Iowa Beef Center
Iowa State University
Iowa State University Extension Dairy Team

MAKING QUALITY CORN SILAGE

Good corn silage is an excellent feed for cattle, both beef and dairy as it contains plenty of protein (avg. 8.1% on DM basis) and energy (mostly starch). It often is one of the most economical feedstuffs in terms of cost per unit of protein or energy. It forms the basis for most lactating dairy cow rations and can provide supplemental forage or roughage for beef cattle. The keys to making good quality corn silage are to harvest at the proper moisture content, fill rapidly and pack well.

Harvest at Optimum Moisture

Harvesting a crop that is too wet often results in a poor, undesirable fermentation and, in the case of upright silos, extensive nutrient loss in seepage. Material that is ensiled too dry is difficult to pack in bags, bunkers or piles, and the resulting oxygen within the silage mass will cause extensive nutrient loss and is prone to spoilage.

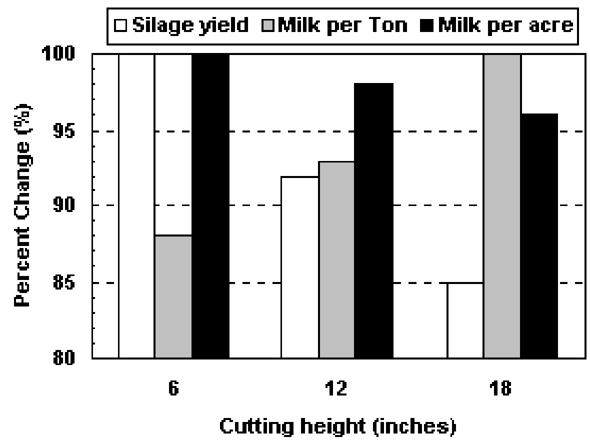
The optimum moisture content for harvesting corn for silage depends on the storage structure utilized. The values below are for the whole plant, not just the ear or kernel.

Optimum moisture (or DM) levels for harvesting corn silage

Storage structure	% moisture	% dry matter
Stack or pile	65-72	28-35
Trench or bunker	65-70	30-35
Bags	60-70	30-40
Upright concrete	62-67	33-38
Oxygen limiting	45-55	45-55

Cutting Height

Corn plants traditionally are cut 6" above the soil surface. Although cutting higher (12-18 in) will reduce yield 7-15%, the resultant silage will be higher in nutritive value since more of the undigestible fiber (mostly lignin) content will be left in the field. The reduction in yield and increased nutrient availability (measured as milk production potential per ton) are illustrated in the graph below. Overall livestock productivity (measured as milk production potential per acre of silage harvested) will only be reduced 2-4%.



Lauer, 1998

If nitrates (NO^3) are suspected, then cutting at 18" will result in material that is lower in nitrates since the majority of nitrates are found in the bottom 1/3 of the stalk. The distribution of NO^3 (ppm) in drought-stresses corn plants are illustrated below.

	Michigan	Wisconsin
Upper 1/3 of stalk	678	153
Middle 1/3 of stalk	3,557	803
Lower 1/3 of	24,471	5,524
Leaves	284	64
Ear	75	17
Whole plant	4.333	978

Length of Cut

The general recommendation for corn silage harvested with a conventional chopper (without a corn processor) is 3/8" theoretical length of cut (TLC). However, if the whole plant moisture level is lower (< 62%) and the material will be stored in a bag or bunker, then the TLC should be reduced to ¼" in order to enable better packing. If a kernel processor is used, then the optimum TLC is ¾". Sharpen the knives on the cutter head and check the adjustment of the shear bar daily.

Corn Processing

Corn processing (often referred to as kernel processing) involves two rollers, located behind (after) the cutter head and running in opposite directions. Their purpose is two-fold: to roll or crack kernels of corn so that the starch is more readily available to rumen bacteria and to reduce the particle size of the cob in order to reduce sorting in the bunk. Corn that is wet (> 68% moisture or < 32% DM) should not be "processed". The value of processing increases when the moisture content is below 67% (above 33% DM).

Packing

The importance of packing when filling a bunker silo or making a silage pile cannot be over emphasized. Dry matter loss during storage increases when density of the material decreases as illustrated in the following table for alfalfa silage stored in 25 bunker silos (Ruppel, 1992).

Density (lbs DM/ft^3)	DM loss (%)
10	20.2
14	16.8
15	15.9
16	15.1
18	13.4
22	10.0

For corn silage, the recommended minimum density is 14 lb/ft3 (wet density) but actual densities can vary widely (Holmes and Muck, 1999).

Parameter	Average	Range	SD
Dry matter, %	34	25-46	4.80
Wet density, lb/ft^3	43	23-60	8.30
Dry density lb/ft^3	14.5	7.8-23.6	2.90

Weight of the tractor used to pack the bunker or pile and packing time (min/ton as fed) are the most important factors affecting final density. As a rule, the packing tractor should run at least as many hours as the chopper. If using a custom harvesting contractor, two packing tractors running simultaneously may be needed as delivery rates of chopped material will be high. In addition, packing a 6" layer will result in greater silage density than packing a 12" layer.

Storage Losses

Storage losses can vary widely depending on a number of factors such as type of structure, packing density, and moisture level of the crop when harvested.

Type of structure	Storage Losses
Stack or pile, uncovered	20-40%
Stack or pile, covered	15-35%
Trench or bunker, uncovered	12-25%
Trench or bunker, covered	8-20%
Bags	6-15%
Upright concrete	8-15%
Oxygen limiting	3-11%

Actual feed costs will be impacted by storage losses as there will be less silage available during feed out as illustrated in the table below. Note that with 25% storage losses, silage that initially cost $60 per ton, now costs $80 per ton due to fermentation and spoilage losses.

Silage value Including storage ($/t)	Percent storage loss							
	5	10	15	20	25	30	35	40
$30	31.58	33.33	35.29	37.50	40.00	42.86	46.15	50.00
$35	36.84	38.89	41.18	43.75	46.67	50.00	53.85	58.33
$40	42.11	44.44	47.06	50.00	53.33	57.14	61.54	66.67
$45	47.37	50.00	52.94	56.25	60.00	64.29	69.23	75.00
$50	52.63	55.56	58.82	62.50	66.67	71.43	76.92	83.33
$55	57.89	61.11	64.71	68.75	73.33	78.57	84.62	91.67
$60	63.16	66.67	70.59	75.00	80.00	85.71	92.31	100.00
$65	68.42	72.22	76.47	81.25	86.67	92.86	100.00	108.33
$70	73.68	77.78	82.35	87.50	93.33	100.00	107.69	116.67

Cover Bunkers & Piles

All horizontal silos (bunkers, trenches, and piles) should be covered with plastic as soon as possible after filling to exclude air and reduce surface spoilage. The plastic should be anchored with dirt, tires, or other heavy items to protect it from wind damage.

What about Inoculants?

Drought stressed corn plants are likely to be less healthy than normal, thereby increasing the opportunity for yeasts and molds to infect the plant. Additionally, fermentation may be compromised due to higher dry matter content and lower packing densities (partially due to less grain present), making it difficult to achieve optimal pH levels and creating an anaerobic condition conducive to further yeast and mold development during storage. Finally, drought-stressed corn silage with low grain content will have higher than normal sugar levels (and lower starch levels), even after fermentation is completed. These sugars will support growth of various spoilage organisms at feed out, causing heating and shorter bunk life. Inoculants may help fermentation by reducing pH and inhibiting yeast and mold growth, thereby extending bunk life when fed during warmer weather.

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