Corn silage management for lactating cows *

Corn plant is one of the crops best suited for silage. High yield per acre and high starch content makes whole corn plant an excellent source of energy for dairy cows. Characteristics such as high forage quality and consistency, and low buffering capacity allow for a longer harvesting window of homogeneous crop and quick pH drop promoting silage stability and lower nutrient losses in the silo. In this article we discuss few critical aspects to corn silage preparation and feeding to lactating dairy cows.

1. Choosing the right hybrid for silage:

There is no "one size fits all". The "right" hybrid will depend on soil quality, weather conditions (temperature, rain distribution, growing season length), cropping system (single or multiple cropping), and herd forage needs. Higher producing cows need more digestible forages while lower genetic potential cows, dry cows, or late lactation cows could be fed hybrids containing lower grain proportion. Market situations sometimes can influence hybrid choice. Highly digestible, high grain corn hybrids produced on site can reduce the need for grain imports to the operation at times of high energy costs.

It is important to consider grain production, whole plant tonnage and forage and grain digestibility in the rumen when choosing a corn hybrid for silage. Grain represents one third to half of the whole plant dry weight at harvesting time. Hybrids with higher grain:forage ratios tend to yield better silages for high producing dairy cows. Specialty and transgenic corn hybrids such as borer resistant (Bt), "LibertyLink", "Roundup Ready" (RR), high oil corn, waxy corn have been successfully used for silage. Some other corn hybrids have been developed specifically for silage (multileaf). Nonetheless, there is little evidence that specialty hybrids can influence milk production significantly when fed to high producing dairy cows mixed in well balanced diets. More recently, a number of studies have shown that brown midrib corn silage can be fed in higher forage diets and may increase milk yield in high producing herds. On the downside, in the past brown midrib corn hybrids have had lower productivity, less drought tolerance, and greater susceptibility to lodging.

Longer growing season makes corn plants accumulate more dry matter. Of course corn of 95 days of relative maturity (RM) could be planted but Louisiana's hot summers allow enough growing degree days (GDD or heat units) for longer corn growing seasons. Relative maturities closer to 120 days are recommendable for Louisiana dairy producers. There are, however, several concerns with late maturing corn that need to be considered by forage corn growers including the risk of hurricanes in south Louisiana, droughts, double cropping, among others. Lodging caused by high winds could be a major problem with later maturity corn because of yield losses, reduced quality, and more intensive labor required for harvesting.

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2. Planting time:

Planting densities can vary widely ranging from less than 20,000 plants/acre to 30,000 plants/acre or more. It is generally recommended planting forage corn at higher densities compared to corn for grain. The main objective of any forage crop for dairy cows is to provide the most energy per land area. Very high densities can decrease ear and plant size, increase fiber content (NDF and ADF), consequently decrease protein and whole plant digestibility, ultimately reducing TDN yield per acre. Low fertility soils cannot support high plant densities. Soil samples should be analyzed to establish an appropriate fertilization program. An experienced seed salesperson or an agronomist should be consulted for adequate recommendations. Forage corn density has been planted targeting 24,000 plants/acre at the Southeast Research Station (Franklinton, LA) in recent years.

3. Harvesting time:

The adequate time for harvesting corn for silage is when the moisture content of the whole plant of corn reaches 65% to 70% (equivalent to say 30% to 35% of dry matter, **DM**). Substantial seepage and storage losses often occur with silages containing 75% moisture or more. Silage seepage is a strong contaminant and runoff into public waters should not be tolerated. The corn plant progressively dries as it matures. Some of the benefits to harvest corn for silage at the correct moisture content include maximization of forage yield and sugar (energy) content, while reducing field losses, and minimizing losses of silage energy by excessive fermentation, less seepage losses, and consequently greater intake. An adequate level of moisture will also contribute to produce silage that will take longer to warm up in the feedbunk (aerobic stability). Moisture content can be determined in drying ovens or by near-infrared analysis. Although these methods are fairly quick and not very expensive, the micro-wave oven can be used to dry chopped samples of a few whole corn plants that are representative of the field. Record fresh weight and calculate the percent of moisture based on the weight of the dry sample. You know the sample is dry when its weight is stable and does not change with further drying. Another practical recommendation is to follow the kernel milkline. The milkline represents an increase in starch content of the grain (kernel). The line advances inwards, towards the cob, as kernels harden. Harvesting is suggested between 1/3 and 2/3 of kernel milkline, targeting 1/2 milkline, which has been shown to produce the best results on cow performance studies. Keep in mind that some hybrids have different dry-down rates of ear and stalk/leaves. That may render ineffective the rule of thumb presented above for an adequate harvesting window based on the milkline alone. Also, heavy rains around the time of harvesting can result in wetter chopped corn plants which can result in spoilage in the silo caused by poor fermentation.

4. Height of cutting and chopping length:

Harvesting corn plants at 8” to 14” above ground level enhances silage digestibility and minimizes soil contamination. Accidentally adding dirt into the silo can cause butyric fermentation and spoilage of the silage. Higher heights of cutting (ranging from 18” to 28”) have been suggested with the intent to increase corn silage digestibility to increase energy content and aid in controlling soil erosion. Nonetheless, recent studies found little or no effect on cow performance with high-cut corn silage.

The theoretical length of cut (**TLC**) recommended is 3/8”, but it may range from 1/4” to 3/4” depending on factors such as hybrid, moisture level, and harvester equipment. Using the right TLC will assure adequate forage packing in the silo and enough effective fiber for cows when silage is unloaded.

5. Silo filling and cover:

Silage is a method of forage preservation under anaerobic conditions. That means air should be removed as much as possible from the silo in order to obtain good silage quality. To achieve this goal, certain management aspects must be emphasized. Forage should be harvested, chopped, packed well and covered in the silo as fast as possible.

Air and rain infiltration can cause poor fermentation and spoilage in the silo. Rain will increase moisture/seepage, favor growth of undesirable bacteria (for example *Clostridium sp.*), and wash nutrients away. The resulting silage will have low nutritional value and will likely be avoided by cows (low dry matter intake). Intake is directly related to milk production in lactating dairy cows, therefore low intake equals low milk yield.

There are a number of types of silos: upright or tower, trench or bunker, and stacks. The silo should be air-tight and sealed for at least 21 days to allow for adequate fermentation time. Most silos used in Louisiana require cover (trench, bunker, stacks). Packing chopped forage in horizontal silos (trench, bunker, stacks) is mainly a function of packing equipment weight, layer height before packing/frequency of fresh forage delivery, and time spent packing. Those factors should be adjusted according to the situation at each operation in order to obtain higher silage density and to promote ideal fermentation. Weather-resistant plastic sheets are the most common horizontal silo covers. Covering silos should begin at the center and progress outwards to remove air. If stacked silage is the storage of choice, special attention should be given to packing and covering to minimize aerobic losses.

6. Alternatives/corrective practices at ensiling:

Making silage past the optimum stage is a very common situation in the field. Under those conditions, fecal grain loss may reach as much as 25% of the whole corn kernels ingested by cows. Mechanical kernel processing is a viable practice to increase starch digestibility in the rumen and reduce fecal grain loss. Processing corn silage consists of passing the chopped forage between two rolls spaced 1/16” to 1/8” apart. The TLC should be increased to 3/4” when chopped corn is processed to assure sufficient supply of effective fiber. Conditions that warrant mechanical processing include late harvesting resulting in kernels drier than recommended (i.e. blacklayer), hybrids with vitreous (hard) kernels, and hybrids with higher grain/forage ratio. Processing hybrids with soft kernels and low grain/forage ratio may not be necessary and could result in negative cow performance. Corn processors are becoming common attachments used by custom harvesters and should be taken advantage whenever possible.

Another common product used is the inoculant. Inoculants are additives that contain bacteria beneficial to silage fermentation. The use of inoculants is recommended when ensiling conditions are less than ideal. Those conditions may include forage ensiled wetter or drier than recommended, slow ensiling process or delayed packing, and ensiling while raining. Silage inoculation with homolactic bacteria (*Lactobacillus plantarum, Pediococcus sp., and Enterococcus sp.*) and *Lactobacillus buchnerii* increases silage fermentation rate and pH reduction, promotes faster silage stabilization, and reduces dry matter loss. Inoculants can also increase silage aerobic stability. Inoculants containing mixed cultures of homolactic bacteria and *Lactobacillus buchnerii* applied at the chopper have been shown to produce. It is important to remember that inoculants will

only attenuate problems caused by faulty ensiling methods. Therefore, inoculants serve as an extra “insurance”, but using appropriate ensiling techniques should still be the goal.

7. Feeding corn silage to lactating dairy cows:

Corn silage is a good source of energy readily available in the rumen, but is usually low in protein and minerals compared to the requirements of a lactating dairy cow (Table 1). Several studies have compared corn silage with other forage sources and their mixtures for feeding lactating dairy cows. Usually corn silage-based diets result in similar or greater dry matter intake and milk yield than other forages alone. Mixes of corn silage with other forages have been shown to improve animal performance over diets containing corn silage as the sole source of forage.

Table 1. Typical composition of corn silage samples analyzed at the Southeast Research Station Forage Quality Laboratory.

	# Samples	Average	Range
	---------- % ----------		
Dry matter	434	31.9	15.5 - 50.0
	---------- % DM ----------		
CP[§]	424	8.28	5.0 - 11.7
NDF[§]	430	46.2	32.5 - 63.6
ADF[§]	429	28.7	17.5 - 40.8
TDN[§]	429	66.3	57.3 - 74.7
Calcium	95	0.16	0.06 - 0.28
Phosphorus	100	0.22	0.10 - 0.32
Magnesium	99	0.15	0.03 - 0.26
Potassium	98	0.90	0.02 - 1.70
	---------- ppm DM ----------		
Copper	100	3.83	1.00 - 11.0
Zinc	101	22.6	12.00 - 37.0
Manganese	101	48.0	3.00 - 126.0

[§] CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; TDN = total digestible nutrients.

To achieve the best results from diets containing corn silage, consult a dairy nutritionist to adjust the diet according to cows’ requirements. Milk yield can be successfully supported by dietary crude protein of 17.5% DM or less in corn silage-based diets. Pay particular attention to dietary fiber and starch. Inadequate amounts of highly fermentable grains in low fiber diets can cause rumen acidosis. In diets containing corn silage as the only forage, NDF content should be near 30% DM, ¾ of which should be NDF strictly from forage (>20% diet DM). Unprotected fat supplementation in combination with acidic conditions in the rumen can cause butterfat to drop. Finally, the diet may need to be corrected under some circumstances. Co-products of corn, such as dry distillers’ grains plus soluble (**DDGS**) are quickly becoming important feed sources in dairy diets. Corn protein is inherently low in lysine. Feeding corn co-products in high corn silage diets warrants caution regarding amino acid ratios (lysine to methionine).

8. Final remarks:

It is important to check for silage quality to assure adequate ration balancing for your cattle. After opening the silo, grab samples from several spots (at least 5-6) approximately one foot deep from the exposed silage surface. Samples should be composited into a single sample (approximately 1 lb) and sent to a qualified laboratory. The Southeast Research Station Forage Quality Laboratory is equipped for analyses of dry matter, protein, fibers, and many macro and trace minerals.

REMEMBER THAT YOUR INVESTMENT IN SILAGE WILL ONLY PAY DIVIDENDS IF WELL PRESERVED HIGH QUALITY CORN SILAGE IS ADEQUATELY FED TO PRODUCTIVE COWS.

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