1. Nitrogen fertilization of forage sorghum

Forage sorghum is important summer annual forage for livestock in Kansas. Many farmers are planting sorghum “feed” this summer due to concerns over a potential short hay crop. A number of questions have come in regarding N fertilizer, both yield response (in light of high N costs), and the potential for high nitrates if the summer remains dry.

Current N recommendations for sudangrass, forage sorghum, and millets in Kansas are to apply 40 to 50 pounds of N per acre at planting and again after each cutting, where multiple cuttings are obtained with full-season cropping.

To re-test the validity of these recommendations, a study was initiated last summer near Randolph in Riley County. This sorghum was a brown mid-rib (BMR) hybrid, planted in mid-June. The conditions were generally good from planting until harvest July 20, with adequate, but not excessive moisture.

The yields, protein content, and nitrate concentration in the first cutting are reported in Table 1. Harvest was made at early boot stage, prior to heading. This resulted in slightly reduced yields, but very good quality forage, with protein levels exceeding 10% at recommended N rates. Nitrate levels in the forage were extremely high where the higher N rates – higher than recommended -- were applied, rendering the forage potentially toxic to cattle (>6,000 ppm nitrate is considered toxic). Thus this study confirms that N rates must be limited at planting. Applying all the N required for a full-season, multiple-cutting crop at planting is not a safe practice.

<table>
<thead>
<tr>
<th>N rate, applied as UAN at planting time, coulter banded</th>
<th>Yield, first cutting (tons dry matter/acre)</th>
<th>Protein content, %</th>
<th>Nitrate in forage (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.84</td>
<td>7.88</td>
<td>51</td>
</tr>
<tr>
<td>25 lbs N/a</td>
<td>0.98</td>
<td>7.69</td>
<td>296</td>
</tr>
<tr>
<td>50 lbs N/a</td>
<td>1.06</td>
<td>10.25</td>
<td>1,620</td>
</tr>
<tr>
<td>75 lbs N/a</td>
<td>0.94</td>
<td>10.25</td>
<td>8,600</td>
</tr>
<tr>
<td>100 lbs N/a</td>
<td>0.94</td>
<td>11.06</td>
<td>10,600</td>
</tr>
</tbody>
</table>
A number of N sources and methods of application were also compared. The results from these treatments on first cutting yields, protein content, and nitrate content are given in Table 2. All treatments were compared at the rate of 50 pounds per acre. Treatments were applied at planting time.

<table>
<thead>
<tr>
<th>N source and application method (50 lbs N/acre)</th>
<th>Yield, first cutting (tons dry matter/acre)</th>
<th>Protein content, %</th>
<th>Nitrate in forage (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAN, broadcast</td>
<td>1.01</td>
<td>9.63</td>
<td>2,540</td>
</tr>
<tr>
<td>UAN, surface banded</td>
<td>1.10</td>
<td>9.50</td>
<td>1,350</td>
</tr>
<tr>
<td>UAN, coulter banded</td>
<td>1.06</td>
<td>10.25</td>
<td>1,620</td>
</tr>
<tr>
<td>Urea, broadcast</td>
<td>1.07</td>
<td>10.00</td>
<td>4,960</td>
</tr>
</tbody>
</table>

All the products tested gave similar yields, protein levels, and nitrate contents. UAN surface banded or coulter banded, or urea broadcast, resulted in slightly higher yields than UAN broadcast. All the nitrate levels were found to be below the 6,000 ppm toxic level, though the broadcast urea was approaching that level of concern.

The data in Table 3 gives the yield and quality values for the second cutting of forage taken on September 2, 2011 from selected N treatments where 50 pounds of N was applied at planting and an additional 25 or 50 pounds was applied immediately after the first cutting to enhance yield and quality of the second cutting. Data reported is for the second cutting only. First cutting data is similar to that shown in Table 1 for the 50 pound N treatment.

<table>
<thead>
<tr>
<th>N rate, source, and method of application</th>
<th>Yield, second cutting (tons dry matter/acre)</th>
<th>Protein content, %</th>
<th>Nitrate in forage (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.73</td>
<td>6.06</td>
<td>18</td>
</tr>
<tr>
<td>UAN, 25 lbs N/a surface band</td>
<td>1.17</td>
<td>5.69</td>
<td>21</td>
</tr>
<tr>
<td>UAN, 50 lbs N/a surface band</td>
<td>1.46</td>
<td>6.50</td>
<td>96</td>
</tr>
<tr>
<td>Urea, 25 lbs N/a broadcast</td>
<td>1.22</td>
<td>6.63</td>
<td>41</td>
</tr>
<tr>
<td>Urea, 50 lbs N/a broadcast</td>
<td>1.47</td>
<td>7.06</td>
<td>215</td>
</tr>
</tbody>
</table>

The data from the second cutting shows a significant response to N rate, but no difference among N sources. There was a significant response to the use of a urease inhibitor with urea at this time (data not shown). Moist soils and high temperatures in late July, when the application was made, created conditions conducive for ammonia volatilization from surface applications of urea. Also, this harvest was not made until after heading. This resulted in lower quality forage, as reflected by reduced protein content, but higher yields.

**Summary**

Current recommendations for N fertilizer rates for forage sorghum are 40-50 pounds of N per acre per cutting. This experiment confirmed that this is an appropriate rate to apply for optimum yield and quality. Exceeding these rates, even under good growing conditions, could lead to high nitrates in the forage, and be potentially toxic. Producers should not use rates above 50 pounds N per acre at planting in an attempt to save trips, and avoid the need to fertilize for a second cutting.
This experiment was conducted following a soybean crop, which may explain the relatively low response to N at the first cutting. Forage sorghum planted into corn stalks or doublecropped following wheat would likely respond to the recommended 40-50 pound N rate.

Concerns about N fertilizer effects on nitrate levels in the forage are important. Testing sorghum, sudan, or millet hay for nitrates is an important practice to ensure the safety of the cattle being fed. The K-State Soil Testing Laboratory offers nitrate analysis services to Kansas farmers and ranchers. The lab can be contacted at soiltesting@ksu.edu, or by calling 785-532-7897, for information on nitrate testing.

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2. Applying nitrogen fertilizer to nitrogen-stressed soybeans

Although soybeans can fix good part of their own nitrogen (N) if they are well nodulated, this is no guarantee that soybeans will not suffer from nitrogen deficiency at a crucial time in their development. Soybeans are heavy users of N, removing about 3-4 lbs of N per bushel of seed. They need all the N they can fix plus N from the pool of N available in the soil.

Planting soybean without inoculation into soils where soybean has never been grown can result in very poor nodulation and N deficiency. Similar problems can occur when inoculation fails, or if soybeans are planted on severely acid soils that limit nodulation. In these situations, it is logical to ask if soybeans will respond to N fertilizers.

In both 2009 and 2010, a number of fields planted into “virgin” soybean ground or into returned Conservation Reserve Program ground in north central Kansas were observed to be poorly nodulated and N-deficient, even though the seed was commercially inoculated. A field study was conducted in 2009 and continued at a different location in 2010 to determine whether these poorly nodulated, N-deficient soybean would respond to applied N fertilizers. And, if so, how much N could successfully be used.

**Methods**

In 2009, this study was conducted on a farmer’s field near Solomon that had noticeably N-deficient soybean. This field was planted no-till into sorghum residue from the previous year on May 20 at 140,000 seeds/a. A liquid inoculant was sprayed on the soybean seeds as they were loaded into the planter. This field had no history of soybean production. Examination of the root system showed few or no nodules present. Nitrogen fertilizer was applied on July 20, 2009, to soybean displaying N-deficiency symptoms at the R1 to R2 (flowering) growth stages. The N was applied as urea co-granulated with a urease inhibitor and nitrification inhibitor (Super-U) by surface banding the material between the soybean rows. Rainfall occurred within a few hours of N application.

This study was repeated in 2010 on a farmer’s field near Gypsum that had very poorly nodulated, N-deficient soybean. In this case, the soybean was planted into conventional tilled soil at 130,000 seeds/a on June 19, 2010. Soybean seed was treated with an inoculant prior to planting. This field had no history of soybean production. The N was again broadcast-applied as urea co-granulated with
a urease inhibitor and nitrification inhibitor (Super U) on July 22, 2010. Rainfall did not occur until 14 days after treatments were applied.

**Results**

The results from both studies for 2009 and 2010 are summarized in the table below. In 2009, response to the highest N rate, 120 lbs/a, was highly significant, with a 21 bu/a advantage over the control.

Yields at Gypsum in 2010 were lower due to dry weather. However, similar results were obtained, with an 11-bu response to the first 120 lbs of N/a compared to the control. No additional response was obtained to the 150-lb rate applied in 2010. When pooled across years, the data show a response to 120 pounds of N per acre.

The data from these studies show that applying N fertilizer to poorly nodulated, N-deficient soybean enhances yield. Applying 120 lbs N/a was effective in each of these two years. At current fertilizer and commodity prices these responses would provide a good return on investment, though limiting the application to 60 pounds of N would have been more economical with the modest yields, and N response obtained in 2010, with current N and soybean prices. Additional research will be conducted to further refine appropriate N rates if opportunities develop in the future.

<table>
<thead>
<tr>
<th>N Rate (lbs/acre)</th>
<th>2009</th>
<th>2010</th>
<th>2-year average</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>28</td>
<td>18</td>
<td>23</td>
</tr>
<tr>
<td>30</td>
<td>37</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td>60</td>
<td>42</td>
<td>26</td>
<td>33</td>
</tr>
<tr>
<td>90</td>
<td>43</td>
<td>26</td>
<td>34</td>
</tr>
<tr>
<td>120</td>
<td>49</td>
<td>29</td>
<td>39</td>
</tr>
<tr>
<td>150</td>
<td>N/A</td>
<td>29</td>
<td>N/A</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>4.4</td>
<td>4.0</td>
<td>3.9</td>
</tr>
</tbody>
</table>

This study was conducted in cooperation with Tom Maxwell, Central Kansas District Extension Agent, and Andrew Tucker and A.R. Asebedo, graduate students in Agronomy.
Other considerations when applying nitrogen to soybeans

While N applied to N-deficient soybeans at the pod development or early pod fill stages of growth can increase yields (as long as the apparent N deficiency is not simply a response to soil compaction), there are risks:

* Leaf burn. It would be much safer to apply urea than UAN solution.
* Volatilization. Urea applied to the soil surface under warm, damp, windy conditions may volatilize if it is not worked into the soil by rainfall. This risk can be minimized by having the urea treated with Agrotain, a urease inhibitor.
* Dry weather after application. If it doesn’t rain after the N application, the N may not get down into the soil in time to benefit the plants. Also under moisture stress, as in the 2010 study, the yield may be limited by more than a lack of N.
* Plant damage during the application process. At this time of year, making a fertilizer application with ground equipment could damage some of the plants. Whether the benefits would outweigh the amount of plant damage is a judgment call.
If producers are willing to take those risks to get a possible yield increase, how should they proceed? First look closely at the root system and determine if nodules are present. If no or very few nodules are present 4-6 weeks after planting, and the plants are yellow and N deficient, what rate of N should be used? The best advice would be to apply 40 to 60 lbs N per acre as urea, treated with Agrotain, to N-deficient dryland soybeans, preferably at about the R1 stage, or beginning flowering. Higher rates should be considered for high yielding irrigated soybeans. UAN should only be used if it can be applied directly to the soil surface. UAN applied to the foliage will cause leaf damage. Nitrogen can be applied as late as early pod fill and still be effective, provided rainfall or irrigation occurs soon after application.

There is no guarantee this will help yields enough to pay off, but beans that are chlorotic, poorly nodulated and stunted due to N deficiency will almost surely have very low yields and N application would be beneficial.

Irrigated soybeans with high yield potential may also respond to N applications, even if they are not N deficient. There was some K-State research several years ago on late-season applications of N to soybeans, conducted by Ray Lamond, former K-State soil fertility specialist. This research was on irrigated soybeans with high yield potential, and the plants were not showing N deficiency at the time of application. Lamond applied 20 and 40 pounds of N per acre to the beans at the R3 stage, early pod development, using UAN and urea + Agrotain.

The N increased yields at most locations. The yield increases ranged from about 6 to 10 bushels per acre – or about 5 to 10 percent. The high rate (40 lbs N/acre) of UAN caused severe leaf burn. Lamond concluded that late-season supplemental N at a rate of 20 lbs/acre should be applied to irrigation soybeans with high yield potential at the R3 growth stage.

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3. Rescue treatments for marestail, pigweed, and kochia in soybeans and sorghum

Sometimes weeds escape all attempts at control and can quickly get rather large. When that happens, producers will need to consider a rescue treatment with a herbicide if the problem is widespread enough. Most often, this is a problem in short crops such as soybeans. It can also be a problem in later-planted crops such as grain sorghum when the sorghum is still small. Corn usually gets tall enough by late June that rescue treatments are either not needed or not effective, since weed escapes would also be quite tall.

**Rescue control in soybeans**

*Marestail:* If marestail is present after soybean emergence, the best option for postemergence control of marestail in Roundup Ready soybeans is probably a tank-mix of FirstRate or Synchrony herbicides with a full rate of glyphosate.
**Pigweed**: Controlling escaped pigweed in soybean can be difficult if they are resistant to glyphosate. Essentially, the only option is to use a PPO-inhibiting herbicide such as Blazer, Cobra, or Flexstar or Reflex. However, even PPO-inhibiting herbicides have their limitations. The larger the pigweeds are, the harder it becomes to get complete control. In general, the labels for PPO-inhibiting herbicides limit pigweed size to 2- to 6-leaf stage; after that, the level of control decreases. Also be aware that there are crop rotation restrictions following the use of Reflex or Flexstar

**Kochia**: Unfortunately, there are not many postemergence herbicides in soybeans that provide good kochia control other than glyphosate. Thus, controlling the kochia prior to planting and using a residual herbicide may be critical if glyphosate-resistant kochia is present. Pursuit and Raptor may provide control of small kochia if it is not ALS-resistant, but will not control ALS-resistant kochia. Also, these products have a number of crop rotation restrictions.

**Rescue control in grain sorghum**

**Marestail**: Marestail is generally not a postemergence problem in grain sorghum since dicamba or 2,4-D are typically included with glyphosate in the burndown treatment ahead of grain sorghum. In the event that marestail have not been controlled, using dicamba, 2,4-D, or Huskie with atrazine postemergence may control the marestail.

**Pigweed**: Producers have several postemergence herbicide options to control pigweeds in sorghum. Growth regulator herbicides like 2,4-D and dicamba can control small Palmer amaranth and common waterhemp. The addition of atrazine to the growth regulator herbicides will increase control, provided pigweed species isn’t triazine-resistant. In addition, Huskie plus atrazine provides excellent control of emerged pigweed. Generally, as pigweed get larger they are harder to control.

**Kochia**: If a postemergence application becomes necessary in grain sorghum, one good option is a herbicide premix of dicamba or Starane/Starane NXT and atrazine. Another good choice would be Huskie and atrazine. As with pigweed, large kochia are much more difficult to control.

**Rescue control in corn**

Although there are some postemergence herbicide options for corn, most of these treatments have to be applied when the weeds and/or corn are small. By now, corn is too tall for any applications unless you have very late-planted corn. True rescue treatments with herbicides at this time of year when the weeds are tall are basically not possible. It may be possible to utilize a preharvest weed control treatment when corn is near black layer to control weeds and facilitate corn harvest.

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4. Comparative Vegetation Condition Report: June 5 – 18

K-State’s Ecology and Agriculture Spatial Analysis Laboratory (EASAL) produces weekly Vegetation Condition Report maps. These maps can be a valuable tool for making crop selection and marketing decisions.

Two short videos of Dr. Kevin Price explaining the development of these maps can be viewed on YouTube at:
http://www.youtube.com/watch?v=CRP3Y5NIggw
http://www.youtube.com/watch?v=tUdOK94efxc

The objective of these reports is to provide users with a means of assessing the relative condition of crops and grassland. The maps can be used to assess current plant growth rates, as well as comparisons to the previous year and relative to the 21-year average. The report is used by individual farmers and ranchers, the commodities market, and political leaders for assessing factors such as production potential and drought impact across their state.

The maps below show the current vegetation conditions in Kansas, the Corn Belt, and the continental U.S, with comments from Mary Knapp, state climatologist:
Map 1. The Vegetation Condition Report for Kansas for June 5 – 18 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the greatest photosynthetic activity is occurring in the eastern third of the state. Reduced biomass production is beginning to be seen in Cherokee County, where the shallow clay pan results in quick shifts between excess moisture and damaging drought.
Map 2. Compared to the previous year at this time for Kansas, the current Vegetation Condition Report for June 5 – 18 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that biomass production in the northern portions of the state is less. Rainfall in the north central, in particular, has been well below last year. Extreme southwest Kansas is showing greater photosynthetic activity than last year, but last year was so poor this does not indicate good conditions.
Map 3. Compared to the 23-year average at this time for Kansas, this year’s Vegetation Condition Report for June 5 – 18 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that aside from Doniphan County, only a small portion of northern Meade and southern Gray counties have above-average photosynthetic activity. There is also an area of above-average biomass production along the Kansas River Valley in Pottawatomie and Shawnee counties. These areas benefitted from isolated rains during this two-week composite period. In east central Kansas, the warmer-than-average temperatures and lack of rainfall are resulting in decreased biomass production.
Map 4. The Vegetation Condition Report for the Corn Belt for June 5 – 18 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the northern and eastern portions are showing the greatest photosynthetic activity. There has also been an increase in activity in the Black Hills region of South Dakota. Of concern are the decrease in activity in parts of Illinois, Ohio, and the Boot Heel of Missouri. The latest Drought Monitor shows deteriorating conditions in these areas.
Map 5. The comparison to last year in the Corn Belt for the period June 5 – 18 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that greatest increase in NDVI values are from northeastern Nebraska to Illinois. Crop progress in these areas is well ahead of last year. Decreased photosynthetic activity is most noticeable in western Nebraska, western South Dakota, and central Kansas. These areas had much more precipitation last year. Current precipitation deficits are having a negative impact on vegetation.
Map 6. Compared to the 23-year average at this time for the Corn Belt, this year’s Vegetation Condition Report for June 5 – 18 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the western portions of the region have the greatest decrease in biomass production. The central portions of the region are showing above-average biomass production. Much of this is due to the advanced stage of the crops.
Map 7. The Vegetation Condition Report for the U.S. for June 5 – 18 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that highest NDVI values are in the upper New England area, as well as West Virginia. Soil moisture in that area is reported to be 74 percent adequate. In contrast, the western High Plains has low NDVI values as heat and drought stress continue.
Map 8. The U.S. comparison to last year at this time for the period June 5 – 18 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that parts of Texas have higher photosynthetic activity, while the central Atlantic Region, as well as parts of the Central and Northern Plains have lower activity. Moisture in the Northern Plains has been much less than last year at this time, while the Southern Plains have enjoyed more precipitation. Amarillo, in the Texas Panhandle, has received 7.08 inches for the year-to-date. Last year at this time, it had received only 1.17 inches.
Map 9. The U.S. comparison to the 23-year average for the period June 5 – 18 from K-State’s Ecology and Agriculture Spatial Analysis Laboratory shows that the Plains have lower biomass productivity than average, as drought continues in the region. While Amarillo has seen much more rainfall than last year at this time, it is still at only 75 percent of normal for the year-to-date.

Note to readers: The maps above represent a subset of the maps available from the EASAL group. If you’d like digital copies of the entire map series please contact us at kpprice@ksu.edu and we can place you on our email list to receive the entire dataset each week as they are produced. The maps are normally first available on Wednesday of each week, unless there is a delay in the posting of the data by EROS Data Center where we obtain the raw data used to make the maps. These maps are provided for free as a service of the Department of Agronomy and K-State Research and Extension.

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These e-Updates are a regular weekly item from K-State Extension Agronomy and Steve Watson, Agronomy e-Update Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time.
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