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NebGuide

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Harvesting Corn and Sorghum for Silage

This publication describes how to make high-quality corn and sorghum silage.

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Quality Silage

Silage feeding quality is determined by 1) the nutrient content of the crop stored, 2) the stage of maturity and moisture content when harvested and 3) the effectiveness of silage preservation.

Corn vs. Sorghum Silage

Generally, forage sorghum silage has 80 to 90 percent of the energy value of corn silage per unit of dry matter. Forage sorghum silage has less energy value because of a lower percentage of grain-to-forage, a higher percentage of the grain passing through the animal undigested, and a stalk of lower digestibility. Under irrigation, corn typically produces more dry matter per acre. However, on dry land in Nebraska's southern, central, and western counties, forage sorghums will normally produce higher dry matter and energy yields per acre than corn.

Depending on the forage sorghum variety, the moisture content may be too high for making the best silage for beef cattle until a few days after the first frost. When you wait this long to harvest, the taller varieties may begin to lodge and create problems during harvesting. For dairy and beef cattle, early harvest is not detrimental to performance. In fact, more mature sorghum silage is used less efficiently for milk production. However, dry matter yields increase with maturity and compensate for the lower efficiency of the mature crop.

Grain sorghums can make silage nearly equal to corn silage. However, under irrigation, they normally produce lower silage dry matter yields than corn. On dry land, the dry matter yield per acre is usually less than for the best forage sorghums. Digestible energy yield from grain sorghum silage may be equal to or higher than many forage sorghums. Because grain makes up 50 percent or more of the total dry matter of grain sorghum silage, and the seed coat is tough, relatively large amounts may pass through

cattle undigested. Therefore, consider rolling the grain sorghum as it is put in or taken out of the silo. An alternative to rolling the whole plant is to harvest the crop in the hard dough stage when the grain and seed coat are softer and more easily broken by mechanized harvesting and animal chewing.

During years when grain sorghum does not reach maturity for grain harvest, some producers have successfully "head-chopped" grain sorghum in which only the heads and small amounts of stalk are chopped and ensiled. This has proven to be a high-quality feed for beef cattle, especially if rolled or ground to break up 95 to 98 percent of the grain. In dairy lactation trials conducted in Arkansas, head-chopped silage was inferior to sorghum grain, partially due to the higher fiber content. However, when properly fed in a balanced ration, rolled, head-chopped silage maintained normal milk yields. Replacing sorghum grain or well-eared corn silage with immature grain sorghum silage or head-chopped silage may reduce milk production and efficiency of gain. However, if grain harvest is not possible, grain sorghum silage or head-chopped silage may be viable alternatives to salvage the feeding value of your sorghum crop.

Sudangrass and sudan-sorghum crosses have about 65 to 80 percent of the energy value of corn silage per unit of dry matter. Moisture content is a major problem in producing desirable silage from these crops. Early-cut sudangrass and sudan-sorghum crosses usually require wilting to produce satisfactory silage. The last cutting can be harvested following frost when moisture content is reduced to desirable levels.

Stage of Maturity and Crop Moisture Content

Stage of maturity is important for two reasons: (1) maximum production of digestible nutrients, and (2) its relation to moisture content for proper ensiling and dry matter intake.

Corn has maximum feeding value and the most desirable moisture content at physiological maturity, or at the formation of the black layer in the kernel. You can check for black layer development by splitting kernels lengthwise or by cutting off the tip of the kernel. At this stage, ears will be in the full dent to hard dent stage. The corn plant will usually contain 65 to 68 percent moisture and dry matter harvested per acre will be greatest. Digestibility of the whole plant is also near maximum. At maturity, most upper leaves will still be green, but lower leaves will be in various stages of drying. Approximate yield reductions from harvesting corn ahead of physiological maturity are shown in *Table I*. Harvesting the corn crop two weeks before physiological maturity will often result in a 20 percent reduction in dry matter yield. However, total digestible nutrients are not decreased quite as much by early harvest as the potential grain yield because the fiber in the stalk is more digestible when harvested earlier.

Table I. Grain yield reductions from early harvest of corn silage.

Period before physiological maturity	Reduction of dry matter yield
(days)	(%)
5	5
10	10
15	20

When several days will be involved in silage harvest, start chopping when about 75 percent of the ears are dented and the moisture content of the green chop is in the high 60s. Delaying harvest could result in enough ear drop, stalk breakage, and lodging to more than offset losses of potential yield from early harvest. Delayed harvest also increases the possibility of molding and heating for a corn crop ensiled too

dry.

When harvest is delayed or frost occurs so that corn plant moisture drops below 60 percent, proper ensiling is important to avoid high dry matter losses. Fine chopping and firm packing are essential. Adding water to the top two to three feet of the forage as it is put into the silo will help obtain a firm pack. Add enough water to bring the moisture content of the ensiled forage to 60 to 65 percent. This will take about seven gallons of water per ton of silage for each 1 percent increase in moisture content. Distribute water uniformly onto the silage as it is added to the silo for maximum absorption.

Ideally, harvest forage sorghums when fully ripe and at a moisture content below 70 percent. This may not occur until after frost. However, lodging and excessive leaf loss may occur if bad weather delays harvest following frost. If forage sorghum contains more than 68 to 70 percent moisture at harvest and is stored in an upright silo, excessive seepage may occur. This can damage the silo wall as well as cause silage nutrient losses. Consequently, bunkers or trenches are recommended for such high-moisture forages. When both are available, high-moisture forage sorghum can be mixed and ensiled with relatively dry corn silage to help correct the moisture problem in both forages.

Moisture content of corn silage decreases as the plant matures. Sorghums also decrease in moisture as they mature but do not appear to drop as fast or as much as corn. You may want to test for moisture content as well as observe maturity at the beginning of silage harvest. Several procedures could be used, including oven drying, laboratory analysis, and use of small electric moisture testers. All methods require gathering a representative sample for drying. If a microwave or small electric tester is used, a fairly accurate moisture determination requires only 15 to 20 minutes.

Harvest and Storage Methods Affect Silage Quality

One objective in making silage is to preserve the original nutrients of the crop with minimum losses. This involves exclusion of air and formation of a low-oxygen environment. This can be done most easily using oxygen-limiting silos, but excellent preservation can also be accomplished using conventional upright and horizontal silos, or silage bags, with careful management.

Fineness of Chop

Length of chop is important because it can affect packing qualities of silage and silage consumption. The value of fine chopping increases as the crop advances in maturity and when moisture content drops below 60 to 65 percent. Most forage harvesters will chop corn or sorghum silage at 1/4- to 3/8-inch theoretical length of cut without difficulty when moisture is above 65 percent. When moisture is below 65 percent, a 2.5- to 3-inch recutter screen may be necessary to maintain the equivalent of the 1/4- to 3/8-inch theoretical chop length. Unless knives are kept sharp and properly set so that the forage is finely chopped, overly dry silage will be stringy and many corncobs will remain in large pieces. These conditions may cause poor packing as well as reduced consumption.

For dairy cattle, the chop length should be 3/8- to 1/2-inch. If chopped finer than this, dairy cows may develop abomasal displacements, low milk fat test, and off-feed problems. The length of chop dictates particle size of corn silage which affects chewing and saliva production by cows. The more cows chew, the more saliva is produced to help buffer the rumen and maintain normal milk fat tests. A 1/4-inch chop is suitable when corn silage is fed with other forages to dairy cattle. A 5/16- to 3/8-inch chop is recommended when corn silage is the only forage in the diet. At 3/8-inch chopping length, over 90 percent of corn kernels will be broken and passage of whole kernels into the manure will be minimal. Chopping silage to less than 3/8 inch not only may cause feeding problems in dairy cattle, but will also

increase energy costs of harvest.

A slight increase in rate and efficiency of cattle gains has been observed when the drier silages were finely chopped. There is little concern about the nutritional effects of fine chopping for growing and finishing beef animals. Silage chopped less than 3/8-inch is satisfactory and gives equivalent gain and efficiency as that chopped at a 5/8-inch length.

Table II. Factors affecting the amount of corn silage stored (dry matter).[a]	
Dry matter content (% moisture)	**Pounds/cubic feet**
29.5 (70.50)	12.1
45.8 (54.2)	11.8
Fineness of chop	
1/4 - 3/8 inch	12.8
5/8 - 3/4 inch	11.2
Depth of settled or packed silage	
10 ft	10.7
15 ft.	11.7
20 ft.	12.4
30 ft.	13.3
[a]Grass and forage sorghum and immature corn silages are 1 to 2 pounds heavier than well-eared corn silage.	

Fineness of chop also affects the amount of silage that can be packed into the silo (*Table II*). These data were obtained on small experimental upright silos and should be close to weights for trench or bunker silos. They show a 14 percent increase in dry matter storage with the finer chop, indicating that finer silage chop results in firmer packing in the silo. In tall, upright silos, dry matter stored may approach 17 to 18 pounds (dry matter basis) per cubic foot.

Table III gives suggested storage structures, chop length, and recutter screen sizes for harvesting corn silage.

Firm Packing

A firm pack is necessary to reduce oxidative losses. Weight of the ensiled forage largely determines the pack obtained in upright silos. Thus, wetter silages tend to pack better and result in slightly more dry matter per cubic foot (*Table II*).

Tractors are effective for packing horizontal silos. Most horizontal silos will be packed by either payloaders or tractors with rubber tires. Both pack well if silage is added in thin layers. Crawler tractors finish the top more smoothly and appear to reduce top spoilage of uncovered silos compared with packing by payloaders or tractors with rubber tires. Continue packing for about a half hour after the last load has been spread each day. Crown the silo so rain water will drain off and unsupported and unpacked edges will be eliminated. Make horizontal silos as deep as practical, because this will reduce

the percentage of silage exposed to air and will facilitate better packing. The approximate dry weight of corn silage stored in silos is presented in *Table IV* and wet weights in *Table V*.

Table III. Suggested structures, chop length and screen size for harvesting corn for silage.

Moisture in standing crop	Usual maturity	Ideal structure for storage	Optimum length of crop	Screen size
70% or more	Milk stage	Stack, trench or bunker less than 10 ft deep.	1/2 inch	None needed
65% or 69%	Early dough to hard dough	Stack, trench or bunker, more than 10 ft deep, or upright silo.	1/2 inch	None needed
60% to 69%	Well-dented to mature	Upright structures or trench or bunker more than 14 ft deep.	3/8 inch 1/4 to 3/8 inch	2 1/2- to 3-inch screen below knives 2-to 2 1/2-inch screen below knives
50% to 59%	Mature seed to one-half dry stalk	Upright structures in very good condition of tightness.	1/4 to 3/8 inch, sharp knives	2- to 2 1/2-inch screen below knives
50% or less	Half to completely dry stalk	Gas-limiting structure.	3/8 to 1/2 inch, sharp knives	2-inch screen below knives

Table IV. Approximate weight of well-eared, well-packed, corn silage.[a]

Depth of silage	Weight at depth indicated	Average weight for silage above depth indicated
(ft.)	(Dry matter per cubic foot, lb.)	
5	12.2	8.8
10	13.1	10.7
15	14.1	11.7
20	14.5	12.4
25	14.8	12.9
30	15.0	13.3
35	15.2	13.6
40	15.4	13.9
45	15.5	14.1

50	15.6	14.3

[a]Actual weight is influenced by several factors as discussed in text plus the percentage of dry matter from grain. Forage sorghum and grass silage will usually be 5 to 10 percent heavier if stored in the range of 55 to 72 percent moisture.

Table V. Concrete silo capacities for corn silage (tons).

	Moisture content of silage			
Diameter and settled depth	**55%**	**60%**	**65%**	**70%**
12×30	47	54	62	74
12×40	66	75	87	103
12×50	85	97	111	132
14×40	93	106	121	143
14×50	121	137	158	185
14×55	134	153	157	210
16×50	163	184	210	250
16×60	200	230	260	300
16×65	220	250	280	330
18×50	210	240	270	320
18×60	260	290	340	390
18×70	310	350	400	460
20×60	330	370	420	490
20×70	390	440	500	580
20×80	460	510	580	670
24×60	490	540	620	710
24×70	580	650	740	850
24×80	680	760	850	980
24×90	780	860	970	1,110
30×80	1,090	1,280	1,480	1,630
30×90	1,240	1,480	1,710	1,880

Fill Quickly

Filling the silo quickly reduces the time exposed to air and reduces respiration and oxidative losses. Losses are greatest from slow filling, coarse chop, and lower moisture forages.

Cover with Plastic

Covering properly with plastic will reduce top spoilage, and in the drier silages will usually result in improved color, which indicates a reduction in oxidation losses. Prevent pumping air under the plastic and protect the cover from puncture. To eliminate both problems, cover the plastic with low quality

chopped forage to a depth of 4 to 6 inches or cover with tires. Chopped forage may be more difficult or impossible to apply and retain on top of plastic covered stacks with steep sides. Consequently, a gradual slope of stack sides will improve preservation.

Problems with using chopped forage over the plastic are:

1. wind may blow the forage off the plastic,
2. if the layer is thick, moisture will be retained and provide a place for fly breeding through the summer,
3. and decayed forage will drop down and contaminate the good silage unless removed periodically.

Tires have been widely used to weight plastic. Problems with using tires include:

1. labor required to put on and take off,
2. they are much less effective in sealing a silo cover, because any small leak will allow exposure of a large surface of silage to air,
3. and rodent damage may be encouraged, because tires offer rodents some protection. Rodent damage can be reduced by cutting the tires in half thus eliminating a place for rodents to hide.

Plastic bags are marketed for silage storage. If the silage is packed firmly, sealed properly, and no punctures develop during storage, silage will be well-preserved with a minimum of spoilage. The disadvantages of bags include:

1. they are more expensive per ton of forage than horizontal silos,
2. they are easily punctured, requiring frequent monitoring and patching,
3. and because of the plastic bag, removing silage may be more difficult and require more time.

However, plastic silage bags allow the greatest flexibility in storing silage. Silage can be stored at different fields rather than at only one location.

Summary

High quality corn and sorghum silage depends on harvesting at the correct stage of maturity, moisture content, and length of cut. Matching the appropriate chop length and moisture content to the storage structure and class of livestock to be fed will allow you to use your silage resources as effectively as possible.

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