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Extension

SP731-E

Economic Implications of Growing Native Warm-Season Grasses for Forage in the Mid-South

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Introduction

As many Tennessee producers are aware, cool-season grasses, such as tall fescue and orchardgrass, suffer from poor forage production during the summer months. This has led to the search for cost-effective alternatives to bridge this summer "forage slump." Native warm-season grasses (NWSG), bermudagrass and summer annuals are potential alternatives that can provide ample forage during this period. In the past few years, NWSG, such as switchgrass, big bluestem, little bluestem, indiangrass and eastern gamagrass, have begun to receive considerable attention as forage crops in the Mid-South. Many of their attributes, such as being native, long-lasting and having low input requirements, make them well worth considering.

However, economic analyses of NWSG in the Mid-South are limited to switchgrass, and only then for biofuel production. The Center for Native Grasslands Management has developed a Web-based, interactive, decision-support tool to examine various scenarios associated with summer forage production. This tool can be used to examine the impacts of fuel cost, seed cost and planting rates, herbicide cost and application rates, and fertilizer price and application rates on the economics of grazing and haying NWSG, bermudagrass and summer annuals. The tool is based on UT budgets developed for forages (http://economics.ag.utk.edu/budgets.html). Using output from this decision-support tool and January 2011 current prices (Table 1), this publication offers insight into the economic implications of several inputs and outputs of NWSG as a forage in the Mid-South. Seed, fertilizers, herbicides and fuel costs may vary greatly over time, so this publication is meant to serve only as a guide.

How Are Expenses Accounted For?

Expenses are broken down into three categories: variable expenses, fixed expenses and labor expenses. The total expenses are the sum of these three categories. Variable or out-of-pocket expenses are those that may vary from year to year. This includes fertilizer, herbicides, opportunity cost and diesel fuel. Fixed expenses include prorated establishment cost and machinery expenses such as insurance and depreciation. Labor expenses include wages, Social Security and Medicare taxes, and payroll administration costs.

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Table 1. January 2011 seed, herbicide, fertilizer and other associated input costs used in this publication for forage production. Rates are based on current recommended application rates.

Input	Cost[1]	Big bluestem/ indiangrass Rates	Bermudagrass Rates	Sudan-Sorghum Rates
Big bluestem seed	$ 7 lb PLS	4 lb / acre	--	--
Indiangrass seed	$ 10 lb PLS	4 lb / acre	--	--
Bermudagrass seed	$ 10.75 lb PLS	--	7 lb / acre	--
Sudan-sorghum hybrid seed	$ 1.25 lb PLS	--	--	20 lb / acre
Urea + urease inhibitor	$ 352 T	30 lb / N establishment 60 lbs / N production	60 lb / N establishment 240 lb / N production	120 lb / N production
DAP (P_2O_5)	$ 502 T	30 lb / P establishment and production	40 lb / P establishment 60 lb / P production	30 lb / P production
Muriate of potash (K_2O)	$ 542 T	30 lb / K establishment and production	40 lb / K establishment 80 lb / K production	60 lb / K production
Lime	$ 30 T	Not applied	2.0 T establishment 0.67 T production	0.50 T production
Glyphosate	$ 0.25 oz	80 oz	Not applied	Not applied
Imazapic	$ 2.25 oz	4 oz	Not applied	Not applied
2,4-D Amine	$ 0.62 oz	Not applied	Not applied	32 oz
Gramoxone Max	$ 0.85 oz	Not applied	24 oz	24 oz
Cimarron	$22.90 oz	Not applied	0.20 oz	Not applied
Surfactants	$ 0.10 oz	Not applied	8 oz	8 oz
Diesel	$3.75 gal			

[1] PLS: pure live seed

Establishment Costs

For this publication, we assumed that the likelihood of successful establishment of all three grass types is the same. Because many producers are more experienced with bermudagrass and/or summer annuals, the likelihood of a successful establishment of those forages may be higher than for NWSG.

For the purposes of this publication, we used big bluestem/indiangrass mixture as the NWSG forage choice. Establishment costs for NWSG included seed, fertilizer and herbicides. For evaluation of forage budgets, it is customary to prorate establishment expenses over the life of the stand. For the following analyses, we used 10 years, a conservative estimate, for stand life.

Because NWSG seedlings use most of their energy building an extensive root system at the expense of aboveground growth, nitrogen is not recommended during establishment. This is because nitrogen applied during this time benefits weeds more than the NWSG seedlings (for more information, see UT Extension publication *Establishing Native Warm-Season Grass for Livestock Forage in the Mid-South*, SP731-B). Using the economic tool and January 2011 prices, we estimated the cost of establishment over a range of fertilizer application rates (no fertilizer to 60 lbs each of P and K). Depending on these inputs, total costs for establishing big bluestem/indiangrass was $160-225 per acre or, for out-of-pocket expenses only, $145-205 per acre.

Based on this analysis, it is clear that seed was the most expensive input for big bluestem/indiangrass establishment, accounting for up to 60-70 percent of the establishment budget. Using the economic tool, we varied seed prices to reflect the range we have observed over the past five years, but kept other expenses constant. Expect a 30 percent increase in cost of establishment if seed prices double. For example, if seed price for big bluestem were to increase from $7 to $14 per PLS lb, the total establishment costs would increase from approximately $180 to $239.

Production Costs

Annual production costs included variable expenses such as fertilizer, herbicides, fuel and miscellaneous machinery expenses, twine or fencing expenses, and interest on operating expenses. Fixed expenses included prorated establishment costs and machinery expenses such as depreciation, interest and insurance. Labor expenses were accounted for separately.

Using the January 2011 prices and current production recommendations for fertilizer and herbicides,

we estimated the production costs for three key summer forage options: sorghum-sudan hybids (sudex), bermudagrass and NWSG. We determined that the annual production costs (per acre) were $293.42 for sudex, $239.42 for big bluestem/indiangrass and $452.78 for bermudagrass.

Fertilizer Costs

Compared to bermudagrass and summer annuals, NWSG can be produced with less fertilizer. Unless your soils test in the low category, applications of potassium or phosphate are not recommended. However, soil fertility should be monitored over the life of the stand so that removal of nutrients, especially in hay production, does not deplete the soil.

Nitrogen costs are the dominant expense in a fertilizer budget. Current recommended nitrogen application rates for big bluestem/indiangrass are 60 lbs N/ac for hay production or pasture. There are instances where up to 120 lb N/ac may be recommended, such as where forage and biofuels are being produced from the same field, but rates above this level should not be applied. Based on current production recommendations, big bluestem/indiangrass hay had lower out-of-pocket expenses than either bermudagrass or sudex hybrids. This is because nitrogen recommendations for bermudagrass and sudex hybirds are 2-4 times greater than those for big bluestem/indiangrass, thus making nitrogen a large portion of the production budget. Accounting for yield differences among the forages (all based on large round bales), the doubling of the cost of urea resulted in 9 percent higher expenses per ton for big bluestem/indiangrass, 13 percent higher expenses per ton for sudex and 21 percent higher expenses per ton for bermudagrass. For every $1/ton increase in urea, the total production expenses per ton increased $1.95 for sudex, $2.37 for bermudagrass and $0.85 for big bluestem/indiangrass (Fig. 1).

Yields for Summer Forages

Although estimating production costs on a per-acre basis is fairly straightforward, calculating cost per ton depends on per-acre yields. To allow for consistent and reasonable comparisons, we used a single set of assumptions about per-acre yield in our analyses. Those yields, expressed on the basis of tons per acre, were as follows: sudex, 3.5; NWSG, 4.0; and bermudagrass, 6.0. These figures are based on the production inputs included in Table 1 and fields with "typical" productivity. Obviously, yields vary by producer, management practices, year and even by field. In some of the figures below, we also allowed for some variation, 1 ton per acre above and below the estimated averages. You should consider your own experience when deciding which yield is appropriate for your operation.

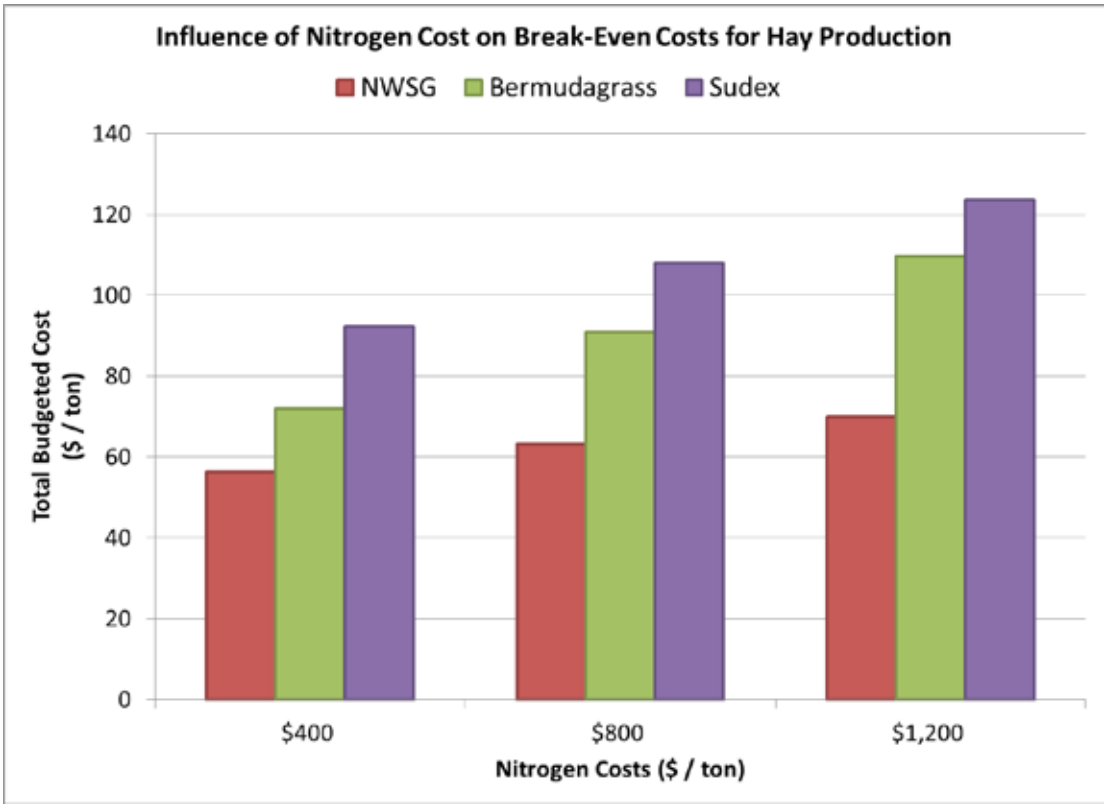

Figure 1. Relationship between budget expenses (total cost per ton) and increasing nitrogen costs for warm-season forages used for hay production in Tennessee. In this figure, we varied the cost per ton for nitrogen but kept the application rates constant at current recommended levels for each respective forage. Prices for P and K were also kept constant. Calculations were based on assumed average per-acre hay yields of 4 tons for big bluestem/indiangrass, 3.5 tons for sudex and 6 tons for bermudagrass.

Yield and Gain Impacts on Budget

Yield of big bluestem/indiangrass depends greatly on stand age and producer experience. During the establishment year, do not expect any production. In the second year, production will normally be about 50 – 70 percent of full potential or about two to three tons per acre. In the third year, big bluestem/indiangrass are fully established and can be hayed or grazed with expected yields of approximately four tons per acre. For the purpose of this publication, we assumed $65 (for large round bales) as the value of big bluestem/indiangrass, bermudagrass and sudan hybid hay. Because so much hay produced in this region is tall fescue, we also included that species in some of our analyses for comparison. All costs for tall fescue production inputs were the same as for the warm-season species. (See http://economics.ag.utk.edu/budgets.html for recommended inputs for tall fescue hay production.)

Break-even point occurs when total income produced equals the cost of production. The break-even point for hay production varied, depending on the level of inputs. Under the assumptions of P and K application during establishment (30 lbs of each nutrient) and 60 lbs N per acre during production, big bluestem/indiangrass that yielded 4 tons per acre had a break-even point of approximately $53 per ton. This means you would need to sell your hay for at least $53/ton to cover all of your operating expenses (Fig. 2). However, without any nitrogen fertilizer inputs, big bluestem/indiangrass hay would break-even at approximately $47 per ton. Comparable per-ton figures for the other hay crops we evaluated were $75 for bermudagrass, $83 for sudex and $123 for tall fescue (based on an assumed yield of 2.5 tons per acre). The greater per-acre total annual yield of warm-season forages make them more economical to produce than cool-season hay crops.

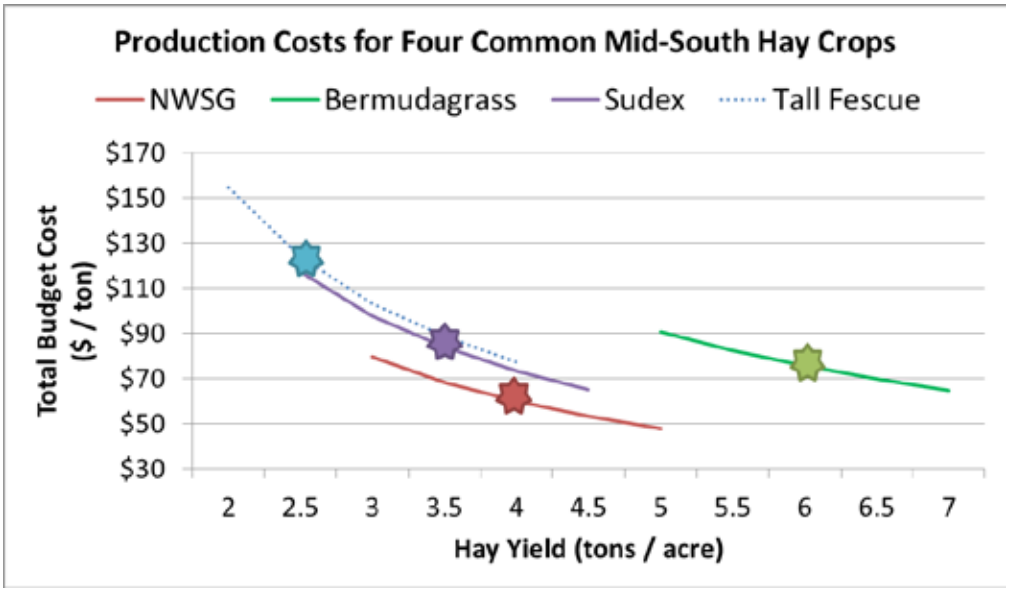

Figure 2. Relationship between total budget expenses (per acre) and annual yield (tons per acre) for four common forages used for hay production in the Mid-South. As yield increased, cost per ton produced dropped for all forages. Stars represent assumed average yield and lines represent a reasonable range of variation around those averages (plus or minus one ton per acre) for each respective forage.

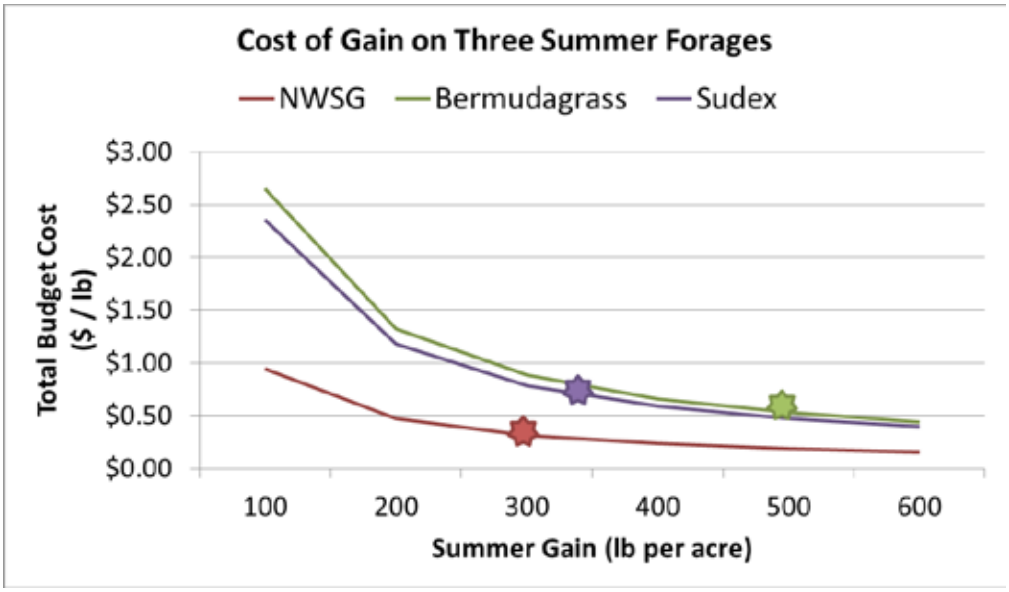

Figure 3. Relationship between total budget expenses (per acre) and gain (per acre) for three summer forages used for pasture in the Mid-South. As gain per acre increases, cost per pound of gain produced dropped for all three forages. Stars represent the average gain per acre for each respective forage.

During a season-long (approximately 90 – 100 days) grazing trial conducted by the University of Tennessee, average daily gain (ADG) for weaned steers was 1.65 lbs for switchgrass and 2.21 lbs for big bluestem/indiangrass mixes. To put this in perspective, average daily gain for steers grazing tall fescue during the same time period is approximately 0.8 lbs. Another way to examine gain is the total number of pounds gained per acre over the course of the season. This is a good way to compare forages that have different stocking rates. For big bluestem/indiangrass mixes, gain per acre is 299 lbs. Bermudagrass, with its higher stocking rate, averages nearly 494 lbs over the season, while sudex averages 334 lbs of gain per acre. When broken down by production costs, this worked out to $0.31 per pound of gain for bluestem/indiangrass, $0.54 per pound for bermudagrass and $0.75 per pound for sudex (Fig. 3). Using 2010-2011 pricing, gain per acre is worth approximately $1.20 per pound. After subtracting the expenses, this would give you a profit of $264.40 for bluestem/indiangrass, $327.96 for bermudagrass and $165.04 for sudex.

How Long Does it Take to Pay off the Investment?

The length of time it takes for big bluestem/indiangrass to create a positive income stream is an important consideration. As mentioned previously, production is zero in year 1 and around 2 tons per acre in year 2. Assuming a yield of 4 tons per acre for big bluestem/indiangrass in year 3 and following, it will take four years to recoup the investment assuming 0, 30 and 30 lbs of N-P-K at establishment and 60, 30 and 30 lbs of N-P-K during production and recommended seeding and herbicide rates at January 2011 costs (Fig. 4).

In comparison, sudex has much higher production costs. Because it is an annual, the question of a pay-off period (realizing positive cash flow) needs to be approached as a break-even analysis. Using current production recommendations for sudex, you would have to value the hay at $84 per ton to cover your production costs (Fig. 5). Although there is a wide range of pricing for bermudagrass, for simplicity of comparison we used an average value of $65 per ton (large round bales). At this price, bermudagrass hay would not be a profitable forage option. At $75 per ton, bermudagrass will break even in year 6 and at $104 per ton, bermudagrass would be profitable starting in year 1.

What is the Rate of Return on my Investment?

Although bermudagrass and big bluestem/indiangrass are likely to have life spans longer than 10 years, we used 10 years to conservatively estimate the profitability of these grasses. For this analysis, we assumed the same inputs as in previous analyses, but varied the cost per ton of nitrogen. For each forage, we determined the cumulative costs over the 10 years and the cumulative revenue from the same period. This allowed us to calculate a rate of

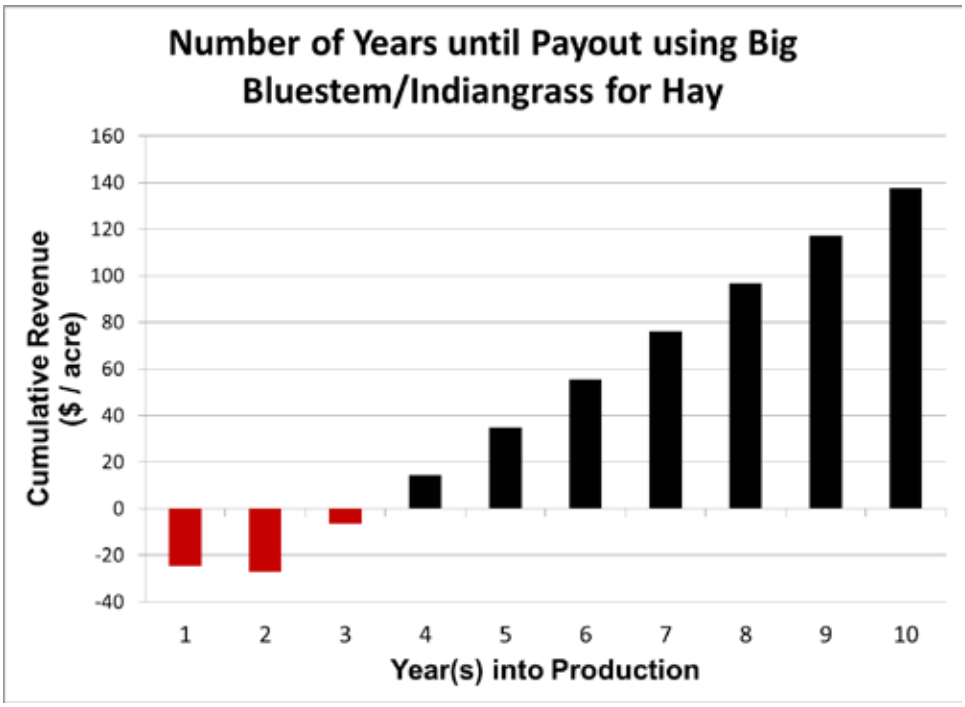

Figure 4. Assuming limited P and K inputs during establishment and production and 60 lbs N applied annually during production, the pay-off period for establishing big bluestem/indiangrass was four years at a hay value of $65 per ton. Yield assumptions in this scenario included 2 tons per acre during year 2 and 4 tons per acre in year 3 and beyond. Establishment has been prorated over the 10-year horizon. Year 2 has a lower net revenue because it included annual production costs and reduced yield. With lower establishment costs and annual costs of production compared to other summer forages, big bluestem/indiangrass can become profitable in year 4.

return over the 10-year period. With increasing N costs, the rate of return for all three forage options dropped – none were profitable at $1200/ton urea (Fig 6). Positive rates of return occurred for NWSG at $800/ton for urea and for bermudagrass at $200/ton for urea. As was mentioned for previous analyses, higher market values for bermudagrass would result in higher rates of return for bermudagrass. When valued at $65/ton, summer annuals such as sudex are not profitable investments. Perennial grasses such as big bluestem/indiangrass and bermudagrass are much more profitable enterprises. As this analysis demonstrates, rate of return is highly dependent on nitrogen costs.

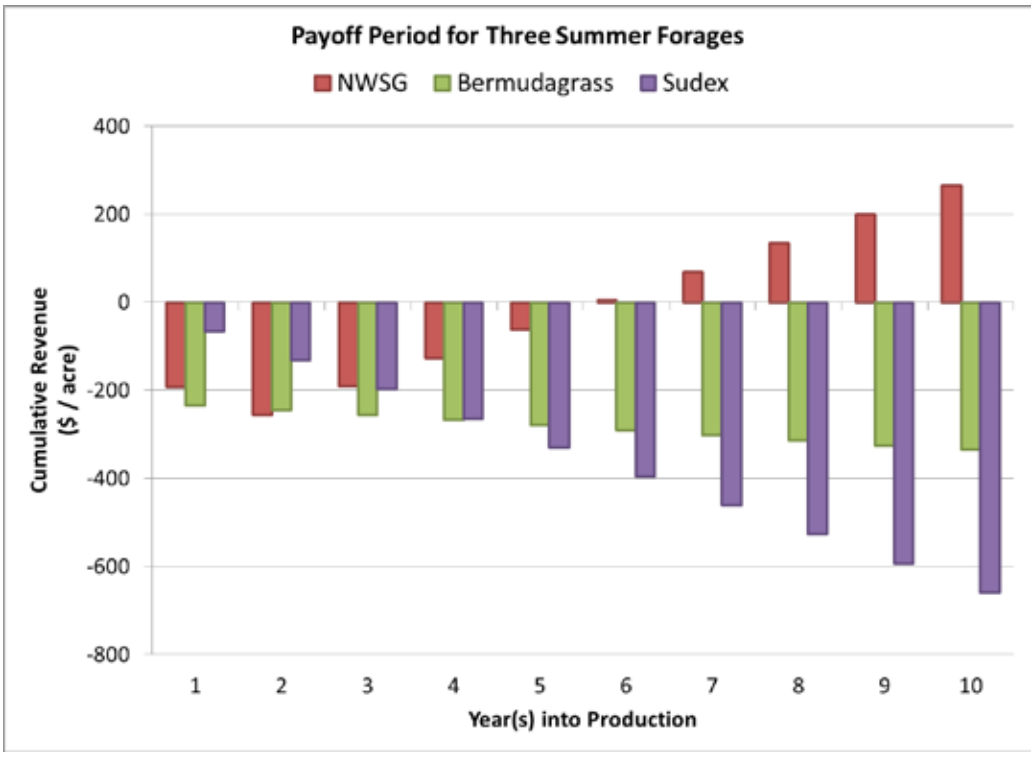

Figure 5. Comparison of pay-off periods for three warm-season forage options for the Mid-South. Assuming an average hay value of $65 per ton for large round bales, sudex production costs are not offset by the value of the hay produced. As an annual, sudex requires a yearly investment in establishment as well as production costs. At $65, bermudagrass is not an economical choice. However, profitability with bermudagrass hay is sensitive to price. For bermudagrass to reach the payoff period at year 4, the hay would need to be valued at $75 per ton.

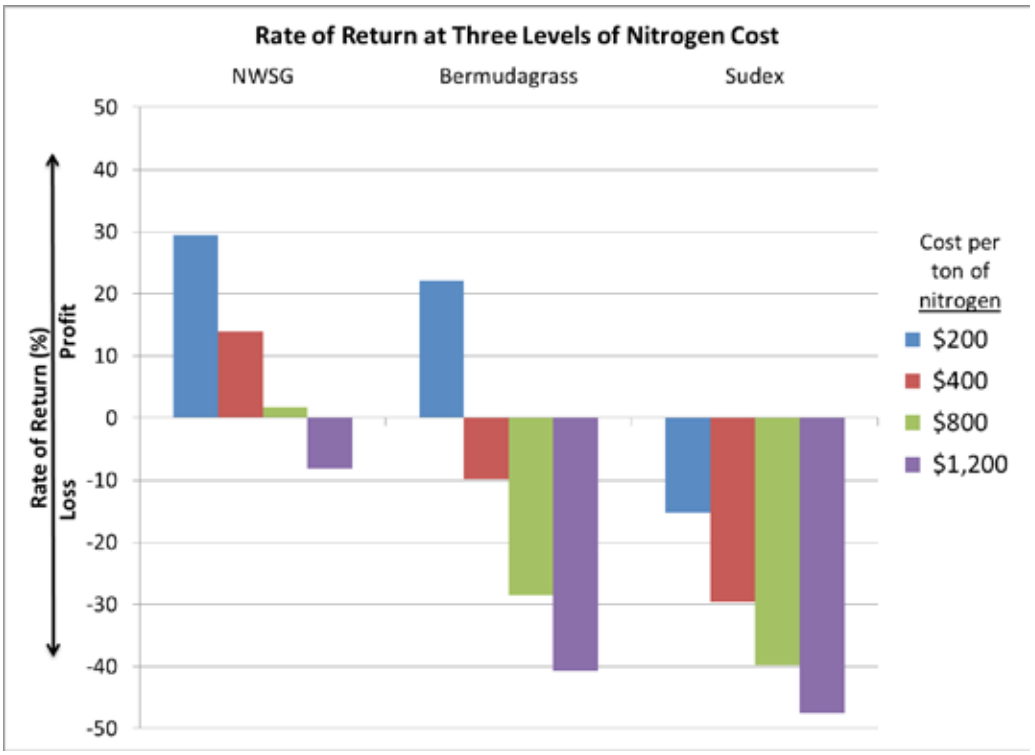

Figure 6. Impact of nitrogen cost on rate of return for three Mid-South forage options. When nitrogen is cheap, bermudagrass and big bluestem/indiangrass are profitable options. However, as nitrogen cost increases, bermudagrass becomes a less viable option. More expensive summer annuals did not provide positive returns under the assumptions of this model.

Final Thoughts

The information in this publication is intended to allow you to evaluate the implications of using various summer forages, especially NWSG, on your farm. Actual conditions and outcomes will, no doubt, vary, but these scenarios can help you make better-informed decisions. Please take advantage of the on-line tool (http://nativeforages.utk.edu) and use input figures that are appropriate for your forage program. You can also make whatever assumptions you consider appropriate regarding yields and hay values. Before adoption of any forage or grazing system, the economics of production should be examined to determine if they are compatible to your farm management. These analyses suggest big bluestem/indiangrass could make a valuable contribution to Mid-South farms (Fig. 7). They are most economical in a system where fertilizer inputs are low. For producers looking for a low-input alternative summer forage, NWSG, particularly big bluestem/indiangrass, are a suitable choice.

Figure 7. Because of excellent gains and low inputs, NWSG can be a cost-effective option for summer forages in the Mid-South.

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