Forage sorghum

Forage sorghum is a large, warm-season, annual grass that is adapted to Pennsylvania and can be grown as a silage crop. Forage sorghum can be a profitable alternative crop, provided that it is managed well and used in the right situations. For instance, forage sorghum is cheaper to produce, has comparable yields, but has slightly lower forage quality when compared to corn for silage. The objective of this fact sheet is to describe some attributes of forage sorghum, provide some management recommendations, and describe the potential role of forage sorghum in the forage/livestock systems used on many Pennsylvania farms.

CHARACTERISTICS OF FORAGE SORGHUM

Forage sorghum is a member of the sorghum family and is closely related to grain sorghum, broomcorn, sorghum-sudangrass, and sudangrass. Forage sorghum is best adapted to warm regions and is particularly noted for its drought tolerance compared to corn. Forage sorghum has higher temperature requirements than corn. For example, the minimum temperature for sorghum growth is about 60°F and highest yields occur when the mean temperatures during the growing season are between 75°F and 80°F. Forage sorghums have even been grown successfully in short-season areas of Pennsylvania where 95-day corn is considered full season. Forage sorghum growth can range from 5- to 15-feet tall, depending on the hybrid. Hybrids can be fertile and produce grain yields comparable to grain sorghum, or they can be sterile and produce no grain.

Forage sorghum usually does not regrow following harvest, unlike sorghum-sudangrass or sudangrass, so forage sorghum is best adapted to a single-cut harvest for silage. Forage sorghum silage is usually slightly lower in energy than corn silage and is similar in protein. Yields of forage sorghums are comparable to corn and can range from 15- to 30-ton per acre depending on the soil, weather, and the hybrid. Both grain sorghum and especially forage sorghum have more resistance to deer damage than does corn. Consequently, they are also adapted to fields where deer damage makes corn production unprofitable.

PRODUCING FORAGE SORGHUM

Cultural practices

Forage sorghum is most often planted in rows with a corn planter to facilitate harvest, reduce lodging, and permit cultivation for weed control. Most corn planters need special sorghum plates or feed cups to handle sorghum seed. Air planters may require a special drum or plate. Like corn, forage sorghum yields increase with narrower rows.

Planting should be delayed until soil temperatures reach 65°F at the 2- to 4-inch depth. Planters should be set to place seed at a depth of 3/4 to 1 1/4 inches. Planting too early or too deep are two of the main causes of sorghum stand problems. It is important to pay attention to these details to ensure consistent success with forage sorghum. Forage sorghum yields also can be reduced with late planting, although not to the extent yields would be reduced with late-planted corn. In most areas, yields will be maximized with a mid-May to early June planting date. Forage sorghum has performed well in no-till systems when conditions are favorable in the seed zone. It has less tolerance than corn to cool soil conditions under heavy residue or to soils that may be wet where furrow closure is a problem.

Optimum planting rates for forage sorghum are about 8 to 12 pounds of seed per acre. Seed lots often contain about 14,000 to 17,000 seeds per pound, and sorghum emergence is often about 75 percent, so these planting rates will result in plant populations of 85,000 to 150,000 plants per acre. Many growers have found that once they develop some experience planting the crop, seeding rates in the low end of this range are adequate. Excessive seeding rates can increase the risk of lodging problems.

Fertility recommendations

Forage sorghum should be fertilized similar to corn for silage. Soil pH should be maintained above 6.0 with target pH of 6.5. A forage sorghum silage crop removes large amounts of nutrients, so soil testing is essential with this crop. The nutrient recommendation for a soil testing in the optimum range for P and K is 120 pounds of N, 65 pounds of P_2O_5, and 120 pounds of K_2O for a crop with a 21-ton per acre yield potential. Nutrient requirements can be

adjusted by increasing or decreasing the recommendation by 30-15-30 pounds for each 4-ton per acre change in the yield goal. Nutrient requirements should be adjusted for previous crop credits and manures. Some evidence indicates that sorghum may utilize N from previous crops such as soybeans more effectively than corn, but this has not been confirmed in Pennsylvania. Starter fertilizers similar to those used for corn can be used with forage sorghum when planted with a row planter, but if the crop is drilled they should be avoided to prevent starter fertilizer injury.

Weed control

Fewer herbicides are available for forage sorghum compared to corn, so control of some problem weeds may be a challenge without tillage. Consult the *Penn State Agronomy Guide* for the latest weed control recommendations. Be sure that the herbicides you select are labeled for sorghum harvested for *silage*. Some herbicide products are only labeled for use on sorghum that will be harvested for *grain.* Once established, forage sorghum is a competitive crop and will shade many weeds later in the season. Sorghum is sensitive to some corn herbicides such as Dual or Lasso, but seed is available that is treated with safeners that allow the use of these herbicides on sorghum. Be sure to request the correct safener for the herbicide you plan to use. Cultivation is also an effective option when forage sorghum is grown in rows.

Insect control

Insects are generally not a problem on forage sorghum and no chemical controls are recommended in Pennsylvania. Sorghum roots produce a substance that is toxic to corn rootworm larvae so sorghum can be planted following corn without the use of a soil insecticide. In addition, the risk of corn rootworm damage to corn following sorghum is low and no rootworm insecticide treatment is required for the corn. Although occasional infestations of aphids can develop in the whorl or on the heads of sorghum, these rarely cause any economic damage.

Hybrid selection

Forage sorghum hybrids can vary considerably in yield potential, height, forage quality, grain content, and maturity. It is important to match the traits of the hybrid to the production situation and the desired use of the crop.

Maturity is an important consideration for the medium-season and short-season areas of Pennsylvania. Full-season forage sorghums will not mature in these areas and the crop will have to be killed by frost before harvest can begin. This causes harvest delays because of prussic acid concerns, and may result in forage quality reductions. Sorghum maturity is rated either as full, medium, and early or by the days needed to flower. Adapted forage sorghums range from full season in southeastern counties to early maturity in the short-season areas of the state. Seed suppliers can provide hybrid maturity recommendations for specific areas.

Crop growth and development

Smaller seed size and higher temperature requirements for sorghum result in slower emergence and lower seedling vigor compared to corn. Since forage sorghum is adapted to warm conditions, early season growth is also slow compared to corn. However, forage sorghum grows rapidly when temperatures rise in July and August. Sorghum will continue to grow when adjacent corn fields are exhibiting leaf rolling due to water stress. If moisture stress becomes severe, sorghum will become dormant until the stress is relieved. Severe drought stress or cool, late season temperatures may delay the maturity of the crop. Generally, this delayed maturity will not be a major problem if the crop is harvested for silage.

Harvesting

Forage sorghum is best utilized as a silage crop, although it can be grazed or cut for hay if managed appropriately. Like most crops, forage sorghum responds well to good silage management practices—harvest at the right moisture content for the silo, chop uniformly, fill the silo as quickly as possible, and pack the silage well. Sorghum yield and forage quality are maximized at levels between 60 and 72 percent moisture content. This usually occurs between the medium-dough and hard-dough stages. Harvesting at moisture contents higher than 72 percent may cause problems during the ensiling process and will decrease intake by cattle. Harvesting drier sorghum can reduce the energy and protein value. Forage sorghum typically dries down slowly. For sealed silos or large upright silos, consider planting an earlier maturing hybrid or adding a dry feedstuff such as ground ear corn to reach the desired moisture level. The recommended chop length is 3/8- to 1/2-inch. Consider using a recutter screen if the crop is dry and the grains are hard. This will crack more kernels and reduce the potential for kernel passage through the animals.

Prussic acid and nitrates

Be aware of the potential for prussic acid poisoning or nitrate toxicity with forage sorghum, but also realize that these problems are not normally a concern when sorghum is harvested for silage. Prussic acid occurs mostly in young plants or plants harvested shortly after a frost or drought-ending rain. The regrowth from plants killed by a frost is particularly high in prussic acid content, but this regrowth is rare in Pennsylvania. Because prussic acid is volatile, it dissipates during the harvesting and ensiling process and is rarely a problem in sorghum silage. Wait four days following a killing frost to harvest forage sorghum. This allows any prussic acid formed to dissipate before harvesting. Generally after four weeks of ensiling, any prussic acid problem has been alleviated. Questionable forage can be tested for prussic acid (HCN) at the Pennsylvania Department of Agriculture Summerdale Laboratory in Harrisburg (717-787-8808). The concern of prussic acid and nitrate poisoning is greatest when sorghum is grazed less that 24 to

30 inches in height, immediately after a killing frost, or on regrowth of sorghum killed by an early frost.

Nitrates can be a problem with forage sorghum as they are with corn silage, but again this is rare and usually associated with harvesting a heavily manured or fertilized crop during or immediately following a severe stress such as a drought. The ensiling process reduces nitrate content in the silage. When high nitrate levels are suspected, leave 10 to 12 inches of stalk in the field, because nitrates tend to accumulate in this region of the plant.

UTILIZING FORAGE SORGHUM

Forage quality

Forage sorghums typically have slightly lower energy values than corn silage, but are similar in protein. When compared to sorghum-sudangrass, forage sorghum silage is higher in energy and lower in protein (Table 1).

Because of the lower quality of forage sorghum crops compared to corn, they are best used in situations where forage sorghum yields are higher than corn or where livestock energy requirements are less than what is supplied by corn silage.

Adaptation of forage sorghum

In many Pennsylvania situations, corn silage will produce high yields of a high quality forage and is a preferred silage crop compared to forage sorghum. On droughty, shallow soils, however, forage sorghum yields may be more consistent than corn. In addition, input costs (Table 2) are lower for forage sorghum so the crop is established with less financial risk. Under these conditions, forage sorghum may be an attractive alternative to corn. Even when the reduced value of forage sorghum silage is considered, forage sorghum can be more profitable than corn in some situations (Table 3).

Forage sorghums are also adapted to farms that experience considerable deer damage to corn. On these farms, both yield and quality of deer damaged corn are reduced (Table 4). Here, substitution of forage sorghum for corn can make a large difference in the profitability of a silage

Table 1. Quality of forage sorghum silage compared to corn silage and sorghum-sudangrass.

	Crude protein	TDN	NEL	NEM	NEG
	% dry matter		Mcal/lb		
Corn silage	8.1	70	0.73	0.74	0.47
Sorghum silage	7.5	60	0.61	0.60	0.34
Sorghum-sudangrass	10.8	55	0.56	0.52	0.26

NEL = net energy of lactation, NEM = net energy of maintenance, and NEG = net energy of gain.
Source NRC, revised edition, 1989

Table 2. Variable costs associated with corn and forage sorghum production (1995 estimates).

Item	Corn silage	Forage sorghum
	$/A	
Fertilizer, lime	93	93
Herbicides	20	20
Insecticides	12	0
Seed	32	10
Labor	26	26
Repairs, maint., fuel, interest	38	37
Total variable costs	221	186

Table 3. Estimated returns to management for either forage sorghum or corn silage production on a droughty soil with a low (13 T/A) or average (21 T/A) yield potential for corn silage.

Item	Corn silage	Forage sorghum	Corn silage	Forage sorghum
Receipts				
Yield (T/A)	13	15 [a]	21	21
Price ($/T)	23	20	23	20
Total	289	300	483	420
Variable costs	189[b]	152 [b]	221	186
Fixed costs	44	44	44	44
Land	30	30	50	50
Total costs	263	226	315	280
Returns	36	74	168	140
Cost ($/T)	20.23	15.07	15.00	13.33

[a] Assumes a 2-T/A yield advantage to forage sorghum on a low-yield potential field.
[b] Variable costs are lower due to reduced fertilizer recommendations on low yielding fields.

Table 4. Example of a corn and forage sorghum yield and quality response in a field with moderate deer grazing pressure. Data are from plots at Rock Springs, 1992.

Item	Corn silage	Forage sorghum
Yield (T/A)	9.0	14.0
Protein	5.8	7.1
ADF	34.2	34.3
TDN	64.3	64.1

production enterprise (Table 5). Forage sorghum can also be grown in a mixture with corn on such fields. Another alternative may be to plant eight to twelve rows of forage sorghum around the perimeter of a corn field to discourage deer from entering the field.

Table 5. Estimated returns to management for either forage sorghum or corn silage production on a droughty soil where deer damage has reduced the yield and quality of corn silage.

Item	Corn silage w/deer	Forage sorghum
Receipts		
Yield (T/A)	9	14
Price ($/T)	20	20
Total	180	280
Total Costs	263	226
Returns ($/A)	-83.00	54.00
Cost ($/T)	29.22	16.14

Forage sorghum is also particularly well suited to some classes of livestock, such as dairy heifers and dry cows. These animals have lower energy requirements than lactating animals or those on a finishing ration. Sorghum can provide an almost-complete ration for these animals when supplemented properly. Nonprotein nitrogen additives such as urea and anhydrous ammonia can make forage sorghum almost a complete ration for growing heifers.

Some growers in full-season areas of Pennsylvania have utilized a double-crop rotation to produce dry cow and heifer feed very economically. Their rotation involves a winter cereal grain harvested for silage followed by a forage sorghum harvested for silage. This rotation facilitates manure spreading and contributes nicely to a nutrient management plan because of the large amounts of N and other nutrients removed from the soil.

Occasionally, in good years, forage sorghum production may exceed silage storage capabilities on the farm. Nonsterile (grain bearing) forage sorghums can be harvested for grain. Harvesting and storing the grain as a high-moisture product improves the feed efficiency, as does processing the grain in a roller mill.

SUMMARY

Forage sorghum is a crop that has a potential under some soil/crop/livestock situations in Pennsylvania. Like other crops, it responds to good management; paying attention to the details of producing forage sorghum will improve the likelihood of success with the crop. Too often it has been regarded as an emergency crop and not managed to obtain its top potential. Consider several key aspects of forage sorghum management to ensure success: (1) grow it in a situation where it is adapted and will result in economical feed, (2) pay attention to planting depth and planting date, (3) select a hybrid adapted to the area, and (4) harvest on time and with good silage management practices. With these considerations, forage sorghum can be an important crop alternative for livestock farms in Pennsylvania.

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