Corn and Sorghum Silage Production Considerations

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INTRODUCTION

Corn silage has long been the silage of choice for dairies. The main advantage of corn over sorghum is that corn tends to be a more consistent product from a nutritive value standpoint. However, in order for corn to be of high nutritional value it must produce large amounts of grain. In periods of drought, grain production from corn can be severely limited. In those areas where rainfall or irrigation is expected to be lacking for good corn silage production, sorghum should be considered. This paper will discuss practices to consider for successful production of each crop.

CORN

Hybrid Selection

Seed companies will generally have the best source of information for choosing a corn hybrid for a particular field. Unfortunately, only limited information is available from Universities or the Extension service to help with variety selection. Variety trial data from the Texas South Plains, Panhandle, and Central Texas area can be found at http://varietytesting.tamu.edu. Results from New Mexico variety trials can be found at http://aces.nmsu.edu/pubs. It is important when choosing a variety that it be adapted to your area. This is where the seed companies can generally be of help. Any corn hybrid that is grown for grain in a particular region can potentially be used for silage production. However, companies do designate some hybrids specifically for silage production. These hybrids are typically a little longer in maturity than the hybrids grown for grain. The longer maturity hybrids will tend to result in more total overall biomass.

New hybrids today often come with a combination of biotechnology traits for herbicide tolerance and insect resistance. These *traits* are generally derived by techniques involving **GMO** or genetically modified organisms. Traits that may be included in a hybrid are:

1) Glyphosate or Roundup herbicide tolerance
2) Liberty herbicide tolerance
3) Stalk boring insect protection
4) Rootworm insect protection
5) Ear feeding worm protection

Hybrids today will come in various combinations of any of these traits, and often are sold with multiple modes-of-action for the same trait. While these *stacked* traits make it much easier to control weeds and insects, it also can add considerably to the cost of seed. Seed can vary from as much as $60 to $300 a bag. In selecting a hybrid, first determine which of these traits provide value to you. For example, if the corn will be planted to a field that previously was in another crop, then rootworm insect protection may not be necessary. However, corn planted after corn may warrant this trait. Therefore, it is important to know the common pests in your area of production and the management that may facilitate pest problems. Typically the fewer traits that a hybrid has, the cheaper the seed will be.

Planting, Row Spacing, and Seeding Rate

Once soil temperatures rise above 50 °F corn can be planted. However, the cooler the soil temperature the longer it will take for corn to emerge. In most cases, it is better to delay planting and let soil temperatures rise to at least 55 °F. This will help ensure quick emergence and vigorous early season growth. Producers should also consider stagger planting fields of corn; particularly if equipment is not available to harvest and ensile large quantities of forage in a timely manner. Another advantage of using staggered planting dates is that production risks due to adverse weather are reduced. If the corn is to be irrigated, staggered dates may also allow for water to be concentrated on fewer acres during pollination and early grain-fill.

Seeding rate should be increased 10 to 20 % over rates used for grain production. Seeding rate will vary depending on yield goal and hybrid. New hybrids tend to require higher seeding rates even under low yield environments. Corn can be successfully planted on row spacing's of 15 to 40 in. Narrow rows have an advantage in that the corn will canopy over the ground quickly, which will reduce weed competition and lower the loss of water due to surface evaporation. The disadvantage of narrow rows is that in-season tillage may be more difficult as will be ground-rig application of herbicide or insecticide. As row spacing is narrowed seeding rate should be towards the higher end of what is recommended for the area. Research has shown that higher yields can be achieved with higher seeding rates, but must have adequate water. However, the higher yield may be coupled with slightly lower quality. As seeding rate increases the percentage of the silage yield coming from the grain fraction of the total biomass goes down. Total fiber increases while digestible fiber, and thus whole plant digestibility, decreases. On a per acres basis, the total milk produced may go up with higher population, but will go down slightly on a per ton basis.

Fertility Needs

Corn grown for silage will require more fertilizer than when only harvesting the grain. When only grain is harvested a significant amount of nutrients are returned to the soil that is in the stover portion of the corn plant. General recommendations for nitrogen required for corn silage are 8 to 10 lbs of N per ton (wet) of yield goal. The amount of nutrients removed in a ton of silage can be easily determined. Average numbers reported by the International Plant Nutrition Institute are in Table 1.

Table 1. Average nutrients removed in harvested crop[1)]

Crop	Unit	N	P_2O_5	K_2O_5
Corn	lb/bu (dry)	0.75	0.44	0.29
Corn Silage (67 % Moist.)	lb/ton	8.30	3.60	8.30

[1] International Plant Nutrition Institute. Updated 2010.

Weed Control

There are many options for weed control in corn. In general, a pre-emergence product such as atrazine or metolachlor (or a combination of both) should be applied prior to or at planting. If the corn hybrid planted is Roundup Ready, then a glyphosate containing product can be used for post-emergence weed control. It is important that glyphosate be used with other herbicides in order to avoid the development of weed resistance. Several other post-emergence herbicides are available for both broadleaf and grass weed control in corn.

Water Needs

For quality corn silage production, water needs of the crop will equal that of corn grown for grain. That is because of the importance of grain for tonnage and quality. Corn silage that is dependent on rainfall for its water needs is best grown under those regions that receive 26 in or more of annual rainfall. If grown under irrigation, the irrigation capacity should be similar for that required for grain production. Daily peak water demand will be the same as that for grain production. Peak water use in the TX Panhandle and E. NM regions may exceed 0.4-0.5 in/day. Therefore, a minimum well capacity of 5.0-6.0 GPM/ac is recommended to help meet this demand. In extremely dry seasons and with no deep profile moisture, this minimum capacity may not be enough, as was experienced in the region in 2011. Compared to growing corn for grain, a couple of inches of irrigation water can usually be conserved at the end of the season, since silage is harvested prior to grain reaching physiological maturity. Care should be taken in not terminating irrigation too quickly. Plant-available soil water must be maintained up to the point of harvest, since starch will be accumulating in the grain up to the time the silage is chopped.

Harvest

Whole plant moisture at harvest ideally should be between 65 and 70 % moisture. If the forage is too wet, seepage losses and the risk of acidity will increase. If too dry, packing of the silage can become more of an issue and oxygen exclusion will be difficult leading to dry matter losses. Traditionally, corn silage was harvested when the milkline of the grain had moved halfway to the base of the kernel. With new stay-green hybrids, the percent moisture may not be low enough until the grain milkline has progressed two-thirds of the way down the kernel. The only way to accurately evaluate whole-plant moisture is to collect a plant sample and have it tested. Under good drying conditions, whole-plant moisture content will typically drop 0.5 percentage points a day.

Utilizing Stressed Corn

Corn that is stressed from drought, or possibly from hail, is often harvested for silage. The quality of this silage will largely be dependent on how much grain is produced. Severely stressed corn with little grain may have a feeding value of only 70 % of normal silage. If only moderately stressed then the feeding value would likely be between 80 and 95 % of normal. One way to improve the quality of stressed corn is to simply raise the cutter bar. Tonnage will be reduced about 1 ton for every 4 or 5 in the cutter bar is raised. However, a higher percentage of the silage tonnage will come from whatever grain is present, thus increasing overall quality. Nitrate can be high in stressed corn. Raising the cutter bar height will also tend to lower the nitrate concentration since nitrate tends to

accumulate in the lower portion of the stalk. Nitrate level should be checked prior to ensiling. The ensiling process should lower the nitrate level approximately 50 %, but should be checked prior to feeding.

FORAGE SORGHUM

For a complete discussion of forage sorghum production, see the publication '*Western Forage Sorghum Production Guide'* at http://amarillo.tamu.edu/amarillo-center-programs/agronomy/.

Hybrid Selection

When choosing a sorghum hybrid for silage production both yield and nutritive value should be considered. There is wide variability in yield and nutritive value among forage sorghum hybrids. Which of these is emphasized depends on how the silage is to be utilized. For lactating cows, feed value will likely be the most important consideration. However, for dry cows, or even in the feedyard, yield may be more important, particularly if acreage to grow the silage is limiting. Agronomic characteristics such as potential for lodging or days to maturity may also be important factors.

Two main types of forage sorghum hybrids, brown midrib (**BMR**) and non-BMR, are being utilized most often for silage production. The BMR hybrids are characterized by the expression of a brown midrib, but more importantly they contain less lignin than non-BMR hybrids. Lowering the lignin content increases the overall digestibility of the fiber component of the forage, and thus improves overall nutritive value. The disadvantage of the BMR hybrids is that lodging can be more of an issue, particularly if harvest is delayed past the optimum stage. The average of yield and nutritional characteristics for 35 BMR and 22 non-BMR hybrids in a trial conducted in 2011 at the Texas AgriLife Research Field Lab near Amarillo, TX is reported in Table 2.

Table 2. Comparison of and BMR and non-BMR forage sorghum in 2011[1)].

		Sorghum Type	
Characteristic		**non-BMR**	**BMR**
Silage, Ton/Ac @ 65 % Moist.	Mean	21.9	20.1
	Range	18.1-24.5	15.0-25.4
C. Protein, %	Mean	6.7	7.3
	Range	4.6-9.3	4.7-9.6
NDF, % DM	Mean	51.4	51.1
	Range	38.8-61.1	41.6-61.3
ADF, % DM	Mean	35.1	34.5
	Range	27.5-41.5	29.0-40.0
NDFD, % DM	Mean	40.7	46.5
	Range	36.0-45.4	38.3-51.2
IVTD, % DM	Mean	69.5	72.7
	Range	60.9-76.3	66.7-77.0
Milk, lb/ton DM	Mean	1,780	2,045
	Range	1,353-2,159	1,651-2,344

[1)] 2011 Texas Panhandle Forage Sorghum Silage Trial. http://amarillo.tamu.edu.

It is often assumed that a high grain yield is necessary for forage sorghum to produce high quality forage. While this tends to be true with conventional forage sorghums, it is not true with BMR hybrids. Research has shown that BMR hybrids can have a very low percentage of grain in the silage, yet be very high in nutrition. In the figure below, the percent grain in pre-ensiled forage was compared to the percent *in vitro* true digestibility (**IVTD**) of the pre-ensiled forage sorghum. Conventional forage sorghums IVTD increased quadratically and plateaued at 78.0 % when the silage was 34.5 % grain. In contrast, in the BMR forage sorghums, IVTD plateaued at 80.8 % when grain content was only 2.0 % of the total weight.

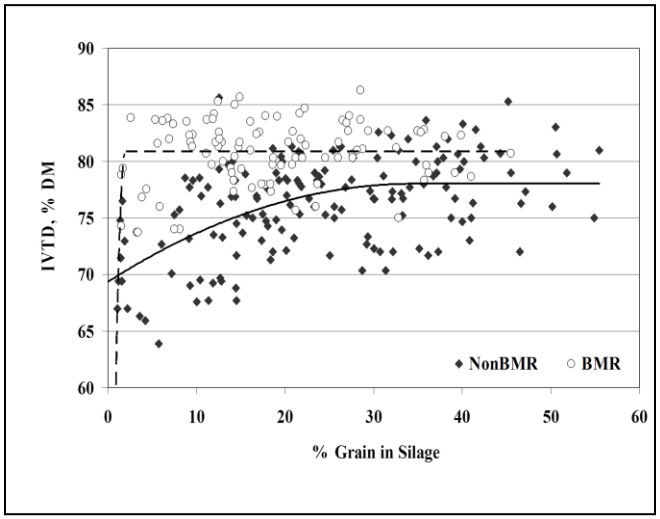

Figure 1. Grain content and *in vitro* true digestibility (IVTD) relationships for pre-ensiled conventional (non-BMR) and brown midrib (BMR) forage sorghum in four years of variety trials (Texas AgriLife Research, Amarillo, TX; McCollum et al., 2005.)

Planting, Row Spacing, and Seeding Rate

Forage sorghum can be broadcast or drilled, but most producers plant it in rows with a planter for better emergence and for ease of harvesting with silage equipment. The recommended soil temperature for rapid germination is 60 °F or higher (at 6 in depth for 10 d). However, earlier planting at 55 °F is possible, but it runs the risk of delayed emergence and damage to the crop from late freezes. The desired planting depth for sorghum is ¾ to 1½ in.

Seeding rates will vary depending upon intended use, row spacing, seed size, and irrigation (Table 3). Seed size will vary ranging from 12,000 to 22,000 seeds/lb. In general, recommended rates range from 30,000-120,000 seeds/acre, depending on sorghum type, row spacing, and anticipated irrigation amount. Research in Eastern New Mexico and the Texas Panhandle has shown that excellent silage yields can be obtained with irrigation from seeding rates as low as 75,000 seeds/acre; and little (if any) advantage has been seen with seeding rates over 120,000 seeds/acre. Narrow row spacing (6-20 in) will require a higher seeding rate than wider row spacing (> 20 in). Many growers underestimate the ability of sorghum to compensate for low seeding rates and will unnecessarily increase their production costs by planting at higher rates. If irrigation is limited, seeding rates should be reduced. Dryland seeding rates should be one-half or less of those for irrigated.

Table 3. Generalized seeding rates for forage sorghum grown for silage based on anticipated irrigation applied in the Texas Panhandle and Eastern New Mexico regions.

Forage Sorghum Type	Irrigation (acre-in)	Planting Rate (1000 sd/acre)
Conventional (non-BMR)	0	30 – 50
	4 – 8	50 – 90
	9 – 18	90 – 120
Brown Mid-rib (BMR)	0	30 – 50
	4 – 8	50 – 75
	9 – 18	75 – 100

Fertility Needs

Sorghum will typically grow better than corn on infertile soil, but will respond favorably to good fertility conditions. Soil pH is an important consideration. Sorghum will not grow well in soils with pH greater than 8.0. In very high pH soils, sorghum will emerge and turn yellow from iron and/or zinc deficiency and not yield well. Fertilizer needs will be similar to that of corn on a per ton basis. A general rule of thumb is that 8-9 lb of N will be used for every ton (wet) of silage produced (24 – 27 lb/dry ton); however, excellent yields have been obtained with as little as 6.5 lb N/acre/ton of expected yield. It is important that N not be over applied as this tends to promote lodging.

In the absence of a soil test, general recommendations for phosphorus (P) and potassium (K) are 30-80 lb/ac of each at planting; however, yield responses to these fertilizers may be minimal if soil levels of P and K are medium or higher. Phosphorus often times is limiting, particularly in highly calcareous soils where levels of available P are low. Soil tests indicating P levels lower than 20 ppm (Olsen-P) will likely require a P fertilizer application. The general P recommendation for forage sorghum is 2.75 to 3.25 lb P_2O_5/acre for every ton (wet) of expected yield. Regional soils are often adequate in K, and rarely is any benefit of adding K reported.

Weed Control

Herbicide options are much fewer in sorghum than in corn. Because of the lack of many good options for weed control after the crop emerges, it is very important that a good pre-emergence product be applied. Atrazine or Milopro are good pre-emergence options, if broadleaf weeds are the primary problem. If annual grasses are an issue, then a product containing the active ingredient s-metolachor should be used. Common trade names containing s-metolachor are Dual II Magnum, Cinch, Parallel, and others. Bicep II Magnum and Cinch ATZ are products that contain a combination of atrazine and s-metolachlor. If s-metolachlor is used, seed **MUST** be treated with a seed safener.

A new post-emergence product on the market that is very effective on many broadleaf weeds is Huskie. Huskie is especially effective on Palmer amaranth. Atrazine can also be used post-emergence, but it is critical that weeds be small (less than 4 in) at the time of application.

Water Needs

Forage sorghum requires less water than corn and is more drought and heat tolerant. However, forage sorghum does respond well to timely irrigation. In the Texas Panhandle and Eastern New Mexico region, maximum sorghum silage yields can usually be obtained with 12 to 16 in of irrigation water. *Typical high yields for forage sorghum are about 25 tons/ac; however, yields over 30 tons/ac have been achieved. Water use efficiency of sorghum silage ranges from 0.9 to 1.3 ton/ac-in of total water available to the plant. Typically, conventional* non-BMR hybrids will produce more tonnage than BMR hybrids on the same amount of water, although this is beginning to change with better BMR hybrids being released.

Getting forage sorghum to dry down to the proper moisture level for ensiling can sometimes be an issue. For this reason it is often best to terminate irrigation several days to 2 wk prior to the anticipated harvest date.

Harvest

Similar to corn, forage sorghum should be harvested when the whole-plant moisture is between 65 and 70 %. Typically this is when the grain is in the soft dough stage. It is very important that forage sorghum be harvested at the proper time. This is especially true with hybrids that produce a lot of grain. If the grain matures past the soft dough stage it may become too hard to digest properly. In addition, lodging becomes an issue with some BMR hybrids that are left in the field beyond the soft dough stage. It is more difficult to judge proper plant moisture based on grain stage of maturity with forage sorghum than corn. Hence, cutting plants and measuring whole plant moisture is even more critical with forage sorghum.

SUMMARY

Table 4 contains a summary of the differences between corn and sorghum grown for silage. Each producer must weigh their options and make a final selection based on their unique circumstances.

LITERATURE CITED

McCollum, F.T., K.C.McCuistion, and B. Bean. 2005. Brown midrib and photoperiod sensitive forage sorghums. Pg. 36 in Proc. Plains Nutr. Coun. Spring Conf.

Table 4. Comparing the differences between corn and sorghum

Seed Cost	Corn seed will typically cost approximately $100/ac compared to $15/ac for sorghum.
Water Use	Full production corn silage will require 20-25 in of irrigation water compared to 14-18 in for sorghum silage.
Yield	Fully irrigated corn will typically yield between 27 and 32 ton/ac compared to sorghum silage at 20 to 26 ton/ac on average.
Silage Quality	Corn typically will be of better feed value than sorghum, however, some sorghum hybrids have been shown to be equal in nutritional value to corn.
Drought Tolerance	Sorghum is better able to withstand periods of drought than corn.