td>
<td></td>
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</tr>
<tr>
<td>DeKalb</td>
<td>DKS 44-20</td>
<td>110</td>
<td>59.1</td>
<td>13.3</td>
<td>55,000</td>
<td>1.34</td>
</tr>
<tr>
<td>Syngenta Seeds</td>
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<td>110</td>
<td>57.2</td>
<td>13.2</td>
<td>45,300</td>
<td>1.41</td>
</tr>
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<td>12.4</td>
<td>43,600</td>
<td>1.57</td>
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<td>45,200</td>
<td>1.39</td>
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<td>57.9</td>
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<td>1.70</td>
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<td>13.2</td>
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<tr>
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<td>1.41</td>
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<td>12.6</td>
<td>44,000</td>
<td>1.49</td>
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<tr>
<td>C.V.%</td>
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<td>1.7</td>
<td>3.8</td>
<td>11.6</td>
<td>11.6</td>
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<td>Test weight Lb/bu 2010</td>
<td>Harvest Moisture</td>
<td>Plant Population plants/ac</td>
<td>Head Population heads/plant</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
<td>-------------</td>
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<td>-----------------</td>
<td>-----------------------------</td>
<td>----------------------------</td>
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<td>57.3</td>
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<td>52,000</td>
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<td><strong>46,900</strong></td>
<td><strong>1.38</strong></td>
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<td><strong>C.V.%</strong></td>
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<td><strong>1.1</strong></td>
<td><strong>1.6</strong></td>
<td><strong>9.5</strong></td>
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<td><strong>L.S.D.</strong></td>
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<td><strong>NS</strong></td>
<td><strong>8,400</strong></td>
<td><strong>0.19</strong></td>
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</tbody>
</table>

Cooperator: Southwest Research and Extension Center  
Conventional Tillage Practices: Sorghum-fallow-sorghum rotation  
Fertilizer: N: 80 lbs/ac  
P: 20 lbs P2O5  
K: 0  
Seeding rate: 56,000 seeds/ac  
Planting Date: April 26, 2010  
Harvest Date: August 20, 2010  
Herbicide: 2 qt/ac Cinch ATZ Lite Preemergence

Monthly Rainfall (in.)

<table>
<thead>
<tr>
<th></th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Total</th>
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</thead>
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<tr>
<td>2010</td>
<td>2.79</td>
<td>1.34</td>
<td>2.07</td>
<td>9.93</td>
<td>1.10</td>
<td><strong>17.23</strong></td>
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<tr>
<td>Long term mean:</td>
<td>2.30</td>
<td>4.30</td>
<td>3.45</td>
<td>2.08</td>
<td>2.71</td>
<td><strong>14.84</strong></td>
</tr>
</tbody>
</table>

Notes:
The 9.93 inches of rainfall in July (57%) was received after all hybrids were headed out.
2010 Soybean Variety Performance Tests

C.B. Godsey
B. Heister
W. Vaughan

Oklahoma State University
Department of Plant and Soil Sciences
Production Technology Report
PT 2011-1
2010 Soybean

Cooperators
Rich Kochenower, OK Panhandle Research and Extension Center
Jay Franklin, Craig County Producer
Brent Rendel, Ottawa County Producer
Doug McMurtry, Alfalfa County Producer
Tommy Puffinbarger, Alfalfa County Educator
Bob Leadford, Garvin County Educator
Trey Lamb, Garvin County Educator
Don Mertz, Kay County Producer
Bob Ross, Muskogee County Producer

Cooperating Station Superintendents
Ray Sidwell, North Central Research Station, Lahoma
Erich Wehrenberg, Agronomy Research Farm, Stillwater
Bobby Weidenmaier, Caddo Research Station

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Information on Soybean Variety Trials

Numerous soybean lines and varieties were evaluated in performance tests during 2010. Commercially available varieties, both public and private, and advanced experimental lines were included within the tests. Tests were designed to provide information to assist producers in identifying superior varieties and make crop management decisions. Tests include both early-season and full-season environments. Early-season tests were planted during April and contained maturity group (MG) III and IV. Full-season test were planted during June and into the beginning of July and included varieties in MG IV, V, and VI.

Public varieties included in tests are considered to be competitive for the region, and are represented by established varieties, new releases, and advanced experimental lines. Varieties of private seed company origin are submitted based on decisions by the respective company.

2010 Soybean Crop Overview

The 2010 Oklahoma soybean growing season started off excellent but heat and lack of soil moisture in late July and early August decreased yield in a lot of locations throughout the state. In most cases double crop soybeans planted in late June have turned out the best due to reproduction stages occurring after mid-August. In a lot of cases, we observed some significant shattering due to weather and perhaps weak pods from environmental stresses during grain fill.

Planted acreage of this year’s soybean crop was estimated at 500,000 acres. Average yield at the time of this report was estimated at 23 bushels per acre.

Pest problems

Plant disease was minimal during the 2010 growing season; Asian soybean rust was not detected in Oklahoma. We did observe several different insect problems during 2010. Early in the growing season we had relatively heavy infestations of garden webworm that had to be controlled. Later in the season fall armyworm and corn earworm were problems in some areas. Grasshoppers were also a problem in some areas. Blister beetles were observed in some fields and treated for but overall pest problems were minor, especially in later planted soybean fields.

Methods

Full-season test locations were near Webbers Falls, Pauls Valley, Newkirk, Fort Cobb, Cherokee, Lahoma, Miami, Vinita, and Stillwater. All test plots were planted using four 30-inch rows that were 25 feet long. Plots were seeded at a rate of eight seeds per row foot (139,392 seeds per acre). At planting, *Bradyrhizobium japonicum* in a liquid formulation was applied with the seed. Tests were conducted using randomized complete block design with four replications. All locations were conventionally tilled prior to seeding with the exception of Cherokee, Miami, and Stillwater. Irrigation was used only at the Fort Cobb location. Two rows the entire length of the plot was harvested with a small plot combine to determine grain yield.
Interpreting Data

Performance of soybean varieties is affected by many factors, including year, location, soil type, and time of planting. Details of establishment and management of each test are listed in footnotes below the tables.

Small differences in yield are usually of little importance. The reason being that two varieties at a single location can differ because of “chance” factors which may include soil fertility, soil type, depth of top soil, etc. To decide if a yield difference is “real”, use the Least significant differences (LSD) at the bottom of all tables. Differences between varieties are significant only if they are equal to or greater than the LSD value. If a given variety out yields another variety by as much or more than the LSD value, then we are 95% sure that the yield difference is real, with only a 5% probability that the difference is due to chance alone. For example, if variety X is 5 bushels/acre higher in yield than variety Y, then this difference is statistically significant if the LSD is 5 or less. If the LSD is 5 or greater, then we are less confident that variety X really is higher yielding than variety Y under the conditions of the test.

Results reported here should be representative of what might occur throughout the state but would be most applicable under environmental and management conditions similar to those of the tests. The relative yields of all soybean varieties are affected by crop management and by environmental factors including soil type, summer conditions, soil moisture conditions, diseases, and insects.

Additional information on the Web
A copy of this publication as well as additional variety information and more information on soybean management can be found at

www.soybean.okstate.edu/

An individual is encouraged to review 2 to 3 years of variety test results before making a variety selection. Because soybean varieties change often multiple years of data are not compared in this publication but previous years data can be found at the previously mention website.
Table 1. Sources of seed for the 2010 Oklahoma Soybean Variety Trials.

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Location Summary:

The Ardmore location was a full-season test. The average yield was 25 bu/ac, which is good considering the extremely dry June and August that was experienced. In addition, the above normal temperatures in August probably reduced yield potential as this time period overlapped with blooming and early pod-fill.
Table 3. Full-season glyphosate resistant soybean production variety trial Ardmore, OK 2010.

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<td>Progeny Ag Products</td>
<td>5.7</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>19</td>
<td>76</td>
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</tr>
<tr>
<td>5650 RR</td>
<td>Progeny Ag Products</td>
<td>5.6</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>18</td>
<td>72</td>
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<tr>
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<td>Terral Seed, Inc.</td>
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<tr>
<td>REV 49R22</td>
<td>Terral Seed, Inc.</td>
<td>4.9</td>
<td>na</td>
<td>na</td>
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<td>Terral Seed, Inc.</td>
<td>4.8</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>14</td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>

LSD (P=0.05) 14

<sup>1</sup>O = no shattering or lodging, 5 = very severe shattering or lodging.
Location Summary:
Growing conditions at the Cherokee location were excellent early in the growing season, however, in September during pod fill the location experienced drier than normal conditions which resulted in a yield loss. In addition, temperatures in August were above normal for a 2 week period that probably lowered yield potential. This was a full-season crop following a cover crop mix that was terminated in early spring. Shattering at this location was relatively severe, most likely a result of the environmental conditions during pod fill.

Table 2. Information on soil chemical properties and management practices for the Soybean Production Test at Cherokee, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.8</td>
<td>Planting Date</td>
<td>6/3/2010$^1$</td>
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<tr>
<td>Soil Test P Index</td>
<td>110</td>
<td>Seeding Rate (seeds/foot of row)</td>
<td>8</td>
</tr>
<tr>
<td>Soil Test K Index</td>
<td>500</td>
<td>Seeding Depth (in)</td>
<td>1</td>
</tr>
<tr>
<td>Winter cover</td>
<td>crop</td>
<td>Irrigation</td>
<td>none</td>
</tr>
<tr>
<td>Previous Crop</td>
<td></td>
<td>Harvest Date</td>
<td>10/28$^2$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil Moisture at Planting</td>
<td>good</td>
</tr>
</tbody>
</table>

$^1$Planting dates for the full season test.

$^2$Harvest dates for full season test.
Table 3. Full-season glyphosate resistant soybean production variety trail Cherokee, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering Score</th>
<th>Lodging Score</th>
<th>Seed/Lb</th>
<th>Yield</th>
<th>Percent Yield of Trial Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBK RY5220</td>
<td>Hornbeck Seed Co.</td>
<td>5.2</td>
<td>31</td>
<td>1</td>
<td>0</td>
<td>3150</td>
<td>25</td>
<td>135</td>
</tr>
<tr>
<td>MORSOY RT 5388N</td>
<td>Cache River Valley Seed</td>
<td>5.3</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>3700</td>
<td>25</td>
<td>131</td>
</tr>
<tr>
<td>MORSOY RTS4955N</td>
<td>Cache River Valley Seed</td>
<td>4.9</td>
<td>38</td>
<td>0</td>
<td>0</td>
<td>2800</td>
<td>25</td>
<td>131</td>
</tr>
<tr>
<td>REV 56R21</td>
<td>Terral Seed, Inc.</td>
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<td>36</td>
<td>1</td>
<td>0</td>
<td>3150</td>
<td>24</td>
<td>129</td>
</tr>
<tr>
<td>MORSOY RT 5429</td>
<td>Cache River Valley Seed</td>
<td>5.4</td>
<td>33</td>
<td>0</td>
<td>0</td>
<td>3350</td>
<td>24</td>
<td>128</td>
</tr>
<tr>
<td>5218 RR</td>
<td>Progeny Ag Products</td>
<td>5.2</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>2900</td>
<td>23</td>
<td>124</td>
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<td>Hornbeck Seed Co.</td>
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<td>34</td>
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<td>0</td>
<td>2750</td>
<td>23</td>
<td>121</td>
</tr>
<tr>
<td>MORSOY Xtra 49X10</td>
<td>Cache River Valley Seed</td>
<td>4.9</td>
<td>34</td>
<td>0</td>
<td>0</td>
<td>3200</td>
<td>23</td>
<td>121</td>
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<td>0</td>
<td>3000</td>
<td>22</td>
<td>119</td>
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<tr>
<td>S46-U6 Brand</td>
<td>Syngenta Seeds</td>
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<td>0</td>
<td>3200</td>
<td>22</td>
<td>118</td>
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<tr>
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<td>3600</td>
<td>22</td>
<td>118</td>
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<td>Cache River Valley Seed</td>
<td>5.6</td>
<td>35</td>
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<td>0</td>
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<td>19</td>
<td>100</td>
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<td>4807 RR</td>
<td>Progeny Ag Products</td>
<td>5.3</td>
<td>32</td>
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<td>0</td>
<td>2600</td>
<td>19</td>
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<td>MORSOY Xtra 47X10</td>
<td>Cache River Valley Seed</td>
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<td>5622 RR</td>
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<td>0</td>
<td>3050</td>
<td>21</td>
<td>110</td>
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<tr>
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<td>2850</td>
<td>20</td>
<td>105</td>
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<td>Cache River Valley Seed</td>
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<td>1</td>
<td>0</td>
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<td>19</td>
<td>100</td>
</tr>
<tr>
<td>5706 RR</td>
<td>Progeny Ag Products</td>
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<td>2</td>
<td>0</td>
<td>3150</td>
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<td>18</td>
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<td>3650</td>
<td>18</td>
<td>96</td>
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<td>18</td>
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<td>30</td>
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<td>17</td>
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<td>15</td>
<td>81</td>
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<td>Syngenta Seeds</td>
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<td>2850</td>
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<td>26</td>
<td>2</td>
<td>0</td>
<td>3050</td>
<td>13</td>
<td>67</td>
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<tr>
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<td>Terral Seed, Inc.</td>
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<td>31</td>
<td>2</td>
<td>0</td>
<td>3050</td>
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<td>63</td>
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<td>Terral Seed, Inc.</td>
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<td>36</td>
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<td>3000</td>
<td>11</td>
<td>57</td>
</tr>
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<td>Terral Seed, Inc.</td>
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<td>0</td>
<td>2550</td>
<td>10</td>
<td>53</td>
</tr>
</tbody>
</table>

LSD (P=0.05) **8**

1° = no shattering or lodging, S = very severe shattering or lodging.
Table 4. Full-season conventional and Liberty Link soybean production variety trial Cherokee, OK 2010.

| Variety       | Company                  | Maturity Group | Height (in) | Shattering Score | Lodging Score | Seed/Lb | Yield (bu/acre) | Percent Yield of Trial Average
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HALO 4:94²</td>
<td>Hornbeck Seed Co.</td>
<td>4.9</td>
<td>31</td>
<td>1</td>
<td>0</td>
<td>2800</td>
<td>29</td>
<td>129</td>
</tr>
<tr>
<td>Osage</td>
<td>University of Arkansas</td>
<td>5.6</td>
<td>27</td>
<td>1</td>
<td>0</td>
<td>3600</td>
<td>29</td>
<td>128</td>
</tr>
<tr>
<td>HBK C 5025</td>
<td>Hornbeck Seed Co.</td>
<td>5.0</td>
<td>33</td>
<td>0</td>
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<td>2850</td>
<td>28</td>
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<td>University of Arkansas</td>
<td>4.8</td>
<td>27</td>
<td>1</td>
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<td>3450</td>
<td>27</td>
<td>121</td>
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<td>Glenn</td>
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<td>0</td>
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<td>2850</td>
<td>23</td>
<td>105</td>
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<td>Hucheson</td>
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<td>5.5</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>3100</td>
<td>22</td>
<td>99</td>
</tr>
<tr>
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<td>Hornbeck Seed Co.</td>
<td>5.5</td>
<td>24</td>
<td>0</td>
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<td>22</td>
<td>100</td>
</tr>
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<td>HBK C5528</td>
<td>Hornbeck Seed Co.</td>
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<td>39</td>
<td>2</td>
<td>0</td>
<td>2950</td>
<td>22</td>
<td>97</td>
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<td>Jake</td>
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<td>5</td>
<td>24</td>
<td>1</td>
<td>0</td>
<td>3650</td>
<td>20</td>
<td>89</td>
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<tr>
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<td>University of Arkansas</td>
<td>5.2</td>
<td>21</td>
<td>1</td>
<td>0</td>
<td>3700</td>
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<td>5</td>
<td>27</td>
<td>1</td>
<td>0</td>
<td>3600</td>
<td>19</td>
<td>87</td>
</tr>
<tr>
<td>Avg. of 3 RR Varieties</td>
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<td>4.8-5.5</td>
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<td>University of Arkansas</td>
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<td>27</td>
<td>2</td>
<td>0</td>
<td>2950</td>
<td>17</td>
<td>76</td>
</tr>
</tbody>
</table>

LSD (P=0.05) 7

¹0 = no shattering or lodging, 5 = very severe shattering or lodging.

²Liberty Link soybean variety
**Location Summary:**

The Enid location was a double-crop test planted on June 24th. Plots were direct seeded into a long-term no-till field. The average yield was 15 bu/acre when averaged across all varieties. The yield potential of this test was hurt by the below normal precipitation in August and September.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>na(^1)</td>
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</tr>
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<td>na</td>
<td>Seeding Rate (seeds/foot of row)</td>
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</tr>
<tr>
<td>Soil Test K Index</td>
<td>na</td>
<td>Seeding Depth (in)</td>
<td>1.5</td>
</tr>
<tr>
<td>Previous crop</td>
<td>Wheat</td>
<td>Irrigation</td>
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<td></td>
<td></td>
<td>Harvest Dates</td>
<td>8-Nov</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil Moisture at Planting</td>
<td>good</td>
</tr>
</tbody>
</table>

\(^1\) Not available.
Table 3. Full-season conventional and Liberty Link soybean production variety trial Enid, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering&lt;sup&gt;1&lt;/sup&gt; Score</th>
<th>Lodging&lt;sup&gt;1&lt;/sup&gt; Score</th>
<th>Seed/Lb</th>
<th>Yield Average in - bu/acre</th>
<th>Percent Yield of Trial Average</th>
</tr>
</thead>
<tbody>
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<td>5.2</td>
<td>18</td>
<td>0</td>
<td>0</td>
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<td>Glenn</td>
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<td>5</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>3850</td>
<td>18</td>
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<td>100</td>
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<tr>
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<td>15</td>
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<td>12</td>
<td>81</td>
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LSD (P=0.05) 4

<sup>1</sup>O = no shattering or lodging, 5 = very severe shattering or lodging.

<sup>2</sup>Liberty Link soybean variety
Location Summary:

The Fort Cobb location was a full-season irrigated test planted on May 20th. The average yield was 38 and 48 bu/acre when averaged across all glyphosate resistant varieties and conventional varieties, respectively. Yield was reduced just prior to harvest due to a hailstorm that caused shattering.

Table 2. Information on soil chemical properties and management practices for the Soybean Production Test at Fort Cobb, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
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<td>Soil Test K Index</td>
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<td>Seeding Depth (in)</td>
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<td>Harvest Dates</td>
<td>20-Oct</td>
</tr>
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<td>Previous Crop</td>
<td>Peanut</td>
<td>Irrigation</td>
<td>as needed</td>
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Table 3. Full-season glyphosate resistant soybean production variety trial Fort Cobb, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering(^1) Score</th>
<th>Lodging(^1) Score</th>
<th>Seed/Lb</th>
<th>Yield</th>
<th>Percent Yield of Trial Average</th>
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<td>54</td>
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<td>2</td>
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<td>49</td>
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<td>1</td>
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<td>46</td>
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<td>45</td>
<td>118</td>
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<td>Morsoy Xtra 47X10</td>
<td>Cache River Valley Seed</td>
<td>4.7</td>
<td>36</td>
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<td>0</td>
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<td>41</td>
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<td>Croplan Genetics</td>
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<td>2700</td>
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<td>1</td>
<td>2650</td>
<td>30</td>
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<td>2750</td>
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<td>28</td>
<td>73</td>
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</tbody>
</table>

LSD (P=0.05) 7

\(^1\)0 = no shattering or lodging, 5 = very severe shattering or lodging.
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<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering Score</th>
<th>Lodging Score</th>
<th>Seed/Lb</th>
<th>Yield per cent</th>
<th>Trial Average</th>
<th>Yield Average</th>
<th>Percent Yield of Trial Average</th>
</tr>
</thead>
<tbody>
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<td>3400</td>
<td>48</td>
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<td>Avg. of 3 RR Varieties</td>
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<td>0</td>
<td>2600</td>
<td>47</td>
<td>98</td>
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<td>1</td>
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</tr>
</tbody>
</table>

**LSD (P=0.05)** 10

1 = no shattering or lodging, 5 = very severe shattering or lodging.

2Liberty Link soybean variety.
**Location Summary:**

The Goodwell location was a full-season irrigated test planted in early May. The average yield was 59 and 50 bu/acre when averaged across all glyphosate resistant varieties and conventional varieties, respectively.

Table 2. Information on soil chemical properties and management practices for the Soybean Production Test at Goodwell, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
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<tr>
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<td></td>
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<td></td>
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Table 3. Full-season glyphosate resistant soybean production variety trial Goodwell, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering&lt;sup&gt;1&lt;/sup&gt; Score</th>
<th>Lodging&lt;sup&gt;1&lt;/sup&gt; Score</th>
<th>Seed/Lb</th>
<th>Yield bu/acre</th>
<th>Percent Yield of Trial Average</th>
</tr>
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<tr>
<td>REV 47R22</td>
<td>Terral Seed, Inc.</td>
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<td>in</td>
<td>0</td>
<td>0</td>
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<td>72</td>
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<td>HBK RY5220</td>
<td>Hornbeck Seed Co.</td>
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<td>0</td>
<td>0</td>
<td>4200</td>
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<td>116</td>
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<td>Terral Seed, Inc.</td>
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<td>64</td>
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<td>Cache River Valley Seed</td>
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<tr>
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<td>Cache River Valley Seed</td>
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<td>REV 49R11</td>
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<td>Morsoy Xtra 47X10</td>
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<td>58</td>
<td>98</td>
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<td>H BK R5425</td>
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<td>3650</td>
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<td>94</td>
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<td>H BK R4924</td>
<td>Hornbeck Seed Co.</td>
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<td>0</td>
<td>0</td>
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<td>3350</td>
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<td>94</td>
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<td>94</td>
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<td>RC4998</td>
<td>Croplan Genetics</td>
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<td>2800</td>
<td>55</td>
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<td>5650 RR</td>
<td>Progeny Ag Products</td>
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<td>0</td>
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<td>2800</td>
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<td>54</td>
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<td>5218 RR</td>
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<td>3200</td>
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<td>89</td>
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<td>S49-A5 Brand</td>
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<td>0</td>
<td>0</td>
<td>2650</td>
<td>53</td>
<td>89</td>
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<td>4906 RR</td>
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<td>3600</td>
<td>53</td>
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<td>46</td>
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</table>

LSD (P=0.05) 12

<sup>1</sup> 0 = no shattering or lodging, 5 = very severe shattering or lodging.
Table 4. Full-season conventional and Liberty Link soybean production variety trail Goodwell, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering(^1) Score</th>
<th>Lodging(^1) Score</th>
<th>Seed/Lb</th>
<th>Yield bu/acre</th>
<th>Percent Yield of Trial Average</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Hornbeck Seed Co.</td>
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<td>1</td>
<td>0</td>
<td>3600</td>
<td>61</td>
<td>121</td>
</tr>
<tr>
<td>HALO 4:94(^2)</td>
<td>Hornbeck Seed Co.</td>
<td>4.9</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3700</td>
<td>57</td>
<td>114</td>
</tr>
<tr>
<td>Avg. of 3 RR Varieties</td>
<td></td>
<td>4.8-5.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3500</td>
<td>55</td>
<td>110</td>
</tr>
<tr>
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<td>University of Arkansas</td>
<td>4.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3050</td>
<td>52</td>
<td>103</td>
</tr>
<tr>
<td>Glenn</td>
<td></td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3500</td>
<td>52</td>
<td>103</td>
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<td>4350</td>
<td>50</td>
<td>99</td>
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<td>0</td>
<td>2950</td>
<td>49</td>
<td>96</td>
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<td>HBK C 5025</td>
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<td>3</td>
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<td>93</td>
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<td>45</td>
<td>89</td>
</tr>
<tr>
<td>Jake</td>
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<td>4100</td>
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<td>4150</td>
<td>43</td>
<td>84</td>
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</table>

LSD (P=0.05) 7

\(^1\)0 = no shattering or lodging, 5 = very severe shattering or lodging.
\(^2\)Liberty Link soybean variety
Location Summary:

The Miami location was a full-season test planted on June 2nd. The test was planted into a conventional tilled seedbed. The average yield was 28 bu/acre when averaged across all varieties. The average yield was consistent with what area producers observed in 2010. The yield potential of this test was hurt by the below normal precipitation in August.

Table 2. Information on soil chemical properties and management practices for the Conventional Soybean Production Test at Miami, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
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<td>Planting Date</td>
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</tr>
<tr>
<td>Soil Test P Index</td>
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<td>Seeding Rate (seeds/foot of row)</td>
<td>8</td>
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<tr>
<td>Soil Test K Index</td>
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<td>Seeding Depth (in)</td>
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<td></td>
<td></td>
<td>Irrigation</td>
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<tr>
<td></td>
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<td>11/3</td>
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<tr>
<td></td>
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<td>Soil Moisture at Planting</td>
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</table>
Table 3. Full-season conventional and Liberty Link soybean production variety trial Miami, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering(^1) Score</th>
<th>Lodging(^1) Score</th>
<th>Seed/Lb</th>
<th>Yield bu/acre</th>
<th>Percent Yield of Trial Average</th>
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<td>26</td>
<td>0</td>
<td>0</td>
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<td>35</td>
<td>122</td>
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<tr>
<td>Jake</td>
<td></td>
<td>5</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>2500</td>
<td>35</td>
<td>119</td>
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<td>Avg. of 3 RR</td>
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<td>4.8-5.5</td>
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<td>32</td>
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<td>101</td>
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<td>96</td>
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<tr>
<td>Hutcheson</td>
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<td>5.5</td>
<td>34</td>
<td>0</td>
<td>0</td>
<td>2350</td>
<td>26</td>
<td>90</td>
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<td>0</td>
<td>2950</td>
<td>21</td>
<td>72</td>
</tr>
</tbody>
</table>

\(^{1}\)0 = no shattering or lodging, 5 = very severe shattering or lodging.

\(^{2}\)Liberty Link soybean variety

LSD (P=0.05) 7
Location Summary:

The Vinita location was a full-season test planted on June 2nd. The test was planted into a long-term no-till seedbed. The average yield was 13 bu/acre when averaged across all varieties. Yield potential was greatly reduced with the below normal precipitation in June. The lack of rainfall in June put the crop behind in available soil moisture most of the season. The crop was stressed during flowering and early pod fill.

Table 4. Information on soil chemical properties and management practices for the RR Soybean Production Test at Vinita, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.4</td>
<td>Planting Date</td>
<td>6/2</td>
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Table 5. Full-season glyphosate resistant soybean production variety trail Vinita, OK 2010.

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<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height - in -</th>
<th>Shattering Score</th>
<th>Lodging Score</th>
<th>Seed/Lb</th>
<th>Yield - bu/acre -</th>
<th>Percent Yield of Trial Average</th>
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LSD (P=0.05) 7

1. 0 = no shattering or lodging, 5 = very severe shattering or lodging.
**Location Summary:**
Growing conditions at the Newkirk location were excellent early in the growing season, however, in September during pod fill the location experienced drier than normal conditions which resulted in a yield loss. This test was planted in late June.

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<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
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LSD (P=0.05) 7

1° = no shattering or lodging, 5 = very severe shattering or lodging.
Table 4. Full-season conventional and Liberty Link soybean production variety trial Newkirk, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height - in -</th>
<th>Shattering(^1) Score</th>
<th>Lodging(^1) Score</th>
<th>Seed/Lb</th>
<th>Yield - bu/acre</th>
<th>Percent Yield of Trial Average</th>
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<td>0</td>
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<td>23</td>
<td>110</td>
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<td>Hornbeck Seed Co.</td>
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<td>0</td>
<td>0</td>
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<td>21</td>
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<td>5</td>
<td>23</td>
<td>0</td>
<td>0</td>
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<td>3450</td>
<td>20</td>
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<td>4.9</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>3050</td>
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<tr>
<td>Avg. of 3 RR Varieties</td>
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<td>28</td>
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<td>0</td>
<td>2866</td>
<td>18</td>
<td>87</td>
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</tbody>
</table>

LSD (P=0.05) 5

\(^1\)0 = no shattering or lodging, 5 = very severe shattering or lodging.
\(^2\)Liberty Link soybean variety
Location Summary:

The Pauls Valley location was a full-season test planted on June 22nd. The test was planted into a conventional tilled seedbed. The average yield was 46bu/acre when averaged across all glyphosate resistant varieties. Yields were excellent at this location based primarily on planting date. Soybean fields planted earlier than mid-June were hit hard by the late July/early August heat and lack of rainfall. The majority of rainfall that fell in July and Aug was in the early part of July and the late part of August. This period of stress corresponded to the earlier planted soybean’s reproduction stages which resulted in yield reduction.

Table 2. Information on soil chemical properties and management practices for the Soybean Production Test at Pauls Valley, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
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<td>pH</td>
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<td>June 22, 2010</td>
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<td>Soil Test P Index</td>
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<td>Seeding Rate (seeds/foot of row)</td>
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<tr>
<td>Soil Test K Index</td>
<td>330</td>
<td>Seeding Depth (in)</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td>Irrigation</td>
<td>none</td>
</tr>
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<td></td>
<td></td>
<td>Harvest Dates</td>
<td>21-Oct</td>
</tr>
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<td></td>
<td></td>
<td>Soil Moisture at Planting</td>
<td>good</td>
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Table 3. Full-season glyphosate resistant soybean production variety trial Pauls Valley, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering Score</th>
<th>Lodging Score</th>
<th>Seed/Lb</th>
<th>Yield</th>
<th>Percent Yield</th>
<th>Trial Average</th>
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<tbody>
<tr>
<td>Morsoy Xtra 47X10</td>
<td>Cache River Valley Seed</td>
<td>4.7</td>
<td>32</td>
<td>0</td>
<td>0</td>
<td>2550</td>
<td>65</td>
<td>140</td>
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<tr>
<td>5622 RR</td>
<td>Progeny Ag Products</td>
<td>5.6</td>
<td>27</td>
<td>0</td>
<td>0</td>
<td>2700</td>
<td>62</td>
<td>133</td>
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<td>Hornbeck Seed Co.</td>
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<td>27</td>
<td>0</td>
<td>0</td>
<td>2700</td>
<td>59</td>
<td>125</td>
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<td>Terral Seed, Inc.</td>
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<td>57</td>
<td>122</td>
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<td>5650 RR</td>
<td>Progeny Ag Products</td>
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<td>29</td>
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<td>0</td>
<td>3050</td>
<td>56</td>
<td>119</td>
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<td>23</td>
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<td>0</td>
<td>2000</td>
<td>54</td>
<td>116</td>
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<tr>
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<td>Terral Seed, Inc.</td>
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<td>23</td>
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<td>0</td>
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<td>53</td>
<td>114</td>
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</tr>
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<td>Terral Seed, Inc.</td>
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<td>29</td>
<td>0</td>
<td>0</td>
<td>2450</td>
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<td>114</td>
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<td>RC4998</td>
<td>Croplan Genetics</td>
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<td>53</td>
<td>114</td>
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<td>Morsoy Xtra 52X10</td>
<td>Cache River Valley Seed</td>
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<td>52</td>
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<td>50</td>
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<td>Progeny Ag Products</td>
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<td>50</td>
<td>106</td>
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<td>Progeny Ag Products</td>
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<td>Cache River Valley Seed</td>
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<td>Cache River Valley Seed</td>
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<td>2500</td>
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<td>101</td>
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<td>47</td>
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<tr>
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<td>47</td>
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<td>45</td>
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<tr>
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<td>23</td>
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<td>23</td>
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<td>42</td>
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<td>28</td>
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<td>0</td>
<td>2450</td>
<td>42</td>
<td>89</td>
<td></td>
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<td>0</td>
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<td>39</td>
<td>84</td>
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<td>Syngenta Seeds</td>
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<td>Cache River Valley Seed</td>
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<td>26</td>
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<td>0</td>
<td>2800</td>
<td>37</td>
<td>80</td>
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<td>37</td>
<td>79</td>
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<td>75</td>
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<td>28</td>
<td>0</td>
<td>0</td>
<td>2850</td>
<td>30</td>
<td>63</td>
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</tbody>
</table>

LSD (P=0.05) 14

1* 0 = no shattering or lodging, 5 = very severe shattering or lodging.
Location Summary:

The Stillwater location was a double-crop test planted on July 12. The average yield was 23 bu/ac, which is good considering the late planting date. Yield potential was reduced from below normal precipitation in August and September.

Table 2. Information on soil chemical properties and management practices for the Soybean Production Test at Stillwater, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
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<tr>
<td>Soil Test K Index</td>
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<td>Seeding Depth (in)</td>
<td>1.5</td>
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<td></td>
<td></td>
<td>Irrigation</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Harvest Date</td>
<td>11/8/2010</td>
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<tr>
<td></td>
<td></td>
<td>Soil Moisture at Planting</td>
<td>good</td>
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</table>
Table 3. Full-season conventional and Liberty Link soybean production variety trial Stillwater, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering Score</th>
<th>Lodging Score</th>
<th>Seed/Lb</th>
<th>Yield of Trial Average bu/acre</th>
<th>LSD (P=0.05)</th>
</tr>
</thead>
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<td>13</td>
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<td>0</td>
<td>0</td>
<td>3600</td>
<td>30</td>
<td>9</td>
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<td>29</td>
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<td>3900</td>
<td>27</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>3300</td>
<td>24</td>
<td>108</td>
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<td>University of Arkansas</td>
<td>5.2</td>
<td>11</td>
<td>1</td>
<td>0</td>
<td>3300</td>
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<td>University of Arkansas</td>
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<td>Jake</td>
<td>5</td>
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<td>3400</td>
<td>22</td>
<td>98</td>
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<td>97</td>
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<td>Stoddard</td>
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<td>1</td>
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<td>3250</td>
<td>19</td>
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<td>0</td>
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<td>Hornbeck Seed Co.</td>
<td>5.5</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>3150</td>
<td>14</td>
<td>63</td>
</tr>
</tbody>
</table>

<sup>1</sup>0 = no shattering or lodging, 5 = very severe shattering or lodging.
<sup>2</sup>Liberty Link soybean variety
Location Summary:

The Webbers Falls location was a full-season test planted on May 28th. The test was planted into a conventional tilled seedbed. The average yield was 50 bu/acre when averaged across all glyphosate resistant varieties.

Table 2. Information on soil chemical properties and management practices for the Soybean Production Test at Webbers Falls, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.7</td>
<td>Planting Date</td>
<td>May 28, 2010</td>
</tr>
<tr>
<td>Soil Test P Index</td>
<td>215</td>
<td>Seeding Rate (seeds/foot of row)</td>
<td>8</td>
</tr>
<tr>
<td>Soil Test K Index</td>
<td>522</td>
<td>Seeding Depth (in)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Irrigation</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Harvest Date</td>
<td>10-Nov</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil Moisture at Planting</td>
<td>excellent</td>
</tr>
</tbody>
</table>
Table 3. Full-season glyphosate resistant soybean production variety trail Webbers Falls, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering Score</th>
<th>Lodging Score</th>
<th>Seed/Lb</th>
<th>Yield</th>
<th>Percent Yield of Trial Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>5650 RR</td>
<td>Progeny Ag Products</td>
<td>5.6</td>
<td>44</td>
<td>4</td>
<td>1</td>
<td>3650</td>
<td>69</td>
<td>139</td>
</tr>
<tr>
<td>MORSOY RT 5429</td>
<td>Cache River Valley Seed</td>
<td>5.4</td>
<td>43</td>
<td>2</td>
<td>1</td>
<td>3000</td>
<td>65</td>
<td>132</td>
</tr>
<tr>
<td>RC4998</td>
<td>Croplan Genetics</td>
<td>4.9</td>
<td>54</td>
<td>2</td>
<td>1</td>
<td>2650</td>
<td>65</td>
<td>131</td>
</tr>
<tr>
<td>HKB RY5220</td>
<td>Hornbeck Seed Co.</td>
<td>5.2</td>
<td>43</td>
<td>2</td>
<td>2</td>
<td>2800</td>
<td>62</td>
<td>125</td>
</tr>
<tr>
<td>5115 RR</td>
<td>Progeny Ag Products</td>
<td>5.1</td>
<td>58</td>
<td>4</td>
<td>1</td>
<td>2800</td>
<td>60</td>
<td>122</td>
</tr>
<tr>
<td>HKB RY4920</td>
<td>Hornbeck Seed Co.</td>
<td>4.9</td>
<td>49</td>
<td>3</td>
<td>2</td>
<td>2850</td>
<td>59</td>
<td>119</td>
</tr>
<tr>
<td>REV 57R21</td>
<td>Terral Seed, Inc.</td>
<td>5.7</td>
<td>46</td>
<td>0</td>
<td>2</td>
<td>2650</td>
<td>58</td>
<td>118</td>
</tr>
<tr>
<td>HKB R5425</td>
<td>Hornbeck Seed Co.</td>
<td>5.4</td>
<td>57</td>
<td>3</td>
<td>0</td>
<td>2600</td>
<td>58</td>
<td>117</td>
</tr>
<tr>
<td>5330 RR</td>
<td>Progeny Ag Products</td>
<td>5.3</td>
<td>44</td>
<td>2</td>
<td>1</td>
<td>2600</td>
<td>58</td>
<td>116</td>
</tr>
<tr>
<td>5622 RR</td>
<td>Progeny Ag Products</td>
<td>5.6</td>
<td>49</td>
<td>4</td>
<td>1</td>
<td>3100</td>
<td>58</td>
<td>116</td>
</tr>
<tr>
<td>HKB R5529</td>
<td>Hornbeck Seed Co.</td>
<td>5.5</td>
<td>32</td>
<td>3</td>
<td>0</td>
<td>2550</td>
<td>57</td>
<td>115</td>
</tr>
<tr>
<td>REV 49R22</td>
<td>Terral Seed, Inc.</td>
<td>4.9</td>
<td>52</td>
<td>3</td>
<td>1</td>
<td>2550</td>
<td>56</td>
<td>113</td>
</tr>
<tr>
<td>HKB R5525</td>
<td>Hornbeck Seed Co.</td>
<td>5.5</td>
<td>41</td>
<td>2</td>
<td>1</td>
<td>2650</td>
<td>55</td>
<td>111</td>
</tr>
<tr>
<td>REV 54R10</td>
<td>Terral Seed, Inc.</td>
<td>5.4</td>
<td>56</td>
<td>4</td>
<td>1</td>
<td>2900</td>
<td>54</td>
<td>109</td>
</tr>
<tr>
<td>Morsoy Xtra 49X10</td>
<td>Cache River Valley Seed</td>
<td>4.9</td>
<td>49</td>
<td>3</td>
<td>1</td>
<td>3100</td>
<td>53</td>
<td>107</td>
</tr>
<tr>
<td>S46-U6 Brand</td>
<td>Syngenta Seeds</td>
<td>4.6</td>
<td>53</td>
<td>3</td>
<td>1</td>
<td>2200</td>
<td>53</td>
<td>106</td>
</tr>
<tr>
<td>REV 48R10</td>
<td>Terral Seed, Inc.</td>
<td>4.8</td>
<td>43</td>
<td>3</td>
<td>2</td>
<td>2500</td>
<td>53</td>
<td>106</td>
</tr>
<tr>
<td>REV 49R11</td>
<td>Terral Seed, Inc.</td>
<td>4.9</td>
<td>47</td>
<td>2</td>
<td>1</td>
<td>2250</td>
<td>51</td>
<td>104</td>
</tr>
<tr>
<td>MORSOY RT 5388N</td>
<td>Cache River Valley Seed</td>
<td>5.3</td>
<td>40</td>
<td>2</td>
<td>1</td>
<td>3600</td>
<td>51</td>
<td>103</td>
</tr>
<tr>
<td>REV 48R22</td>
<td>Terral Seed, Inc.</td>
<td>4.8</td>
<td>48</td>
<td>3</td>
<td>1</td>
<td>2150</td>
<td>51</td>
<td>103</td>
</tr>
<tr>
<td>5706 RR</td>
<td>Progeny Ag Products</td>
<td>5.7</td>
<td>45</td>
<td>4</td>
<td>1</td>
<td>2950</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>RC 50075</td>
<td>Croplan Genetics</td>
<td>5.0</td>
<td>43</td>
<td>4</td>
<td>1</td>
<td>3000</td>
<td>49</td>
<td>100</td>
</tr>
<tr>
<td>5218 RR</td>
<td>Progeny Ag Products</td>
<td>5.2</td>
<td>43</td>
<td>2</td>
<td>1</td>
<td>2400</td>
<td>49</td>
<td>99</td>
</tr>
<tr>
<td>MORSOY RTS 4955N</td>
<td>Cache River Valley Seed</td>
<td>4.9</td>
<td>55</td>
<td>3</td>
<td>1</td>
<td>2400</td>
<td>47</td>
<td>94</td>
</tr>
<tr>
<td>4807 RR</td>
<td>Progeny Ag Products</td>
<td>4.8</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>2350</td>
<td>46</td>
<td>94</td>
</tr>
<tr>
<td>REV 48R21</td>
<td>Terral Seed, Inc.</td>
<td>4.8</td>
<td>49</td>
<td>2</td>
<td>1</td>
<td>2800</td>
<td>46</td>
<td>92</td>
</tr>
<tr>
<td>HKB R4924</td>
<td>Hornbeck Seed Co.</td>
<td>4.9</td>
<td>57</td>
<td>4</td>
<td>1</td>
<td>2850</td>
<td>46</td>
<td>92</td>
</tr>
<tr>
<td>4908 RR</td>
<td>Progeny Ag Products</td>
<td>4.9</td>
<td>51</td>
<td>4</td>
<td>1</td>
<td>2650</td>
<td>46</td>
<td>92</td>
</tr>
<tr>
<td>HKB R4729</td>
<td>Hornbeck Seed Co.</td>
<td>4.7</td>
<td>47</td>
<td>4</td>
<td>1</td>
<td>2600</td>
<td>45</td>
<td>91</td>
</tr>
<tr>
<td>REV 49R10</td>
<td>Terral Seed, Inc.</td>
<td>4.9</td>
<td>59</td>
<td>4</td>
<td>1</td>
<td>2350</td>
<td>45</td>
<td>91</td>
</tr>
<tr>
<td>REV 44R22</td>
<td>Terral Seed, Inc.</td>
<td>4.4</td>
<td>42</td>
<td>2</td>
<td>1</td>
<td>2400</td>
<td>45</td>
<td>91</td>
</tr>
<tr>
<td>REV 56R21</td>
<td>Terral Seed, Inc.</td>
<td>5.6</td>
<td>40</td>
<td>2</td>
<td>1</td>
<td>3200</td>
<td>45</td>
<td>90</td>
</tr>
<tr>
<td>REV 47R22</td>
<td>Terral Seed, Inc.</td>
<td>4.7</td>
<td>49</td>
<td>2</td>
<td>2</td>
<td>2550</td>
<td>44</td>
<td>89</td>
</tr>
<tr>
<td>Morsoy Xtra 54X10</td>
<td>Cache River Valley Seed</td>
<td>5.4</td>
<td>48</td>
<td>4</td>
<td>1</td>
<td>2900</td>
<td>43</td>
<td>86</td>
</tr>
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<td>4906 RR</td>
<td>Progeny Ag Products</td>
<td>4.9</td>
<td>53</td>
<td>4</td>
<td>1</td>
<td>2850</td>
<td>42</td>
<td>86</td>
</tr>
<tr>
<td>Morsoy Xtra 47X10</td>
<td>Cache River Valley Seed</td>
<td>4.7</td>
<td>52</td>
<td>3</td>
<td>1</td>
<td>2550</td>
<td>42</td>
<td>84</td>
</tr>
<tr>
<td>MORSOY RTS 4824</td>
<td>Cache River Valley Seed</td>
<td>4.8</td>
<td>50</td>
<td>3</td>
<td>1</td>
<td>2750</td>
<td>40</td>
<td>81</td>
</tr>
<tr>
<td>REV 45R10</td>
<td>Terral Seed, Inc.</td>
<td>4.5</td>
<td>57</td>
<td>3</td>
<td>1</td>
<td>2850</td>
<td>39</td>
<td>79</td>
</tr>
<tr>
<td>Morsoy Xtra 52X10</td>
<td>Cache River Valley Seed</td>
<td>5.2</td>
<td>37</td>
<td>4</td>
<td>2</td>
<td>3700</td>
<td>37</td>
<td>74</td>
</tr>
<tr>
<td>S51-T8 Brand</td>
<td>Syngenta Seeds</td>
<td>5.1</td>
<td>56</td>
<td>2</td>
<td>1</td>
<td>2400</td>
<td>34</td>
<td>69</td>
</tr>
<tr>
<td>4949 RR</td>
<td>Progeny Ag Products</td>
<td>4.9</td>
<td>48</td>
<td>4</td>
<td>2</td>
<td>2650</td>
<td>33</td>
<td>66</td>
</tr>
<tr>
<td>S49-AS Brand</td>
<td>Syngenta Seeds</td>
<td>4.9</td>
<td>54</td>
<td>4</td>
<td>1</td>
<td>2800</td>
<td>25</td>
<td>51</td>
</tr>
</tbody>
</table>

LSD (P=0.05) 9

1 = no shattering or lodging, 5 = very severe shattering or lodging.
Table 4. Full-season conventional and Liberty Link soybean production variety trial Webbers Falls, OK 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Company</th>
<th>Maturity Group</th>
<th>Height</th>
<th>Shattering Score</th>
<th>Lodging Score</th>
<th>Seed/Lb</th>
<th>Yield</th>
<th>Percent Yield of Trial Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. of 3 RR Varieties</td>
<td></td>
<td>4.8-5.5</td>
<td>46</td>
<td>3</td>
<td>1</td>
<td>2500</td>
<td>44</td>
<td>187</td>
</tr>
<tr>
<td>Stoddard</td>
<td>Hornbeck Seed Co.</td>
<td>5</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>2700</td>
<td>30</td>
<td>128</td>
</tr>
<tr>
<td>HALO 5:25</td>
<td>Hornbeck Seed Co.</td>
<td>5.2</td>
<td>36</td>
<td>2</td>
<td>0</td>
<td>2350</td>
<td>30</td>
<td>127</td>
</tr>
<tr>
<td>Ozark</td>
<td>University of Arkansas</td>
<td>5.2</td>
<td>38</td>
<td>0</td>
<td>2</td>
<td>2200</td>
<td>22</td>
<td>95</td>
</tr>
<tr>
<td>UA 4910</td>
<td>University of Arkansas</td>
<td>4.9</td>
<td>37</td>
<td>1</td>
<td>0</td>
<td>2450</td>
<td>20</td>
<td>85</td>
</tr>
<tr>
<td>Glenn</td>
<td>Hornbeck Seed Co.</td>
<td>4.9</td>
<td>42</td>
<td>2</td>
<td>1</td>
<td>2300</td>
<td>19</td>
<td>80</td>
</tr>
<tr>
<td>HALO 4:94</td>
<td>Hornbeck Seed Co.</td>
<td>4.9</td>
<td>33</td>
<td>1</td>
<td>0</td>
<td>2900</td>
<td>17</td>
<td>74</td>
</tr>
<tr>
<td>Hutcheson</td>
<td>University of Arkansas</td>
<td>5.5</td>
<td>30</td>
<td>1</td>
<td>1</td>
<td>2350</td>
<td>17</td>
<td>74</td>
</tr>
<tr>
<td>UA 4805</td>
<td>University of Arkansas</td>
<td>5.6</td>
<td>30</td>
<td>0</td>
<td>1</td>
<td>2350</td>
<td>14</td>
<td>61</td>
</tr>
<tr>
<td>Osage</td>
<td>Hornbeck Seed Co.</td>
<td>5.0</td>
<td>46</td>
<td>3</td>
<td>0</td>
<td>1850</td>
<td>14</td>
<td>58</td>
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<tr>
<td>HBK C 5025</td>
<td>Hornbeck Seed Co.</td>
<td>5.5</td>
<td>46</td>
<td>4</td>
<td>0</td>
<td>2350</td>
<td>12</td>
<td>50</td>
</tr>
<tr>
<td>Jake</td>
<td>Hornbeck Seed Co.</td>
<td>5</td>
<td>32</td>
<td>2</td>
<td>1</td>
<td>2050</td>
<td>7</td>
<td>30</td>
</tr>
</tbody>
</table>

LSD (P=0.05) 9

1 = no shattering or lodging, 5 = very severe shattering or lodging.
2 Liberty Link soybean variety
2010 Sunflower Performance Tests

C.B. Godsey
B. Heister
W. Vaughan
R. Kochenower

Oklahoma State University
Department of Plant and Soil Sciences
Production Technology Report
PT 2011-2
Cooperators
Brent Rendel, Ottawa County Producer
Ed Regier, Garfield County Producer
Jeff Bedwell, Garfield County Extension Educator

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Characteristics of entries...............................................................5

2010 results by location
Enid...............................................................................................6
Goodwell.........................................................................................8
Miami.........................................................................................10
Information on Sunflower Performance Trials
Numerous hybrids were evaluated in performance tests during 2010. Commercially available hybrids and experimental lines were included within the tests. Tests were designed to provide information to assist producers in identifying superior hybrids and make crop management decisions.

Hybrids of private seed company origin are submitted based on decisions by the respective company and hybrid characteristics listed were provided by the companies (Table 2).

Methods
Test locations were near Miami, Enid, and Goodwell. All test plots were planted using four or two 30-inch rows (2 row Goodwell) that were 25 feet long. Plots were seeded at a rate of 18,000-21,000 seeds/ac depending on location. Tests were conducted using randomized complete block design with four replications. Irrigation was used only at the Goodwell location. Two rows the entire length of the plot was harvested with a small plot combine to determine grain yield.

Interpreting Data
Details of establishment and management of each test are listed in footnotes below the tables. Least significant differences (LSD) are listed at the bottom of all but the Performance Summary tables. Differences between varieties are significant only if they are equal to or greater than the LSD value. If a given variety out yields another variety by as much or more than the LSD value, then we are 95% sure that the yield difference is real, with only a 5% probability that the difference is due to chance alone. For example, if variety X is 200 lb/ac higher in yield than variety Y, then this difference is statistically significant if the LSD is 200 or less. If the LSD is 200 or greater, then we are less confident that variety X really is higher yielding than variety Y under the conditions of the test.

Results reported here should be representative of what might occur throughout the state but would be most applicable under environmental and management conditions similar to those of the tests. The relative yields of all sunflower hybrids are affected by crop management and by environmental factors including soil type, summer conditions, soil moisture conditions, diseases, and insects.

Additional information on the Web
A copy of this publication as well as additional information and more information on sunflower management can be found at

http://oilseeds.okstate.edu/
### Table 1. Sources of Seed for the 2010 Sunflower Performance Tests.

<table>
<thead>
<tr>
<th>Source</th>
<th>Address</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Croplan Genetics</td>
<td>525 55th ST SE Minot, ND 58701</td>
<td>701-852-3556</td>
</tr>
<tr>
<td>Syngenta</td>
<td>4102 Timberline Dr. Fargo, ND 58104</td>
<td><a href="http://www.syngenta.com">www.syngenta.com</a></td>
</tr>
<tr>
<td>Mycogen Seeds</td>
<td>1614 Safford Ave. Garden City, KS 67846</td>
<td>1-800-MYCOGEN</td>
</tr>
<tr>
<td>Seeds 2000</td>
<td>115 North 3rd St. Breckenridge, MN 56520</td>
<td>218-643-2410</td>
</tr>
<tr>
<td>Advanta US, Inc.</td>
<td>6109 53rd Ave. SW Fargo, ND 58104</td>
<td>701-282-2952</td>
</tr>
<tr>
<td>Triumph Seed Co., Inc</td>
<td>PO Box 1050 Ralls, TX 79357</td>
<td>888-521-7333</td>
</tr>
</tbody>
</table>
Table 2. Characteristics of sunflower hybrids (provided by the company) entered in the 2010 performance trials.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Company</th>
<th>Maturity</th>
<th>Oil Type</th>
<th>Oil Content</th>
<th>Plant Height</th>
<th>Disease Resistance</th>
<th>Herbicide Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP462NS</td>
<td>Advanta US Inc.</td>
<td>105</td>
<td>NuSun</td>
<td>- - % - -</td>
<td>- - in - -</td>
<td>Phoma, Phomopsis</td>
<td>Clearfield</td>
</tr>
<tr>
<td>F51122NS,CL</td>
<td>Advanta US Inc.</td>
<td>mid-late</td>
<td>NuSun</td>
<td>- - % - -</td>
<td>- - in - -</td>
<td>Phomopsis</td>
<td>Clearfield</td>
</tr>
<tr>
<td>F30008NS,CL</td>
<td>Advanta US Inc.</td>
<td>99</td>
<td>NuSun</td>
<td>- - % - -</td>
<td>- - in - -</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>CG 30 30</td>
<td>Croplan Genetics</td>
<td>90</td>
<td>NuSun</td>
<td>48</td>
<td>medium</td>
<td>Downy Mildew</td>
<td>Express</td>
</tr>
<tr>
<td>CG 356A NS</td>
<td>Croplan Genetics</td>
<td>95</td>
<td>NuSun</td>
<td>46</td>
<td>short</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>CG 460 E NS</td>
<td>Croplan Genetics</td>
<td>95</td>
<td>NuSun</td>
<td>48</td>
<td>medium</td>
<td>Downy Mildew</td>
<td>Express</td>
</tr>
<tr>
<td>CG 559 CL DMR NS</td>
<td>Croplan Genetics</td>
<td>94</td>
<td>NuSun</td>
<td>46</td>
<td>med-tall</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
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<tr>
<td>4651 NS/DM</td>
<td>Syngenta</td>
<td>87</td>
<td>NuSun</td>
<td>46</td>
<td>short</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>3732 NS</td>
<td>Syngenta</td>
<td>100</td>
<td>NuSun</td>
<td>43</td>
<td>62</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>3845 HO</td>
<td>Syngenta</td>
<td>105</td>
<td>High Oleic</td>
<td>45</td>
<td>62</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>3980 NSCL</td>
<td>Syngenta</td>
<td></td>
<td>NuSun</td>
<td>44</td>
<td></td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>8N453DM</td>
<td>Mycogen Seeds</td>
<td>97</td>
<td>NuSun</td>
<td>45</td>
<td>62</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>8N443DM</td>
<td>Mycogen Seeds</td>
<td>96</td>
<td>NuSun</td>
<td>45</td>
<td>62</td>
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<td>Clearfield</td>
</tr>
<tr>
<td>8H449DM</td>
<td>Mycogen Seeds</td>
<td>97</td>
<td>High Oleic</td>
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<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>8N510</td>
<td>Mycogen Seeds</td>
<td>100</td>
<td>NuSun</td>
<td>40</td>
<td>59</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
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<td>Seeds 2000 Inc.</td>
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<td>NuSun</td>
<td>43-45</td>
<td>62</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>SIERRA</td>
<td>Seeds 2000 Inc.</td>
<td>97</td>
<td>High Oleic</td>
<td>43-45</td>
<td>65</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>Firebird</td>
<td>Seeds 2000 Inc.</td>
<td>98</td>
<td>NuSun</td>
<td>42-44</td>
<td>60</td>
<td>Downy Mildew</td>
<td>Express</td>
</tr>
<tr>
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<td>Seeds 2000 Inc.</td>
<td>95</td>
<td>NuSun</td>
<td>43-45</td>
<td>62</td>
<td>Downy Mildew</td>
<td>Clearfield</td>
</tr>
<tr>
<td>X9464</td>
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<td>High Oleic</td>
<td></td>
<td></td>
<td>Rust</td>
<td>Clearfield</td>
</tr>
<tr>
<td>s671</td>
<td>Triumph Seed Co.</td>
<td>94-104</td>
<td>NuSun</td>
<td>44-48</td>
<td>Short stature (38-44)</td>
<td>Rust</td>
<td>Clearfield</td>
</tr>
<tr>
<td>s674</td>
<td>Triumph Seed Co.</td>
<td>94-104</td>
<td>NuSun</td>
<td>45-49</td>
<td>Short stature (38-44)</td>
<td>Rust</td>
<td>Clearfield</td>
</tr>
<tr>
<td>s878HO</td>
<td>Triumph Seed Co.</td>
<td>96-106</td>
<td>High Oleic</td>
<td>43-47</td>
<td>Short stature (48-54)</td>
<td>Rust</td>
<td>Clearfield</td>
</tr>
<tr>
<td>s668</td>
<td>Triumph Seed Co.</td>
<td>96-106</td>
<td>NuSun</td>
<td>45-49</td>
<td>Short stature (42-48)</td>
<td>Rust</td>
<td>Clearfield</td>
</tr>
<tr>
<td>s673</td>
<td>Triumph Seed Co.</td>
<td>94-104</td>
<td>NuSun</td>
<td>44-48</td>
<td>Short stature (40-46)</td>
<td>Rust</td>
<td>Clearfield</td>
</tr>
<tr>
<td>859 CL</td>
<td>Triumph Seed Co.</td>
<td>95-105</td>
<td>High Oleic</td>
<td>42-46</td>
<td>55-65</td>
<td>Rust</td>
<td>Clearfield</td>
</tr>
</tbody>
</table>
**Location Summary:**

The Enid location was a double-crop test planted on June 24th. Plots were direct seeded into a long-term no-till field. The average yield was 1028 lb/acre when averaged across all varieties. This test was affected by a wind storm around mid bloom that caused some lodging, especially in the taller hybrids. The yield potential of this test was hurt by the below normal precipitation in August and September but overall yields were good for a double crop.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>na</td>
<td>Planting Date</td>
<td>June 24, 2011</td>
</tr>
<tr>
<td>Soil Test P Index</td>
<td>na</td>
<td>Harvest Date</td>
<td>October 28, 2011</td>
</tr>
<tr>
<td>Soil Test K Index</td>
<td>na</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous Crop</td>
<td></td>
<td></td>
<td>winter wheat</td>
</tr>
<tr>
<td>Fertilizer Applied</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>Herbicide Applications</td>
<td>Prowl H₂O and Spartan pre-plant</td>
</tr>
<tr>
<td>P</td>
<td>0</td>
<td>Pesticide Applications</td>
<td>with glyphosate</td>
</tr>
<tr>
<td>K</td>
<td>0</td>
<td>Harvest Aid</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 time</td>
</tr>
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Table 4. Sunflower growth characteristics, oil content, and yield for 2010 near Enid, OK.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Company</th>
<th>Lodging†</th>
<th>Height</th>
<th>Oil‡</th>
<th>Yield</th>
<th>Percent of Trial Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>s671</td>
<td>Triumph Seed Co.</td>
<td>0</td>
<td>34</td>
<td>40</td>
<td>1883</td>
<td>183</td>
</tr>
<tr>
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<td>1665</td>
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<tr>
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<td>122</td>
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<td>Advanta US Inc.</td>
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<td>47</td>
<td>36</td>
<td>1235</td>
<td>120</td>
</tr>
<tr>
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<td>Syngenta</td>
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<td>47</td>
<td>37</td>
<td>1224</td>
<td>119</td>
</tr>
<tr>
<td>3980 NSCL</td>
<td>Syngenta</td>
<td>1</td>
<td>43</td>
<td>35</td>
<td>1223</td>
<td>119</td>
</tr>
<tr>
<td>8N433DM</td>
<td>Mycogen Seeds</td>
<td>1</td>
<td>47</td>
<td>39</td>
<td>1196</td>
<td>116</td>
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<tr>
<td>s673</td>
<td>Triumph Seed Co.</td>
<td>0</td>
<td>40</td>
<td>40</td>
<td>1178</td>
<td>115</td>
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<tr>
<td>s878HO</td>
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<td>1</td>
<td>43</td>
<td>35</td>
<td>1095</td>
<td>106</td>
</tr>
<tr>
<td>3080 DMR NS</td>
<td>Croplan Genetics</td>
<td>0</td>
<td>42</td>
<td>41</td>
<td>1078</td>
<td>105</td>
</tr>
<tr>
<td>306 DMR NS</td>
<td>Croplan Genetics</td>
<td>2</td>
<td>46</td>
<td>40</td>
<td>1073</td>
<td>104</td>
</tr>
<tr>
<td>8N510</td>
<td>Mycogen Seeds</td>
<td>1</td>
<td>46</td>
<td>35</td>
<td>1007</td>
<td>98</td>
</tr>
<tr>
<td>Sierra</td>
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<td>45</td>
<td>34</td>
<td>991</td>
<td>96</td>
</tr>
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<td>35</td>
<td>967</td>
<td>94</td>
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<td>33</td>
<td>921</td>
<td>90</td>
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<td>868</td>
<td>84</td>
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<td>35</td>
<td>858</td>
<td>83</td>
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<tr>
<td>559 CL DMR NS</td>
<td>Croplan Genetics</td>
<td>1</td>
<td>47</td>
<td>35</td>
<td>844</td>
<td>82</td>
</tr>
<tr>
<td>356A NS</td>
<td>Croplan Genetics</td>
<td>1</td>
<td>45</td>
<td>39</td>
<td>806</td>
<td>78</td>
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<td>50</td>
<td>36</td>
<td>721</td>
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<td>46</td>
<td>38</td>
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<td>70</td>
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<td>694</td>
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<td>4651 NS/DM</td>
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<td>3</td>
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<td>34</td>
<td>552</td>
<td>54</td>
</tr>
<tr>
<td>3845 HO</td>
<td>Syngenta</td>
<td>3</td>
<td>41</td>
<td>37</td>
<td>528</td>
<td>51</td>
</tr>
</tbody>
</table>

LSD (P=0.05) 324
Trial Mean 36 1028

† Lodging is based on a scale of 1 to 5, with 5 being the most severe.
‡ Oil analysis was performed on one composite sample, so statistical analysis was not possible.
Location Summary:

The trial near Miami was planted on 30 inch beds. The sunflower seemed to perform well on the beds that created a more favorable environment early in the growing season. Yields at Miami in 2010 were good, especially in the top group of hybrids. Average yield, when averaged across hybrid, was 1150 lb/ac and average oil percentage was 45%. Yield was reduced by head clipping weevil in the field. The lack of rainfall in August most likely reduced yield potential.

Table 5. Information on soil chemical properties and management practices for the Dryland Sunflower Performance Test near Miami, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
<tbody>
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<tr>
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<td>19</td>
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<td>September 23, 2011</td>
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</tr>
<tr>
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<td></td>
<td>Previous Crop</td>
<td>Soybean</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>Herbicide Applications</td>
<td>Spartan and Prowl H₂O</td>
</tr>
<tr>
<td>P</td>
<td>40</td>
<td>Pesticide Applications</td>
<td>June 29, 2011</td>
</tr>
<tr>
<td>K</td>
<td>50</td>
<td>Harvest Aid</td>
<td>Yes - Glyphosate</td>
</tr>
</tbody>
</table>
Table 6. Sunflower growth characteristics, oil content, and yield for 2010 near Miami, OK.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Company</th>
<th>Lodging†</th>
<th>Height</th>
<th>Oil‡</th>
<th>Yield</th>
<th>Percent of Trial Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>306 DMR NS</td>
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<td>0</td>
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<td>1</td>
<td>44</td>
<td>43</td>
<td>1332</td>
<td>116</td>
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<tr>
<td>4651 NS/DM</td>
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<td>46</td>
<td>47</td>
<td>1248</td>
<td>108</td>
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<td>460 E NS</td>
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<td>46</td>
<td>1246</td>
<td>108</td>
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<tr>
<td>Firebird</td>
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<td>3</td>
<td>51</td>
<td>43</td>
<td>1209</td>
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<td>46</td>
<td>1145</td>
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</tr>
<tr>
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<td>42</td>
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<td>1099</td>
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<tr>
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<td>87</td>
</tr>
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<td>Syngenta</td>
<td>3</td>
<td>48</td>
<td>44</td>
<td>960</td>
<td>83</td>
</tr>
<tr>
<td>559 CL DMR NS</td>
<td>Croplan Genetics</td>
<td>2</td>
<td>51</td>
<td>47</td>
<td>955</td>
<td>83</td>
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<td>44</td>
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<td>810</td>
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<td>43</td>
<td>735</td>
<td>64</td>
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<tr>
<td>8H499DM</td>
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<td>43</td>
<td>623</td>
<td>54</td>
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</table>

LSD (P=0.05) 598
Trial Mean 45 1150

† Lodging is based on a scale of 1 to 5, with 5 being the most severe.
‡Oil analysis was performed on one composite sample, so statistical analysis was not possible.
Location Summary:

This trial was planted after wheat. Yields at Goodwell in 2010 were a little lower than average. Average yield, when averaged across hybrid, was 1045 lb/ac.

Table 7. Information on soil chemical properties and management practices for the Irrigated Sunflower Performance Test near Goodwell, OK in 2010.

<table>
<thead>
<tr>
<th>Soil Properties</th>
<th>Result</th>
<th>Cultural Practice</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
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<td>Planting Date</td>
<td>July 13, 2011</td>
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<tr>
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† Fertilizer was applied to the preceding wheat crop but sufficient amount of residual N should have been present.
Table 8. Sunflower growth characteristics, oil content, and yield for 2010 near Goodwell, OK.

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| LSD (P=0.05) | 2   | 350  |
| Trial Mean   | 39  | 1045 |

† Lodging is based on a scale of 1 to 5, with 5 being the most severe.
OKLAHOMA SMALL GRAINS
EXTENSION

VARIETY PERFORMANCE TESTS

2009-2010

J.T. Edwards
R.D. Kochenower
R.E. Austin
J.D. Ladd
B.F. Carver
R.M. Hunger
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Seed donated by:
AgriPro Wheat, Vernon, TX
WestBred LLC, Haven, KS

Farmer cooperators for each location are listed in the heading of each summary sheet. In addition, we thank the following who donated land, resources and time, but whose variety trial location was not harvestable due to environmental factors such as drought.

Don Schieber, Kildare

Carl Simon, Elk City
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Protein data will be reported in a separate publication in August of 2010

This and other wheat–related publications can be found at:

www.wheat.okstate.edu
2010 WHEAT CROP OVERVIEW

From an agronomic perspective, the 2009-2010 Oklahoma wheat crop was a huge improvement over the previous year. While final production numbers are not available at the time of this report, it is likely that Oklahoma wheat production will exceed 140 million bushels in 2010, which is roughly double the amount produced in 2009. Unfortunately, excess world ending stocks, a depressed world economy, and lower-than-optimal protein resulted in at-harvest cash prices under $3.00 in many areas of the state.

Planting was in full swing in southwest Oklahoma shortly after Labor Day, and most fields in this region had adequate moisture for emergence and fall forage growth. Timely planting was much more of a challenge in northcentral Oklahoma, however, due to wet soil conditions throughout much of October. Challenges presented by wet soil conditions in the region were compounded by rotational crops planted after failed wheat in the spring of 2009. Yields and prices for these rotational and double-crops were generally good, but the later maturity of these crops prevented wheat sowing in many cases. Similarly, very little wheat was sown in northeastern Oklahoma because of wet conditions and rotational crops that were not harvested in time to sow wheat. Conditions in northwestern Oklahoma and the Panhandle were mostly favorable for wheat sowing in 2009, but dry conditions in the region restricted fall forage growth. Hardest hit by dry conditions were parts of Beaver, Harper, and Woods counties which experienced moderate to severe drought conditions throughout the growing season.

With the exception of northwestern Oklahoma and the Panhandle, the wet conditions last fall persisted through the winter with significant amounts of ice and/or snow. Bitter cold temperatures resulted in winter kill of early-sown wheat that had outpaced cattle stocking density and late-sown wheat that had not established an adequate root system. Cool temperatures prevailed during the spring of 2010, which slowed crop development somewhat but also increased grain yield potential. A brief cold snap during April resulted in some slight freeze injury, but there were no reports of widespread losses from freeze in Oklahoma. May was marked by severe hail storms that were devastating in localized areas. By the first of June, heat had returned and harvest was in full swing. Most of southwest Oklahoma was harvested by June 8, but lingering rain showers and high humidity brought harvest to a crawl during mid June. Heat and dry air returned by June 18 and harvest quickly resumed at full pace. Most of the state was harvested by June 30.

A large portion of the Oklahoma wheat crop was nitrogen deficient in 2009-2010. There are several reasons for this. First, many producers were coming off of several years of poor production and/or crop failures and were simply not in a sound enough cash flow situation to purchase nitrogen in the quantities the crop needed. Second, the wet soil conditions during fall and winter resulted in nitrogen leaching in some areas and inadequate root growth to access nitrogen that had been moved lower in the profile. The wet soil conditions also prevented topdress application of nitrogen fertilizer, especially in southwestern Oklahoma. Some producers attempted to address the issue by aerially applying 25 – 30 lbs./A nitrogen, which probably helped. Still others applied N in quantities under 10 lbs./A, which probably did not help grain yield much. Finally, the cold winter and cool spring did not provide much opportunity for nitrogen mineralization from previous crop residue. Research has shown that this can be a significant source of nitrogen for wheat, but favorable soil conditions for microbial activity are required for that to happen.

Weeds were a major wheat production factor in 2010, just as they have been for over twenty years; however, a few changes occurred during the 2009-2010 crop year. The presence of ALS-resistant ryegrass and cheat were confirmed in the state of Oklahoma, with some ryegrass samples showing signs of resistance to ACCCase inhibitors as well. The other big change in the wheat industry is the strict enforcement of stringent dockage discount schedules at the elevator. Once word of the dockage schedules was released, some producers with extremely weedy fields chose to cut them for hay even though the wheat was past the optimal growth for doing so. One promising development during the crop year, however, was an increase in acreage sown to winter canola and other rotational crops. Crop rotation is the best long-term, weed-control strategy available to producers and it is reassuring to see more acres being rotated.

The fall of 2009 was relatively quiet in terms of insect activity. There were isolated reports of winter grain mite and brown wheat mite activity and a few fields were sprayed for aphids. There were several reports of spraying for greenbugs and bird cherry oat aphids in February, March and April of 2010. The
amount of Barley Yellow Dwarf Virus (BYDV) that became evident in April and May of 2010, indicated that most of these applications were well-justified. BYDV symptoms such as yellowing and purpling of leaves were not hard to find. There was not much stunting of plants, however, indicating that most of the infections occurred after the first of the year. Hessian fly was a factor in 2009-2010, but there were not as many reports of crops being completely devastated by Hessian fly as was the case in 2008-2009. Some of this can likely be attributed to farmers being more aware of Hessian fly and using seed treatments and/or resistant varieties in fields likely to be affected by Hessian fly.

The cold winter prevented fall leaf-rust infestations from overwintering, and for a while, it seemed that foliar disease pressure in Oklahoma could be fairly light. Reports from Texas early in the season, however, clearly indicated that something was different this year. Varieties such as Jagger and Jagalene that had been very resistant to stripe rust in the past were being hammered by stripe rust. By late March, it was clear that the predominant stripe rust race had shifted and the resistance gene(s) in Jagger that had held out so long could no longer be relied upon for protection. By mid April, Jagger and Jagalene plots were completely devastated by stripe rust and could be picked out from a distance at Frederick and Olustee variety trials. Warmer temperatures and drier plant canopies prevailed by late April and much of the concern shifted to leaf rust. Powdery mildew was present as well in susceptible varieties. Consequently, significant application of foliar fungicides occurred in Oklahoma to help limit losses from foliar disease in 2010.

Wheat quality was a concern in 2010. Dockage schedules were strictly enforced by elevators and made clear to producers that weed-infested wheat fields were costing them more than just grain yield. A surplus of wheat on the world market meant that buyers could pick and choose, and many buyers chose not to purchase wheat that was less than 12% protein. Much of the Oklahoma crop fell below this benchmark and left elevator managers and producers scrambling to market the 2010 crop.

Methods

Cultural Practices. Conventional plots were eight rows wide with six-inch row spacing. No-till plots were seven rows wide with 7.5-inch row spacing. Plots were 20 feet long. Conventional till plots received 50 lb/ac of 18-46-0 in-furrow at planting. No-till plots received 5 gal/ac of 10-34-0 at planting. The El Reno and Marshall dual-purpose (DP) trials were sown at 120 lb/ac. All other locations were sown at 60 lb/ac. Grazing pressure, nitrogen fertilization, and insect and weed control decisions were made on a location-by-location basis and reflect standard management practices for the area.

Additional information on the Web

A copy of this publication as well as additional variety information and more information on wheat management can be found at www.wheat.okstate.edu

Marketing rights

Breeding programs responsible for varietal release are indicated as the “source” in results tables. In many cases, however, a separate entity has the marketing rights for these varieties. For this reason, a list of wheat seed companies and the varieties they market is provided below.

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Deliver
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Oklahoma Cooperative Extension Service publication CR-2143

Partial financial support provided by the Oklahoma Wheat Commission
## 2010 Oklahoma Wheat Variety Trial Summary

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| Mean          | 19      | 40        | 75     | 42    | 52         | 25    | 30           | 43     | 45          | 36          | 42      |
| LSD (0.05)    | 6       | 5         | 5      | 7     | 4          | 4    | 4            | 4      | 6           | 6           | 5       |

Oklahoma Cooperative Extension Service publication CR-2143  Partial financial support provided by the Oklahoma Wheat Commission
Afton Wheat Variety Trial

Cooperator: Greg Leonard  
Tillage: Conventional till  
Soil type: Parsons silt loam  
Management: Grain only  
Planting date: 11-12-09  
Previous crop: Corn  
Harvest date: 6-24-10  
Soil test: pH = 7.1, P = 164, K = 266

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## Alva Wheat Variety Trial

Cooperator: Wes Mallory  
Tillage: Conventional till  
Soil type: Grant silt loam  
Management: Grain only  
Planting date: 10-26-09  
Previous crop: Wheat  
Harvest date: 6-21-10  
Soil test: pH = 6.2, P = 109, K = 586

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## Apache Wheat Variety Trial

Cooperator: Bryan Vail  
Management: No-till grain only  
Soil type: Hollister silt loam  
Soil test: pH = 5.9, P = 73, K = 571  
Planting date: 10-26-09  
Previous crop: Soybean  
Harvest date: 6-09-10  
Fungicide = 10 oz/A Stratego on 20 April 2010  

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OK05511
Mean
LSD (0.05)
## Balko Wheat Variety Trial

Cooperator: Johnny Lane  
Tillage: Conventional till  
Soil type: Ulysses-Richfield complex  
Management: Grain only  
Planting date: 9-25-09  
Previous crop: Wheat/fallow  
Harvest date: 6-25-10  
Soil test: pH = 7.6, P = 28, K = 926

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* Shatter ratings recorded at harvest using a 0 - 10 scale, with 0 indicating no shattering and 10 indicating severe shattering
**Buffalo Wheat Variety Trial**

Cooperator: NRCS  
Soil type: St. Paul silt loam  
Planting date: 10-16-09  
Harvest date: 6-21-10  
Tillage: Conventional till  
Management: Grain only  
Previous crop: Wheat  
Soil test: pH = 7.2, P = 60, K = 664

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| Mean        | 27      | 44     | 49     | 57.9    |         |             |
| LSD (0.05)  | 9       | 5      | 4      | 1.0     |         |             |
# Cherokee Wheat Variety Trial

Cooperator: Kenneth Failes  
Tillage: Conventional till  
Soil type: Dale silt loam  
Management: Grain Only  
Planting date: 10-26-09  
Previous crop: Wheat  
Harvest date: 6-18-10  
Soil test: pH = 6.1, P = 109, K = 715

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## El Reno Wheat Variety Trial

**Cooperator:** Bornemann Farms  
**Tillage:** Conventional till  
**Soil type:** Pond Creek silt loam  
**Management:** Dual Purpose  
**Planting date:** 9-29-09  
**Previous crop:** Wheat  
**Harvest date:** 6-10-10  
**Soil test:** pH = 6.5, P = 59, K = 354

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# Frederick Wheat Variety Trial

Cooperator: Great Plains Technology Center  
Tillage: Conventional till  
Soil type: Tillman and Foard silt loam  
Management: Grain only  
Planting date: 10-20-09  
Previous crop: Fallow  
Harvest date: 6-04-10  
Soil test: pH = 8.0, P = 31, K = 806

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## Gage Wheat Variety Trial

**Cooperator:** Curtis Torrance  
**Tillage:** Conventional till  
**Soil type:** St. Paul silt loam  
**Management:** Dual Purpose  
**Planting date:** 9-23-09  
**Previous crop:** Wheat  
**Harvest date:** 6-22-10  
**Soil test:** pH = 7.6, P = 52, K = 798

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* Sample size was too small in 2010 to obtain a test weight measurement
# Goodwell Irrigated Wheat Variety Trial

Cooperator: OK Panhandle Research and Extension Center  
Soil type: Richfield clay loam  
Tillage: No-till  
Planting date: 10-06-09  
Management: Grain only  
Harvest date: 6-29-10  
Previous crop: Soybean

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|                       | Mean                  | 61                  | 58.8                |
|                       | LSD (0.05)            | 7                   | 1.2                 |

(W) = Hard white wheat variety
# Goodwell Nonirrigated Wheat Variety Trial

Cooperator: OK Panhandle Research and Extension Center  
Tillage: No-till  
Soil type: Richfield clay loam  
Management: Grain only  
Previous crop: Sunflower/Fallow  
Harvest date: 6-25-10  
Soil test: pH = 7.8, P = 46, K = 105

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**Experimentals**

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(W) = Hard white wheat variety
## Haskell Wheat Variety Trial

**Cooperator:** Eastern Research Station  
**Tillage:** Conventional till  
**Management:** Grain only  
**Soil type:** Taloka silt loam  
**Previous crop:** Wheat  
**Planting date:** 11-13-09  
**Harvest date:** 6-25-10  
**Soil test:** $\text{pH} = 5.4$, $P = 33$, $K = 123$

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Partial financial support provided by the Oklahoma Wheat Commission
## Homestead Wheat Variety Trial

Cooperator: Brook Strader  
Tillage: Conventional till  
Soil type: Canadian fine sandy loam  
Management: Grain only  
Planting date: 10-27-09  
Previous crop: Wheat  
Harvest date: 6-10-10  
Soil test: pH = 5.8, P = 69, K = 632

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# Hooker Wheat Variety Trial

Cooperator: Dan Herald
Tillage: No-till
Soil type: Dalhart fine sandy loam
Management: Grain only
Previous crop: Wheat
Harvest date: 6-25-10

Soil test: \( \text{pH} = 7.3, \text{P} = 53, \text{K} = 789 \)

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* Shatter ratings recorded at harvest using a 0 - 10 scale, with 0 indicating no shattering and 10 indicating severe shattering
# Keyes Wheat Variety Trial

Cooperator: J.B. Stewart  
Tillage: Minimum-till  
Soil type: Richfield clay loam  
Management: Grain only  
Planting date: 9-25-09  
Previous crop: Wheat/Fallow  
Harvest date: 6-29-10

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| Mean                  | 42       | 41     | 36     | 60.4   |
| LSD (0.05)            | 7        | 6      | 4      | 1.3    |

* Note: all plots were treated with Headline fungicide in April
# Kingfisher Wheat Variety Trial

Cooperator: Rodney Mueggenborg  
Tillage: Conventional till  
Soil type: Tillman silt loam  
Plantsing date: 10-27-09  
Previous crop: Wheat  
Harvest date: 6-08-10  
Management: Grain only  
Soil test: pH = 6.5, P = 47, K = 501

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Mean 52 44 48 61.9

LSD (0.05) 4 3 3 0.6
# Lahoma Wheat Variety Trial

Cooperator: North Central Research Station  
Management: Grain only  
Soil type: Pond Creek Silt Loam  
Planting date: 10-28-09  
Previous crop: Wheat  
Harvest date: 6-23-10  
Fungicide = 14 oz/A Quilt on 27 April 2010

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* Sample size was too small in 2010 to obtain a test weight measurement
### Lamont Wheat Variety Trial

**Cooperator:** Kirby Farms  
**Soil type:** Pond Creek silt loam  
**Placing date:** 10-28-09  
**Harvest date:** 6-23-10  
**Tillage:** Conventional till  
**Management:** Grain only  
**Previous crop:** Wheat  
**Soil test:** pH = 5.8, P = 48, K = 481

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# Marshall Wheat Variety Trial

Cooperator: Henry Fuxa  
Tillage: Conventional till  
Previous crop: Wheat  
Soil type: Kirkland silt loam

- Planting date: 9-17-09 (Dual purpose) & 10-26-09 (Grain only)
- Harvest date: 6-10-10
- Soil test: pH = 5.3, P = 60, K = 329

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Partial financial support provided by the Oklahoma Wheat Commission
## Olustee Wheat Variety Trial

**Cooperator:** David Bush  
**Tillage:** Conventional till  
**Soil type:** Tillman silt loam  
**Management:** Grain only  
**Planting date:** 10-20-09  
**Previous crop:** Wheat  
**Harvest date:** 6-04-10  
**Soil test:** pH = 7.8, P = 23, K = 1026

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1 Scale of 0 - 10 with 0 representing no lodging or shattering and 10 representing severe lodging or shattering
Fall forage production and date of first hollow stem in winter wheat varieties during the 2009-2010 crop year

Jeff Edwards
Small Grains Extension Specialist

Richard Austin
Senior Agriculturalist

Jay Ladd
Lab Technician II

Introduction

Fall forage production potential is just one consideration in deciding which wheat variety to plant. Dual-purpose wheat producers, for example, may find varietal characteristics such as grain yield after grazing and disease resistance to be more important selection criteria than slight advantages in forage production potential. Forage-only producers might place more importance on planting an awnless wheat variety or one that germinates readily in hot soil conditions. Ultimately, fall forage production is generally not the most important selection criteria used by Oklahoma wheat growers, but it is one that should be considered.

Fall forage production by winter wheat is determined by genetic potential, management and environmental factors. The purpose of this publication is to quantify some of the genetic differences in forage production potential and grazing duration among the most popular wheat varieties grown in Oklahoma. Management factors such as planting date, seeding rate and soil fertility are very influential and are frequently more important than variety in determining forage production. Environmental factors such as rainfall and temperature also play a heavy role in dictating how much fall forage is produced. All of these factors, along with yield potential after grazing and the individual producer’s preferences, will determine which wheat variety is best suited for a particular field.

Site Descriptions and Methods

The objective of the fall forage variety trials is to give producers an indication of the fall forage production ability of wheat varieties commonly grown throughout Oklahoma. The forage trials are conducted under the umbrella of the Oklahoma State University winter wheat variety trials at the El Reno and Stillwater, OK test sites. Due to extremely wet conditions this year, however, no data were collected from the El Reno site. Weather data for the Stillwater site is provided in Figure 1.

A randomized complete block design with four replications was used at each site. Forage was measured by hand clipping two 1-meter by 1-row samples at random sites within each plot. Samples were then placed in a forced-air dryer for approximately seven days and weighed. All plots were sown at 120 lb/A in a conventionally-tilled seedbed and received 50 lb/ac of 18-46-0 in furrow at planting. Fertility, planting date and harvest date information are provided in Table 1.

Results

Varieties that have been consistent top-performers during the years were in the top yield grouping once again in 2009 (Table 2). The fact that nine out of the 26 commercially-available wheat cultivars tested were statistically equivalent in terms of forage yield indicates that farmers have a wide variety of choices when it comes to dual-purpose wheat cultivars.

Average occurrence of hollow stem was 71 days after January 1, which was approximately ten days later than typical (Table 3). This delay in onset of first hollow stem was primarily due to wet and cold conditions during most of the winter months. In addition to overall later occurrence of first hollow stem, some varieties moved places in the relative rankings. Endurance, for example, is almost always one of the last varieties to reach first hollow stem, but was medium-late this year. TAM 203 is generally an early-medium first hollow stem variety, but was late this year. The presence of wheat soil borne mosaic virus in the plot area probably explains some of the abnormalities in susceptible varieties, and there are likely several physiological and morphological plant controls impacted by the cold, wet winter. It is likely the relative occurrence of first hollow stem will be closer to normal next year.
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Shaded numbers are not statistically different from the highest-yielding variety within a column.
As mentioned in the introduction, fall forage production is only one parameter to be considered when choosing a dual-purpose wheat variety. Date of first hollow stem, for example, will determine how long fall forage production can be utilized into the spring and should be considered in conjunction with fall forage production. Varieties such as TAM 401 and Fannin are outstanding forage producers, but also have very early dates of first hollow stem. Varieties such as Doans and Endurance are not consistently as good of forage producers as TAM 401 and Fannin, but are above-average forage producers and much later to first hollow stem. Dual-purpose producers should consider these two parameters in conjunction with grain yield after grazing before making a variety choice.

Acknowledgments

The authors want to thank the Oklahoma Wheat Commission and the Oklahoma Wheat Research Foundation for providing partial funding for this research. We want to thank Don and Ray Bornemann for providing land and resources for the El Reno test site. We also acknowledge the hard work of Brad Tipton, Dillon Butchee and Casey Andrews in collecting the data presented in this report.

Table 3. Occurrence of first hollow stem (day of year) for winter wheat varieties sown in 2009 and measured in 2010 at Stillwater, Okla.

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<td>Santa Fe</td>
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