When ranchers think about planting an introduced summer perennial forage variety, there are usually two questions. One is, “Do hybrid varieties that do well in research tests with heavy fertilization also do well with less, or no, fertilizer?” Two is, “If I fertilize my lower yielding variety more heavily, will it yield as well as the hybrid varieties that are expensive to establish?”

Unfortunately, most research tests are not set up to answer both questions. Most variety trials compare several different varieties at a single nitrogen rate that is usually higher than most ranchers use. The reason a high nitrogen rate is used is to determine the genetic potential of the variety. Most nitrogen rate tests use only one variety, so they are very useful if you have that variety, but less useful if you don’t.

A test was designed to answer both of the producer questions listed above. Nine varieties of introduced warm-season perennial forages were selected; seven bermudagrass and two old world bluestem varieties. These were fertilized with five nitrogen rates. The test was located at the Noble Foundation Pasture Demonstration Farm, about 5 miles northwest of Ardmore, Okla. Soil series was Chickasha loam, 1-3% slope and severely eroded due to past management practices. This made the site representative of many fields that producers plant to warm-season introduced perennial forages.

The bermudagrass varieties chosen for the study were Common, a blend of Common and Giant (sold under many trade names), Cheyenne, Wrangler, Coastal, Midland 99 and Tifton 85. Old world bluestem varieties were Plains and WW B Dahl. These varieties were selected because they are commonly grown in the area and represent a mixture of seeded and sprigged varieties. Following is a brief description of each variety.
Common
This bermudagrass can be established from either seed or sprigs. There is no established genetic makeup of “Common” since it is a catchall name for any seeded bermudagrass that has no other name. For this reason, there is tremendous variation within Common. Common usually has a low-growing posture, makes a thick sod and is winter-hardy.

Giant
This bermudagrass can be established from either seed or sprigs. It was selected from Common in the arid southwestern U.S. and has been marketed since the 1960s. It has an upright growth posture and is very high yielding. Unfortunately, it is not winter-hardy and does not survive extreme cold. It is often used in seeded blends of bermudagrass since it is very fast establishing and produces high yields until it freezes out. When that happens, the other varieties in the blend take over.

Cheyenne
This bermudagrass can be established from either seed or sprigs. It is a cross between a bermudagrass found in the Pacific Northwest of the U.S. and a bermudagrass found in southeastern Europe. It was originally released in 1989. It is cold-hardy and fast establishing. Its growth habit resembles Common.

Wrangler
This bermudagrass can be established from either seed or sprigs. It was developed from germplasm at Oklahoma State University. It is cold-hardy and fast establishing. Its growth habit resembles Common.

Coastal
This hybrid bermudagrass can only be established from plant parts, either top growth or sprigs. In Texas and Oklahoma, it is usually established by planting sprigs. It was developed in Tifton, Ga., and released in 1943. Although it is a very old variety, it is still high yielding. It has an upright growth habit. However, it is only somewhat winter-hardy and will sometimes freeze out in areas north of the Red River.

Midland 99
This hybrid bermudagrass can only be established from plant parts and is usually established by planting sprigs. It was developed from genetic material from Oklahoma, Ghana and Afghanistan, and was released jointly in 1999 by Oklahoma State University, the Noble Foundation and the USDA. It is fast establishing, high yielding and winter-hardy. It has an upright growth habit that resembles Coastal.

Tifton 85
This hybrid bermudagrass can only be established from plant parts, either top growth or sprigs. In Texas and Oklahoma, it is usually established by planting sprigs. Tifton 85 was developed in Tifton, Ga., from a cross between Tifton 68 and a stargrass variety from South Africa, and released in 1993. It is extremely high yielding with good quality. It grows and spreads very aggressively. It has an upright growth habit with thicker stems and shorter, wider leaves than other bermudagrass varieties. However, it is not winter-hardy and can freeze out in very cold weather.

Plains
This old world bluestem variety is established from seed. Plains is a blend of 30 similar successions from six countries and was released in 1972. It is the most widespread old world bluestem variety in Texas and Oklahoma. It is commonly used in areas where bermudagrass does not do well, such as more arid climates or upland heavy clay soils. Plains does not consistently do well in wet soil conditions.

WW B Dahl
This old world bluestem variety is established from seeds. WW B Dahl was jointly released by Texas A&M University, Texas Tech University and the Soil Conservation Service (now known as the Natural Resources Conservation Service) in 1994. WW B Dahl is higher yielding than Plains and has higher forage quality. It has broader leaves than Plains. It is adapted to the same soil types as Plains, but is reported to be less winter-hardy than Plains.

Methodology of Test
The test was established in the spring of 2007. The introduced perennial summer forage varieties were planted either from seed (Common, Common/Giant blend, Cheyenne, Wrangler, Plains and WW B Dahl) or sprigs (Coastal, Midland 99 and Tifton 85). No nitrogen fertilizer was applied in 2007, and plots were not harvested for yield in 2007. Plots were harvested for yield in 2008, 2009 and 2010.

Five rates of nitrogen fertilizer were used; 0, 50, 100, 200 and 300 pounds actual nitrogen per acre. Phosphorus and potassium were applied according to soil test results in the spring of each year. Plots receiving 0, 50 and 100 pounds of nitrogen received all their fertilizer in April of each year. The plots receiving 200 pounds of nitrogen per acre were fertilized with 100 pounds of nitrogen per acre in April and 100 pounds of nitrogen per acre after
the first harvest. Plots receiving 300 pounds of nitrogen per acre were fertilized with 100 pounds of nitrogen per acre in April, 100 pounds of nitrogen per acre after the first harvest and 100 pounds of nitrogen after the second harvest. The nitrogen source was ammonium nitrate. The treatments were replicated three times. Plots were harvested four times during the growing season of each year from 2008-2010. The first harvest occurred in late May or early June of each year. Subsequent harvests were made approximately 30 days apart.

Growing season precipitation was highly variable during the three years of the test. The growing season of 2008 was considerably drier than average; the growing season of 2009 was considerably wetter than average; and the growing season of 2010 received nearly average precipitation (Table 1).

<table>
<thead>
<tr>
<th>Year</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>Growing season total</th>
</tr>
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<tr>
<td>30 Year Average</td>
<td>3.19</td>
<td>5.08</td>
<td>4.25</td>
<td>2.47</td>
<td>2.47</td>
<td>4.16</td>
<td>4.36</td>
<td>25.98</td>
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<tr>
<td>2007</td>
<td>1.44</td>
<td>7.74</td>
<td>6.09</td>
<td>2.93</td>
<td>1.42</td>
<td>1.52</td>
<td>2.59</td>
<td>23.73</td>
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<tr>
<td>2008</td>
<td>2.24</td>
<td>3.2</td>
<td>1.79</td>
<td>1.09</td>
<td>3.88</td>
<td>1.59</td>
<td>2.51</td>
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<tr>
<td>2009</td>
<td>7.36</td>
<td>8.51</td>
<td>1.94</td>
<td>3.92</td>
<td>1.96</td>
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<tr>
<td>2010</td>
<td>3.11</td>
<td>4.03</td>
<td>2.72</td>
<td>2.11</td>
<td>3.7</td>
<td>6.44</td>
<td>1.65</td>
<td>23.76</td>
</tr>
</tbody>
</table>

Table 2. Three-year average yields (lb dry matter/acre) of nine different varieties of introduced summer perennial grass varieties obtained with five nitrogen rates in south-central Oklahoma in 2008-2010

<table>
<thead>
<tr>
<th>Variety</th>
<th>0'</th>
<th>50</th>
<th>100</th>
<th>200</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plains</td>
<td>5399 bc</td>
<td>5602 c</td>
<td>6557 cde</td>
<td>5807 c</td>
<td>5750 e</td>
</tr>
<tr>
<td>WW B Dahl</td>
<td>5822 b</td>
<td>7913 b</td>
<td>8638 ab</td>
<td>8355 b</td>
<td>9042 bc</td>
</tr>
<tr>
<td>Cheyenne</td>
<td>3993 cd</td>
<td>4630 cd</td>
<td>5586 def</td>
<td>6159 c</td>
<td>6784 de</td>
</tr>
<tr>
<td>Wrangler</td>
<td>3305 d</td>
<td>3793 d</td>
<td>4087 f</td>
<td>6106 c</td>
<td>7760 cd</td>
</tr>
<tr>
<td>Common</td>
<td>3237 d</td>
<td>4367 cd</td>
<td>5083 ef</td>
<td>5682 c</td>
<td>5464 e</td>
</tr>
<tr>
<td>Common/Giant</td>
<td>5141 bc</td>
<td>5023 cd</td>
<td>7002 bcd</td>
<td>7986 b</td>
<td>7929 cd</td>
</tr>
<tr>
<td>Coastal</td>
<td>4753 bc</td>
<td>6036 c</td>
<td>7675 bc</td>
<td>9226 b</td>
<td>10660 b</td>
</tr>
<tr>
<td>Midland 99</td>
<td>4974 bc</td>
<td>5472 cd</td>
<td>7366 bc</td>
<td>8216 b</td>
<td>9563 bc</td>
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<tr>
<td>Tifton 85</td>
<td>7889 a</td>
<td>10121 a</td>
<td>10158 a</td>
<td>11452 a</td>
<td>13592 a</td>
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</tbody>
</table>

Yields in a column (within a given N application rate) followed by the same letter are not statistically different (α = 0.05).
When fertilized with 50 pounds of nitrogen per acre, Tifton 85 was still the highest yielding variety in the test. WW B Dahl old world bluestem was the second best variety in the test when 50 pounds of nitrogen per acre were used. The other varieties in the test all had similar yields at the nitrogen rate of 50 pounds per acre, except for Wrangler, which was the lowest yielding variety at this nitrogen rate.

When the plots were fertilized with 100 pounds of nitrogen per acre, more differences in yield between varieties were observed. Tifton 85 was again the highest yielding variety in the test (statistically tied with WW B Dahl). Plains, WW B Dahl, Common/Giant, Coastal and Midland 99 all showed statistically similar yields when fertilized with 100 pounds of nitrogen per acre. Common, Cheyenne and Wrangler yielded the least of the varieties tested when 100 pounds of nitrogen per acre were used.

When the plots were fertilized with 200 pounds of nitrogen per acre, Tifton 85 was the highest yielding variety in the test. WW B Dahl, Common/Giant, Coastal and Midland 99 were all tied for second highest yielding variety in the test, and Plains, Common, Cheyenne and Wrangler were the poorest yielding varieties in the test when fertilized with 200 pounds of nitrogen per acre.

Tifton 85 was the best yielding variety in the test when fertilized with 300 pounds of nitrogen per acre. Coastal, Midland 99 and WW B Dahl were statistically the next best yielders when fertilized with 300 pounds of nitrogen per acre. The poorest yielding varieties at 300 pounds of nitrogen per acre were Plains, Common and Cheyenne.

Summary of Information on Best Variety at Individual Nitrogen Rates
Tifton 85 was the best, or tied for the best, yielding variety at every nitrogen rate tested. If a producer lives in a climate where harsh winter weather is unlikely, or is risk tolerant and willing to accept the fact that Tifton 85 may not survive a bad winter, Tifton 85 is an excellent choice based on yield potential. Tifton 85 survived the winter of 2009-10 in our test, but was late emerging in the spring of 2010 and did not yield as well as it did in 2008 and 2009. However, even though it suffered winter injury in 2010, it still out-produced every other entry in the test.

According to the results of our test, if a producer is unwilling or unable to fertilize, the best choices are Tifton 85, Plains, WW B Dahl, Cheyenne, Common/Giant, Coastal or Midland 99. If a producer is willing to apply a small amount of nitrogen, such as 50 pounds of nitrogen per acre, Tifton 85 and WW B Dahl are excellent choices. If a producer is willing to fertilize with at least 100 pounds of nitrogen per acre, Tifton 85, Coastal, Midland 99, WW B Dahl and Common/Giant all made very good yields.

Many producers blend Giant with Common when planting bermudagrass from seed. Our study showed this to be an excellent idea. The average increase from adding Giant to Common was 1 ton of dry matter forage per year over that obtained with Common alone. In our study, Giant survived the winters of 2007-08 and 2008-09, but was severely damaged by the winter of 2009-10. At least 80% of the Giant plants in our plots were killed in the winter of 2009-10. Although Giant only lasted two years in our study, its addition to Common was more than worth the extra seed cost.

In general, if a producer is willing to fertilize with at least 100 pounds of nitrogen per acre, the hybrid (sprigged) bermudagrass varieties and WW B Dahl old world bluestem are superior to the seeded bermudagrass varieties and Plains old world bluestem. An exception is Giant seeded bermudagrass, which will likely last only a few years due to cold damage. If a producer is unwilling to fertilize, the old world bluestem varieties, Common/Giant blend and the hybrid bermudagrass varieties are good choices.

**Optimum Nitrogen Rate for Each Variety**
The optimum nitrogen rate for each variety was determined. The following graphs include the data points for each year and replication. Data points for yields for the drier than average year of 2008 are represented by blue diamonds, yields for the wetter than average year of 2009 are represented by red squares and yields for the average precipitation year of 2010 are represented by green triangles. One can determine a trend of how precipitation affected a variety’s yield by observing these symbols. Three data points are included for each year at each nitrogen rate. These points indicate the yield in each replication. In addition, a line graphing the average response over the three year period is included, with the equation describing the average yield line. Letters on the data points on the average response line denote whether the yield differences are statistically significant at each nitrogen rate.
Plains did not respond to nitrogen fertilizer in any year tested. Many producers do not fertilize Plains due to a perceived lack of response, and our study reinforces this. Plains tended to yield less in the dry year of 2008, and about the same in the wet year of 2009 and the average precipitation year of 2010.

WW B Dahl responded very well to 68 pounds of nitrogen per acre, but not to higher amounts. The data points show that WW B Dahl did much worse than its average yield in the dry year of 2008, and yielded about the same in the wet year of 2009 and the average precipitation year of 2010. Producers with WW B Dahl should strongly consider applying 50-75 pounds of actual nitrogen per acre since the average response was 42 pounds of dry matter forage per 1 pound of nitrogen applied. This was the best response to nitrogen of any variety we tested.

Cheyenne bermudagrass responded well to 100 pounds of nitrogen per acre, but not to higher levels of nitrogen or to 50 pounds of nitrogen per acre. Cheyenne made its poorest yields in the average precipitation year of 2010 and yielded about the same in the dry year of 2008 and the wet year of 2009.

Wrangler bermudagrass made maximum yields when fertilized with 300 pounds of nitrogen per acre, but also out-yielded the check plots when fertilized with 200 pounds of nitrogen per acre. Fertilizing with 50 or 100 pounds of nitrogen per acre did not increase yields above those obtained with no nitrogen. Wrangler yielded considerably less than its average in the dry year of 2008 and yielded slightly more than its average in the wet year of 2009.
The optimum fertilization rate for Common bermudagrass was 100 pounds of nitrogen per acre. Common yielded much less than its average in the dry year of 2008, about its average yield in the wet year of 2009 and more than its average yield in the average precipitation year of 2010.

Coastal bermudagrass optimized yield when fertilized with 200 pounds of nitrogen per acre. Yields of Coastal were highly variable with precipitation and yielded better as the precipitation increased.

Common/Giant blend optimized yield when fertilized with 100 pounds of nitrogen per acre. It yielded less in 2010, not because of precipitation, but because the Giant component of the blend froze out in the winter of 2009-10. Common/Giant blend yielded much more in the wet year of 2009 than in the dry year of 2008.

Midland 99 optimized yields with 300 pounds of nitrogen per acre. Midland 99 was less sensitive to precipitation rate than any other variety and made about the same yield regardless of the growing season precipitation.
The Samuel Roberts Noble Foundation

SOILS

Effect of nitrogen rate on yield of Tifton 85 bermudagrass

Y = 8650 + 15.9N

Summary of Information on Optimum Nitrogen Rate for Each Variety

Plains old world bluestem did not respond to nitrogen at any rate tested. Many producers do not fertilize Plains due to this lack of response. Our research validates their decision. WW B Dahl old world bluestem responded very well to 50 pounds of nitrogen per acre, but not to higher rates. If producers have WW B Dahl, strong consideration should be given to applying 50 pounds of nitrogen per acre. At this nitrogen rate, each pound of nitrogen applied resulted in a yield increase of 42 pounds of dry matter forage per acre, which was the highest conversion of nitrogen to forage observed in the test.

The seeded bermudagrass varieties (Common, Common/Giant blend and Cheyenne) generally responded well to 100 pounds of nitrogen per acre, but not to higher rates. The exception was Wrangler, which showed yield increases only when 200 or 300 pounds of nitrogen per acre were applied.

The hybrid bermudagrass varieties (Coastal, Midland 99 and Tifton 85) responded well to high rates of nitrogen. All three varieties showed positive yield responses at 300 pounds of nitrogen per acre. Producers should consider forage needs and fertilizer prices when deciding on nitrogen rates for these varieties since they can utilize almost any rate of nitrogen a producer is willing to apply.