Texas Cooperative EXTENSION
The Texas A&M University System

MKT-3557L
05/07

The Economic Benefits of Forage Sorghum Silage as an Alternative Crop

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Because of rising energy costs and the need for water conservation, Texas agricultural producers are looking for more efficient methods of using water in crop production. Extension specialists investigated the production, water use, quality, digestibility, nutritional, and feed conversion characteristics of forage sorghum silage varieties and found that forage sorghum silage can be an attractive alternative crop for some producers because it requires about one-third less water than corn silage. As a result, the acreage planted to sorghum silage has increased by 30,000 acres since 2003, resulting in more than $1.7 million in increased net returns relative to other crops. Sorghum silage is a viable source of high-quality silage for the beef and dairy industries in the Texas Panhandle.

Problem

The availability of adequate irrigation water and the rising cost of energy for pumping it are critical concerns of agricultural producers. In response, researchers are studying alternative crops that use less water.

The focus of this report is the estimated economic benefit of planting forage sorghum as an alternative crop for the production of silage, with emphasis on the Panhandle region where more than half the state's silage is produced. In 2004, the Panhandle produced 38 percent of the corn grown in Texas, 15 percent of the cotton, 38 percent of the wheat, 23 percent of the grain sorghum, and 84 percent of fed cattle.[1] The many stocker cattle grazing operations and confined cattle feeding operations use hay and silage for feed (about 5 million head of beef cattle are marketed annually).[1] There is also a growing dairy industry in the Panhandle, with some projections showing that the number of dairy cattle could reach 225,000. The dairy industry also generates a large demand for silage. Corn has been the traditional source of silage for the beef and dairy industries, but the scarcity of water in some areas and the cost of pumping it have many producers looking for alternatives.

Long-range water planning has become a top priority in recent years as the concern over the availability and use of water in the region and the state has risen. Senate Bill 1 (SB1), passed in 1997, put water planning in Texas in the hands of regional planning groups. The Panhandle Water Planning Area (PWPA) consists of 21 counties. In 1990, this area represented 2 percent of the state's population but accounted for about 13 percent of the state's annual water use. More than 90 percent of the water in the PWPA is used for agriculture. The Texas Water Development Board (TWDB) projects that the water demand in the whole Panhandle region will begin to surpass the available water supply in the year 2020. By 2050, the region could have a water deficit of more than 775,000 acre-feet per year.

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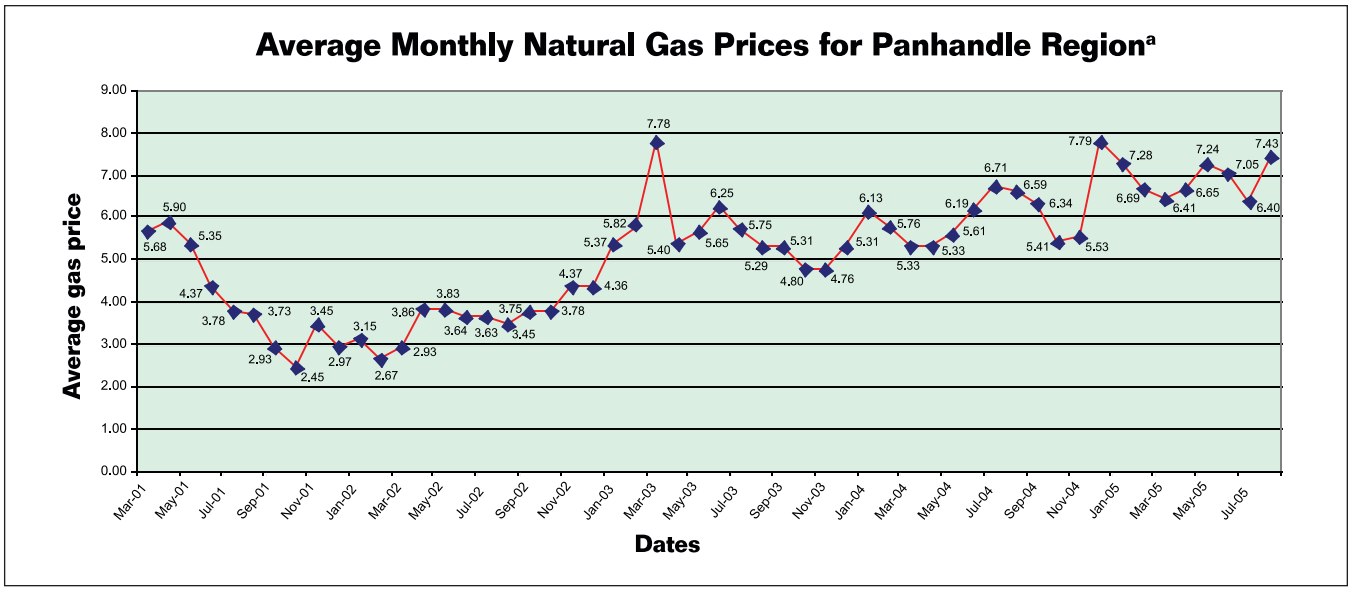
Figure 1.



[a]Source: Texas A&M University Research and Extension Center – Amarillo, Texas.

Another concern is rising energy costs, which have led to higher prices for several crop inputs, including the cost of pumping irrigation water. Figure 1 shows the average natural gas price over the past 5 years for three suppliers in the Panhandle region. The average price increased 54 percent from 2001 to 2005.

Extension's Educational Effort

Limited water in some areas and increasing energy prices have some producers looking for alternative crops. Applied research conducted by Texas Cooperative Extension specialists in Amarillo has demonstrated that forage sorghum silage can be a viable alternative crop for some producers.

At the request of the Texas Seed Trade Association and the National Grain Sorghum Producers Association, Extension agronomists and beef cattle specialists began testing forage sorghum varieties in 1999. In trials conducted at the Texas Agricultural Experiment Station's James E. Bush Farm near Bushland, Texas, different types and varieties of forage sorghum were compared for their agronomic characteristics, water use efficiency, standibility, forage and grain yield, and nutritional value. Forage sorghums were also compared to corn varieties planted in an adjacent trial. Last year, more than 80 forage sorghum varieties were tested and the research is ongoing.

Given the water shortage and silage demand in the Panhandle region, one of the purposes of the research was to determine whether forage sorghum could be an alternative to corn for silage production in the region. Results of the field trials indicate that recently developed varieties of productive, high-quality forage sorghum do have the potential to replace corn. With these new varieties:

- Yield is roughly the same as with corn.
- Far less water is used in production.
- Nutritional quality equals that of corn
- Fuel costs are lower than with corn.

From 2001 to 2003, the Extension field trials showed the average sorghum yield ranging from 19.2 tons to 26.9 tons and the average corn yield ranging from 23.8 tons to 25.5 tons. In addition, forage sorghum required 40 to 53 percent less water than corn. This means forage sorghum can be grown during dry years because drought has less effect on sorghum silage yield than on corn silage yield.

Extension specialists also conducted feed quality trials, which showed that replacing corn silage with sorghum silage did not lower the rate of gain or the feed efficiency of cattle. Certain forage sorghum varieties with lower lignin contents had digestibility and palatability characteristics comparable to corn. In the 2002 study, the in vitro true digestibility for nearly all of the brown midrib forage sorghum varieties tested averaged about 80 percent, as compared to 81.2 percent digestibility for the four corn silage hybrids tested.

Since 2001, Extension specialists have conducted more than 30 educational programs, sorghum silage field days and presentations, with an estimated 2,600 people in attendance. These events included a wide

variety of information, including the agronomic and nutritive characteristics of forage sorghum silage, beef cattle management, summer annuals for grazing, silage production, and forage sorghum as an alternative crop. Presentations were made at state and national conferences (National Grain Sorghum Producers Association, Southwest Nutrition and Management Conference, Texas Seed Trade Association, for example).

Economic Benefit of Sorghum Silage

The sorghum silage research and education conducted by Texas Cooperative Extension and the Texas Agricultural Experiment Station means economic benefits for producers in the form of increased net returns relative to other crops. The acreage planted to forage sorghum increased from 70,000 acres in 2003 to 100,000 acres in 2005.[2] In January, 2005, three seed companies in the Panhandle area were surveyed; they reported significant increases in forage sorghum seed sales and a 20 percent shift from corn silage seed to forage sorghum seed since 2000. Two of the companies stated that the information Extension provided to growers played a significant role in their increased sales.

Because acreage reports do not distinguish between irrigated silage and dryland silage, in this analysis it was assumed that 75 percent of the 30,000-acre increase in sorghum silage was irrigated, resulting in a 22,500-acre increase in irrigated sorghum silage from 2003 to 2005. Because the increase followed several years of applied research and educational activities conducted by Extension specialists in Amarillo, this analysis assumes that the increase is mostly attributable to Extension efforts.

To assess the economic impact of sorghum silage, it is necessary to take into account: 1) the crop or crops producers switched from, 2) the alternative crop or crops producers might have switched to if not for the sorghum silage varieties, and 3) the returns above variable costs (RAVC) for each crop under consideration. Fixed costs were not taken into account based on the assumption that they did not change when producers changed crops.

Crop budgets developed by Extension were used to estimate the relative returns of irrigated forage sorghum and alternative crops; these are presented in Table 1. Budgets represent projected costs and returns for production practices common to the area. The alternative crops selected for this analysis were irrigated corn silage, irrigated grain sorghum, and dryland grain sorghum.

The returns above variable costs per acre for these crops are: irrigated sorghum silage ($124.66), irrigated corn silage ($154.56), dryland grain sorghum ($3.66), and irrigated grain sorghum (-$96.92).

It should be noted that some producers produce these crops with higher returns than are shown in the budgets, while other producers may have lower returns than are shown here. Some producers do not know what their cost of production is and, therefore, do not know what their returns are. While each producer's production capabilities and costs are unique, the budgeted costs and returns represent what Extension specialists in the region believe is most common and realistic. With regard to the -$96.92 per acre return for irrigated grain sorghum, the main point to understand is that net returns for irrigated grain sorghum are usually marginal. As a result, a net return of $0.00 per acre for irrigated grain sorghum was used in this analysis.

Table 1. Crop budgets for 2005: costs and returns per acre.

	Irrigated sorghum silage	Irrigated corn silage	Dryland grain sorghum	Irrigated grain sorghum
Gross revenue	$500.85[1]	$715.15[2]	$88.66[3]	$221.65[4]
Total direct expense (excluding irrigation)	$285.84	$408.04	$85.00	$214.32
Irrigation (natural gas)[5]	$90.35	$152.90	$0.00	$104.25
Total direct expenses	$376.19	$560.94	$85.00	$318.57
Returns above variable cost (RAVC)	$124.66	$154.56	$3.66	-$96.92
RAVC used in analysis	$124.66	$154.66	$3.66	$0.00
Returns relative to irrigated sorghum silage		-$29.20	$121.00	$124.66

Note: Gross revenue for the various crops is based on the following yield prices and quantities:
[1]Revenue based on $23.85/ton price and 21.0 tons yield.
[2]Revenue based on $26.50/ton price and 27.0 tons yield.
[3]Revenue based on $4.03/cwt statewide price as reported by TASS and 22.0 cwt yield.
[4]Revenue based on $4.03/cwt statewide price as reported by TASS and 55.0 cwt yield.
[5]Based on natural gas price of $6.95/MCF.

Logically, a producer would not switch to a different crop if the return above variable costs would be lower. This analysis shows there is minimal to no economic benefit in switching from fully irrigated corn silage to fully irrigated sorghum silage. The primary benefit of sorghum silage is its relative advantage in comparison to other crops, especially for corn silage growers in areas where the availability of water is an issue. While the per acre returns above variable costs are an important component of this analysis, the most important budget aspect is the *relative returns* of the alternative crops compared to irrigated sorghum silage.

To estimate the economic impact of the increased sorghum silage acreage, adopters of irrigated sorghum silage were divided into Groups A and B, described below and in Table 2.

Group A: Irrigated sorghum silage substituted for irrigated corn silage. Group A, which includes half the acreage (11,250 acres), represents producers switching from irrigated corn silage. These acres are divided into acres of fully irrigated corn silage and acres with limited water. As a proxy for this, irrigated corn acres (621,000) and irrigated grain sorghum acres (431,000) in the region were pooled for a total of 1,052,000 acres (2003).[1] The rationale for this is that corn requires significantly more water than grain sorghum. Irrigated corn represents 59 percent of the total, and this percent is used as a proxy for the portion of corn silage acres in Group A that is fully irrigated. The remaining 41 percent of the acres in Group A represents corn silage producers who did not have sufficient water and were considering alternative crops.

The result is 6,637 acres (59 percent x 11,250) representing fully irrigated corn silage and 4,613 acres (41 percent x 11,250) representing limited irrigation corn silage. On the acres with limited water, dryland grain sorghum was used as the alternative crop to compare to sorghum silage because it is a common crop grown in the region and it is often used to break up continuous cotton.

The first step in this analysis was to estimate the net returns per acre for irrigated sorghum silage on the 11,250 acres, using the $124.66 per acre net return figure. The result is $1,402,425 in total net returns (Table 2, row b). The returns above variable cost per acre of $154.56 applied to the 6,637 acres of irrigated corn silage amounts to $1,025,815 in net returns (Table 2, row d). On the remaining 4,613 acres of the dryland grain sorghum alternative, the net returns are $3.66 per acre for a total of $16,884 (Table 2, row f). Subtracting the combined net returns for irrigated corn silage and dryland grain sorghum from the net return for irrigated sorghum silage yields an economic benefit from irrigated sorghum silage of $359,727 (Table 2, row h) for Group A.

It is worth noting that one of the larger feed yards in the Panhandle recently reported paying the same price ($27 per ton) for both sorghum and corn silage, which would favor sorghum silage over corn silage in a direct comparison, as compared to the prices used in this analysis. Silage buyers are beginning to pay a more competitive price for sorghum silage.

Group B: Irrigated sorghum silage substituted for irrigated grain sorghum. Group B, which includes 50 percent of the acres, represents producers switching from irrigated grain sorghum. Irrigated grain sorghum was selected as the alternative crop for this analysis because it is produced in all counties in the region and it uses about the same amount of water as does irrigated sorghum silage.

To estimate the economic benefit on these acres, we begin with the net return per acre for irrigated sorghum silage ($124.66) on all 11,250 acres, or $1,402,425. This is the same as with Group A (Table 2, row j). Using $0.00 net return on the 11,250 acres of irrigated grain sorghum, the net economic benefit of planting irrigated sorghum silage is $1,402,425 (Table 2, row l).

Combining the results of Group A and Group B, the net economic benefit to producers who adopted irrigated sorghum silage is an estimated $1.7 million per year (Table 2, row m).

Summary

Extension specialists have conducted extensive research on many forage sorghum varieties and worked to educate growers on the advantages and disadvantages of forage sorghum silage as compared to corn silage. However, corn silage has a long history with growers, feedlots and dairies, which affects perceptions of the quality of these two types of silage and the way they are priced in the market. However, prices for sorghum silage appear to be becoming more competitive. There is tremendous potential for forage sorghums in the years ahead. If the 54,000 acres of irrigated corn silage (TASS, 2004) in the Panhandle region were converted to sorghum silage, the amount of water saved would be an estimated 400,000 acre inches. This would lower the cost of irrigation pumping by $2.8 million annually (at a natural gas price of $7.00/mcf). With water being an increasingly important issue and with the rising demand for silage from the expanding dairy industry, sorghum silage should be an even more attractive alternative crop.

Table 2.

	Group A (50% of the acres switching from corn silage and dryland grain sorghum)					
A	Total additional acres of irrigated sorghum silage	50.0%	x	22,500	=	11,250
B	Total RAVC for irrigated sorghum silage	11,250	x	$124.66	=	$1,402,425
C	Alternative crop = irrigated corn silage	59.00%	x	11,250	=	6,637
D	Total RAVC for irrigated corn silage	6,637	x	$154.56	=	$1,025,815
E	Alternative crop = dryland grain sorghum	41.00%	x	11,250	=	4,613
F	Total RAVC for dryland grain sorghum	4,613	x	$3.66	=	$16,884
G	Total RAVC for corn and grain sorghum	$1,025,815	+	$16,884	=	$1,042,698
H	Relative economic benefit (b-g)	$1,402,425	–	$1,042,698	=	$359,727

	Group B (50% of the acres switching from irrigated grain sorghum)					
I	Total additional acres of irrigated sorghum silage	50.0%	x	22,500	=	11,250
J	Total RAVC for irrigated sorghum silage	11,250	x	$124.60	=	$1,402,425
K	Total RAVC for irrigated grain sorghum	11,250	x	$0.00	=	$0
L	Relative benefit in RAVC (j-k)	$1,402,425	–	0	=	$1,402,425
M	**Total economic benefit (h+l)**					**$1,762,152**

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Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Edward G. Smith, Director, Texas Cooperative Extension, The Texas A&M University System.

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