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NebGuide

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Making Quality Corn and Sorghum Silage

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If you are going to harvest corn and sorghum forage as silage you need to make quality silage. Here's how.

Harvesting corn and sorghum forage as silage is popular because it adapts to complete mechanization of forage production, harvesting, and feeding. It fits operations where capital can profitably replace labor.

High level management and sizable financial outlays are necessary for efficient silage production and feeding. Crops yield more total digestible nutrients per acre when made into silage than when harvested by other methods. But this does not necessarily guarantee greater profits. To maximize returns, quality silage must be made, with emphasis on minimal harvest and storage costs, and feeding for maximum returns.

Harvested forage is seldom improved during ensiling. The exception is forage excessively high in nitrates. Objectives in making grain crop silage are to harvest the crop when yield of net energy is near maximum, and to store it to minimize total nutrient losses and structure costs.

Corn varieties usually yield 50 to 55% of their total dry matter and 70 to 75% of their nutrient value as grain. This leaves 25 to 30% of the feed value in the forage portion. With increasing costs of fuel, machinery and labor, the cost of harvesting the forage portion may approach its feed value, especially when feed grains and hays are relatively low in price.

Quality Silage

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

Corn vs Sorghum Silage

Corn silage is the standard for high quality silage.

Generally, forage sorghum silage has 80 to 90% of the energy value of corn per unit of dry matter. It has less 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. Also, it is higher in moisture and, as a result, dry matter intake usually will be lower than for corn silage. Under Irrigation, corn will usually produce more dry matter per acre. On dry land in Nebraska's southern, central, and western counties, forage sorghums will normally produce higher average dry matter and energy yield per acre than corn.

The moisture content of forage sorghum is generally 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, thus, create problems in harvesting.

For dairy cows, early harvest is not detrimental to performance. The more mature sorghum silage is less efficiently used for milk production. However, acreage yields increase with maturity and compensate for the lower efficiency of the mature crop.

Male sterile sorghums have about the same feed value as normal forage sorghums per unit of dry matter. Dry matter yield per acre is substantially reduced, however.

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 better forage sorghums. However, digestible energy yield from grain sorghum silage may be equal to or higher than from many forage sorghums. Because grain makes up 50% or more of the total dry matter of grain sorghum silage and the seed coat is tough, relatively large amounts 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 hard dough stage when the grain and seed coat are softer and apt to be more easily broken by mechanized harvesting and animal chewing.

Sudan grass and sudan-sorghum crosses have about 65 to 80% of the value of corn silage per unit of dry matter. Moisture content is a major problem in producing desirable silage from these crops. Early-cut sudan grass 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 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 produces maximum feed value and has the most desirable moisture content at physiologic maturity, or at the formation of the black layer in 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% moisture. Digestibility of the whole plant is also near maximum. Approximate yield reductions from harvesting corn ahead of physiologic maturity are shown in *Table I* and relationship of moisture to dry matter harvested is shown in *Figure 1*.

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

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

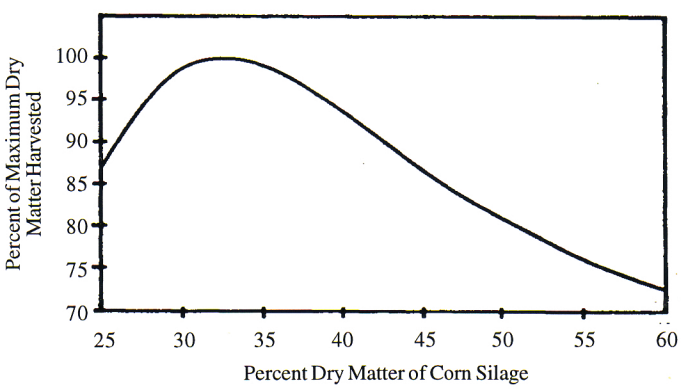

Figure 1. Effect of stage of maturity of corn silage on dry matter harvest per acre.

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.

Where several days are involved in silage harvest, start when about 75% of the ears are dented and the moisture content of the green chop is in the high 60's. Delaying harvest could result in enough ear drop, stalk breakage, and lodging to more than offset losses of potential yield from early harvest.

When harvest is delayed or frost occurs so that corn plant moisture drops below 60%, special attention is needed to avoid high losses. Fine chopping and firm packing can help. Addition of water to the top two to three feet of the forage as it is added to the so will help(obtain a firm pack. Add enough water to bring the moisture content of the chop to 60 to 65%. This will take about seven gallons of water per ton of chop for each 1% increase in moisture content. Distribute uniformly onto the chop as it is added to the silo for maximum absorption.

Ideally, harvest forage sorghums when fully ripe and at a moisture content below 70%. This may not occur until after frost. However, lodging and excessive leaf loss may occur if unfavorable weather delays harvest following frost.

If forage sorghum contains more than 68 to 70% moisture at harvest and is stored in an upright silo, excessive seepage may occur. This can cause leaching damage to the silo wall as well as nutrient losses. Consequently, bunkers or trenches are recommended for such high moisture forages.

Where both are available, high moisture forage sorghum can be mixed with relatively dry corn chop 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. (See NebGuide G74-178.) All will 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 Quality of Silage

One objective in making silage is to preserve the original nutrients 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 in conventional upright and horizontal silos with careful management.

Fineness of Chop

Length of chop is important because it can affect (1) packing qualities of silage and (2) silage consumption. The value of fine chopping increases as the crop advances in maturity and becomes very important when moisture content drops below 60 to 65%. Most forage harvesters will chop corn or sorghum silage at 1/4 to 3/8 inches length without difficulty when moisture is above 65%. When moisture is below 65% a recutter screen may be necessary to maintain the equivalent of the 1/4 to 3/8 inches chop. For dairy cattle the chop length should be 3/8 to 1/2 inch. If cut shorter than this, dairy cows may develop displaced abomasums and milk fat may be reduced when feeding large amounts of such 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% increase in dry matter storage with the finer chop, indicating that finer chop results in firmer packing.

In tall, upright silos, dry matter may increase up to 17 to 18 pounds per cubic foot. A slight increase in rate and efficiency of cattle gains has been observed when the drier silages were finely chopped.

Table 2. Several factors affect amount of corn silage stored (dry matter).[a]

Dry matter content	
(% moisture)	lbs/cu. ft
29.5 (70.5)	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 lb heavier than well-eared corn silage.

Firm Packing

A firm pack is necessary to reduce oxidative losses. Weight of the ensiled material 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 or a vacuum are effective for packing horizontal silos. Vacuum packing, which involves an air tight seal around the silage, is difficult to accomplish for larger silos. Most horizontal silos will be packed by either rubber tired or crawler tractors. 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 to packing with rubber tired tractors. Continue packing for about a half hour after the last load has been spread each day. Crown the silo so that rain water will drain off and unsupported and unpacked edges will be eliminated. Make horizontal silos as deep as practical, since 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 III* and wet weights in *Table IV*.

Fill Quickly

Filling the silo quickly reduces the time exposed to air and reduces respiration and oxidative losses. Losses are greater from slow filling in coarser chop and lower moisture forage.

Table III. 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

[1]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% heavier if stored in the range of 55 to 72% moisture. Adapted from USDA Circular 603 and Farm Technology, July, 1963.

Table IV. Concrete silo capacities for com silage (tons).

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

Cover with Plastic

Covering properly with plastic will practically eliminate top spoilage and in the drier silages will usually result in improved color, indicating a reduction in oxidation losses. Take care to prevent pumping of air under the plastic and to protect the cover from puncture. To eliminate both problems, cover the plastic with low quality chopped forage or weeds to a depth of 4 to 6 inches. 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 make possible much better preservation. Tires have been widely used to weight plastic. Problems with using tires are: (1) labor required to put on and take off, (2) they are much less effective in sealing a so cover, since any small leak will allow exposure of a large surface of silage to air, (3) rodent damage may be encouraged, since tires offer rodents some protection. Rodent damage can be minimized by cutting the tires in half thus eliminating a place for rodents to hide.

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, and (3) the decayed forage will drop down and contaminate the good silage unless removed periodically.

Plastic bags are now 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 are that they are: (1) expensive per ton of forage, (2) easily and frequently punctured, requiring frequent monitoring and patching, and (3) because of the plastic bag, removing silage may be more difficult and require more time.

Silage Additives

Two classes of additives generally proposed for adding to silages are (1) nutrient additives and (2) aids to preservation.

Nutrient Additives

The nutrient additives often proposed are nitrogen products (ammonia and urea), calcium (limestone) and fermentable carbohydrates. For corn and sorghum silages, treating with ammonia usually results in lower ensiling temperatures and reduced protein breakdown. It reduces molding, so helps keep silage fresh during warm weather or when feed-out rate is slow. Little or no advantage in rate or efficiency of gain or in milk production results from adding the non-protein nitrogen at ensiling compared with adding it when the silage is fed. Thus, the choice is mainly one of cost of materials and method of addition.

Adding ground limestone prolongs fermentation and usually increases dry matter loss. Needed calcium can be added to the ration at feeding with similar or better results.

Corn and sorghums ensiled near maturity usually contain enough soluble sugars that addition of molasses or other fermentable carbohydrates are seldom needed. For immature crops, such additions may be helpful, particularly if the crop cannot be wilted to less than 70% moisture.

Aids to Preservation

Most of these additives supply lactic acid producing microorganisms or enzymes. Many of the commercial products available have limited or no research to support their claims. A few companies are conducting or supporting well-designed research. We suggest you use only products supported by impartial research from respected research establishments. Research results using these products on corn and sorghum silage have been quite variable. Kansas researchers have conducted considerable research and report about 3% average decrease in corn silage losses from using products containing lactic acid producing microorganisms or enzymes. Efficiency of gain averaged slightly higher also. Combining these resulted in an average of 4 to 5% increase in value of the original crop harvested. For forage sorghum their data indicated an increased value of 6 to 7%. Using these increases, you can estimate whether average returns are likely to exceed the cost of the additive and its application.

Data from studies in dairy rations are too limited for drawing conclusions.

Economics of Additives

Whether you should include an additive in silage depends on the projected benefits compared to costs of the product and its application. Any performance benefits would need to be added to the value of silage saved. For example, if your silage cost is $20/T and you project a 5% reduction in dry matter loss and a 3% improved efficiency of weight gain, determine the additive benefit as follows. With $20 silage and a 5% reduction in loss, *Table V* shows $1.00 as the value of silage saved. Add to this the $.60 for improvement in efficiency of gain ($20 x 3%). The total benefit equals $1.60 per ton. If the additive cost is $.90 per ton and equipment and application costs are $.30 per ton, then the net value of the additive is per ton ($1.60 $1.20).

Table V. Cost savings from reduced silage loss at different stage values.

	Corn				Forage sorghum			
	(Value of silage/ton, $)							
Reduction in loss	16	20	24	28	12	15	18	21
(%)	(Value of stage saved/ton, $)							
2	.32	.40	.48	.56	.24	.30	.36	.42
3	.48	.60	.72	.84	.36	.45	.54	.63
4	.64	.80	.96	1.12	.48	.60	.72	.84
5	.80	1.00	1.20	1.40	.60	.75	.90	1.05
6	.96	1.20	1.44	1.68	.72	.90	1.08	1.26
7	1.12	1.40	1.68	1.96	.84	1.05	1.26	1.47

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