BMPs for Corn Silage Production

Introduction

Best management practices (BMPs) for high yield potential and quality silage includes corn product selection, planting date, fertility, pest management, fungicides, harvest height, delivery rate, and harvest dry matter (DM) content. This list of best management practices is not a complete list but covers some of the important practices needed to consider when planning a successful silage program.

Corn Product Selection

Selecting the right corn product for silage begins with product maturity. Plant stay green and quality characteristics are also important factors in product selection. Selection priorities will also depend on the type of feed required. Starch content is very important when selecting a product that will be fed to finish beef cattle. Starch content is also important for dairy production, but highly digestible fiber is a more important trait for high producing dairy animals.

- Select a relative maturity that consistently reaches the correct harvest moisture before frost.
- Select products well-adapted for the geographic region using multiyear local performance data whenever possible.
- Select corn products that have good stay-green and disease tolerance characteristics.
- Select corn products to meet specific needs for yield and quality. When comparing corn product ratings, it is recommended to compare ratings within a maturity group.

Planting Date and Rate

- Plant at densities 10 to 20% greater than corn densities used for grain production.[1]
- Full season corn products can be planted in the same planting window as corn planted for grain.
- Corn products planted for silage can be longer season than those planted for grain. A silage crop needs to reach whole plant moisture level around 65%, or around one-half milk line, to reach correct harvest maturity. A grain crop will need to reach black layer before frost to reach correct harvest maturity.
- Plant early to optimize crop utilization of water, nutrients, and sunlight.
- Delayed planting of a full season corn product may cause higher plant height.
- A planting window that follows a small grain silage crop can be a viable cropping option in areas where the growing season is long enough to get a shorter season silage crop to maturity.

Soil Fertility

Corn produced for silage generally requires higher fertility compared to corn produced for grain.

- Soil nutrient removal for potassium and phosphorus will be higher for silage than for grain production, due to the removal of crop residue.
- The protein content of corn silage increases as the availability of nitrogen increases.

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- Nitrogen rates for silage production should be increased by about 20 pounds per acre compared to grain production based on the feed value of corn silage.[2]
- A yield goal of 25 tons per acre will need a total of 250 pounds of nitrogen per acre available to grow a crop which is comparable to a 200-bushel corn crop.

Insect Management

Above ground pests can be more of a problem if the silage crop is planted significantly later than most of the corn planted in an area. Later planted corn can attract high populations of corn borers, western bean cutworms, and other above ground caterpillar (lepidoptera) corn pest adults, and damage may be substantially higher than early planted corn.

- **Corn rootworms** –Corn rootworms (western, northern, and Mexican) are the number one corn pest across the Corn Belt especially where continuous corn is grown and with confirmed resistance to corn products with below ground Bt traits. Crop rotation is an important tool used to reduce rootworm pressure. Additionally, corn planted later or later maturing corn is attractive to females as the silks still may be "green" when other corn fields in the area are in the brown silk stage. Therefore, silage fields may act as magnets to females increasing the number of eggs deposited in those fields.
- **Corn borers** – European corn borer and southwestern corn borer are very important pests that are typically controlled by use of above ground genetically modified Bt corn.
- **Ear feeding caterpillars** - Western bean cutworm and corn earworm can be difficult to control due to correctly timing insecticide applications. Resistance to some Bt traits has been documented for Western bean cutworm and corn earworm.
- **Spider mites** - Banks and two spotted spider mites are an important pest in the arid corn growing regions and in drought-stricken areas just before and during pollination. Miticide applications can be effective if application timing is managed correctly.
- **Early season corn insects** – Black cutworms and seed-feeding soil insects like wireworms, seed corn maggots and white grubs tend to be a problem in corn during a cool, wet spring. The seed treatment used on Bayer corn products should provide control to these insects.[3]

Fungicides

When a fungal pathogen infects a plant, often a natural response to the disease is an increase in lignification in the plant, which results in decrease neutral detergent fiber (NDF) digestibility. Various fungal pathogens that infect the ear, may or may not result in a mycotoxin in the silage; however, if it is a concern samples should be sent to a laboratory that can assess if a mycotoxin is present.

- A fungicide application may increase feed efficiency by lowering dry matter intake.
- A fungal infection may affect both the ear and the stalk, and the level of infection can vary from corn product to corn product and year to year.
- Fungal infections may bring high levels of mycotoxin into the feed.
- Milk production may not be affected by a fungicide treatment.[4]

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Harvesting Height

Increasing the cutting height 6 to 12 inches higher than the traditional cutting height of 6 to 8 inches can increase silage quality.

- Neutral Detergent Fiber (NDF) can decrease by 7 to 10%.
- Starch levels can increase by 6%.
- Milk production per ton can increase by 5%.
- Milk production per acre can decrease by 2%.
- Yield per acre can decrease by 7%.[5]

Not all corn products respond to changing the chop height the same and will not have the same response year to year, but it is important to chop all the silage at the same height when filling a silo.

Bacterial Inoculants

Silage inoculants contain anaerobic (do not need oxygen) bacteria that produce lactic acid that when ensiling is complete will lower the pH of the silage to about four. The ideal result of silage fermentation is the production of higher levels of lactic acid and lower levels of acetic acid. Inoculants can be a tool used to improve the ensiling process for silage that has been chopped at less than optimum DM but not all conditions are conducive for inoculation.

- The success of an inoculant is determined by the size of the natural population of live lactic acid bacteria on the corn at harvest.
- The bacteria in the inoculant have been selected to grow rapidly and efficiently resulting in an increased fermentation rate.
- The higher the natural population is, the more difficult it is for the non-native (added by inoculant) bacteria to dominate the crop and aid in fermentation.
- Natural populations of lactic acid bacteria do not grow well under dry conditions suggesting that inoculants may be more successful in drier crops.
- Inoculants can reduce dry matter losses 2 to 3% in a well-managed bunker.
- The shift in fermentation products (higher lactic acid and lower acetic acid) should increase animal feed efficiency since animals can utilize lactic acid more efficiently than acetic acid.

Non-bacterial silage additives include sugars and enzymes. Another class of silage additives are inhibitors which include propionates, Non-Protein Nitrogen (NPN), and acids. A commercial silage additive may contain several additive types with different functions. The value of an additive will vary depending on the situation and needs. Additives are not designed to compensate for poor silage management.[6]

In Season Stress Effects on Quality

- Corn silage grown under heat and moisture stress can increase the fiber content and raise concerns with nitrate content.
- Corn grown under cooler; lower stress environments can increase the grain production.
- Abiotic stresses such as drought and heat stress can substantially affect corn silage yield potential and quality, although the mechanisms by which they act are different.

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- Depending on the moment at which stress occurs, drought stress can have varying impact.
- If drought stress occurs only at vegetative stages, dry matter yields may be compromised but nutritional composition may not. Alternatively, if drought stress occurs during reproductive stages (i.e. silking), both dry matter yield and nutritional composition can be affected.
- Heat stress, defined as temperatures above 95°F, during the initial stages of kernel development can have a major negative impact in both corn silage yield potential and nutritional composition.
- Select a corn product maturity and planting date to avoid silking and early kernel development during a time of very high environmental temperatures.[7]

Figure 1, Unstressed pollination on left, very stressed on right.

Nitrate levels can increase in the lower stalk during unfavorable conditions, especially drought. Nitrate levels increase when growth is slow, and nitrates are plentiful. There are many ways to reduce the negative impact of nitrates in corn silage.

- Raise the cutter to leave at least 6 to 12 inches of stubble.
- Do not feed until the fermentation process is complete. Fermentation is complete under ideal conditions in three weeks.
- Fermentation will reduce nitrate levels by 30 to 50%.
- Do not plant a silage field where high manure applications have been made or high rates of nitrogen fertilizer have been applied to a droughty soil.
- Minimize plant stresses due to nutrient deficiencies.
- Harvest on bright sunny days.
- Do not harvest for at least three days following a soaking rain that comes after a period of dry weather.
- Dilute a high nitrate feed source by feeding higher concentration grains or low nitrate hay in the ration.
- Analyze silage for nitrates before feeding if there are concerns of elevated nitrate levels.[8]

Silage Harvest Delivery Rate for Pile and Bunker Silos

The quality of the silage can be greatly affected by the consistency and rate of delivery. The packing process is critical as silo is being filled to meet the desired final density.

- Create a constant flow of material. Ensure trucks are delivering forage at a constant rate to avoid piles that overwhelm the packing tractor.
- Adjust delivery rate to match the number and size of choppers to the packing capacity at the silage structure.
- Ensure enough packing tractor time is available to pack the silage to the desired density of 16 pounds of DM per cubic foot (16 lb DM/ft^3).
- Silage cannot be over packed.
- Adding a packing tractor could allow the silage pile to reach desired density.

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- Maximize the efficiency of the packing tractor by always keeping the tractor on the silage face.
- Keep packing tractor(s) constantly driving on the pile, and not merely pushing up feed and waiting for the next load to arrive.
- Ensure tractor drivers compact the entire surface. Stagger the tractors as they push and pack the feed up the face of the pile. Pay special attention to the top half and side of the pile, where packing density tends to be the lowest.

Researchers from Cornell University (Ruppel, 1992) studied the relationship of packing density and DM losses in alfalfa silage stored for an average of 96 days: % DM loss= 29.1 – 0.936 x DM density (lbs DM/ft^3). This relationship is shown in Table 1.

Table 1. The relationship of packing density to DM losses.

Density (lbs. DM/ft^3)	DM Loss (%)
10	10.4
12	8.0
14	7.6
16	6.2
18	4.8
20	3.4

Chart courtesy of Kurt Ruppel, Cornell University[8]

Harvest Dry Matter (DM)

When considering BMPs for silage production, the most important factor to manage is the correct DM level at harvest. The correct harvest DM varies depending on the storage structure used. A DM content of 35% is the target for upright silos, drive over piles, bunkers and silage bags. 35% DM is too low for upright "oxygen limiting" silo structures which can vary from 40 to 50% DM depending on the size and construction of the silo. When corn is harvested at a low DM content seepage may occur. Seepage removes nutrients, particularly soluble nitrogen and carbohydrates, and can damage the silo. Silage that is harvested at a high DM content will have air pockets that prevents anaerobic fermentation and allows molds to develop. In addition, the kernels become harder and less digestible. Silage that is stored at too low or too high DM content can cause poor ensiling which can negatively impact silage quality.

Table 2. Recommended dry matter (DM) content percent by silo type.

Silo Type	Recommended DM content (%)
Upright silo	35 to 40
Upright "oxygen-limiting"	40 to 50
Horizontal silos (piles or bunkers)	30 to 35
Bag silos	30 to 40

Sources

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