# **Key points to make high quality corn silage**

Hugo A. Ramírez Ramírez, Ph. D. - Department of Animal Science
Iowa State University Extension and Outreach - Dairy Team

Making corn silage is one of the most labor intensive and fast-paced operations on a dairy farm. It takes place during a short time and it represents the base for future feed for the cows until the next year. Therefore, it is important to make every effort possible to harvest, store and eventually feed high quality feed.

A developing corn plant stores energy in the kernel in the form of a sugar or carbohydrate called starch. This sugar can be utilized by microbes in a cow's rumen as a rich source of energy. When microbes utilize or ferment sugars, they produce volatile fatty acids (VFA) that fuel a cow's metabolism. The production of corn silage is the result of a fermentation that pickles the forage and makes it stable as long as it is not exposed to oxygen. Since corn silage is the base for many dairy rations is important to keep in mind that we can influence its nutrient content and also how well the cows utilize the nutrients contained in the ensiled material. Attention to details and benchmarks prior and during the harvesting and storing process is essential for a successful silage season. The following is a list of 5 key points that can help promote a good fermentation process to produce high quality corn silage:

1. **Harvest at the right moisture content**

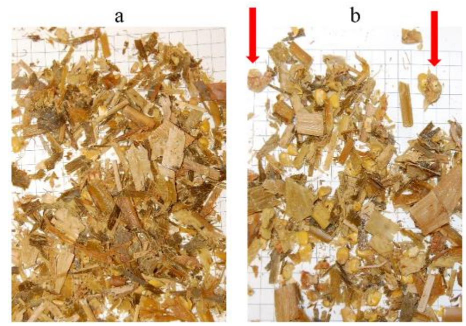
The fermentation or pickling process is carried out by bacteria that transform some of the sugars in the green chop into lactic acid. These bacteria need the right conditions to thrive and drive a positive fermentation; one of these conditions is moisture. Corn silage should be fermented at 35% dry matter or 65% moisture to facilitate packing and promote the growth of desirable bacteria. When monitoring corn fields for silage, a practical rule of thumb is to consider a dry-down rate of 0.5% per day. For example, if a corn field is at 32% DM, it will take approximately 6 more days to gain 3 percentage units to reach 35% DM.

$$\frac{3\%}{0.5\%/day} = 6\ days$$

This is only an approximation, the best way to ensure proper DM content is to take samples over time to keep track of DM and decide when to harvest.

2. **Chop length and kernel processing**

In order to promote a good fermentation, it is necessary to remove as much oxygen as possible from the forage being ensiled. To accomplish this, the forage is packed down and compacted. The theoretical length of cut (TLC) for processed corn silage is 3/4"; if the forage is not processed then the TLC should be 1/4 to 1/2". If chop length is too coarse it becomes difficult to pack and there could be problems due to spoilage and poor fermentation. Kernel processing literally unlocks the energetic potential of the starch contained in the corn kernels because the protective layer of the kernels is damaged which leaves the starch exposed for microbial fermentation in the rumen. Properly processed corn silage should have no whole kernels and no pieces of cob should be visible. These pictures are samples of processed corn silage, note the few half-to-whole kernels in figure (a) compared with the many half-to-whole kernels in figure (b) and even two pieces of corn cob with kernels still attached (arrows).




**3. Inoculants**

As mentioned before, the fermentation of green chop into silage is carried out by bacteria that produce lactic acid, hence the name lactic acid-producing bacteria (LAB). There are naturally occurring LAB in the green chop that can carry out this fermentation; however, there are other bacteria that also compete for the same sugars to produce other kinds of acids. This competition process slows down the action of LAB which in turn has the potential to lower the nutritional value of the material being ensiled. The reason for this is that the green chop is naturally degrading and being consumed by other microbes, this process stops when LAB produce enough lactic acid to lower the pH to around 4.0. This is an acidic pH that inhibits the growth of microbes and halts further degradation. Bacterial inoculants contain live but inactive LAB, these bacteria become active when rehydrated, thus it is important to use water that has not been treated with chlorine! These LAB have been selected for the ability to produce lactic acid and speed up the fermentation process so that forage “pickles” faster preserving more material and nutrients in the silage. When buying inoculants, it is important to examine the claims and look for validation studies supporting these claims, also follow manufacturer directions for storage, handling and application rates (typically 100,000 colony forming units per gram of fresh forage).

**4. Packing**

The objective of packing is to remove as much air as possible to create an anaerobic environment. This refers to removing as much oxygen as possible so that LAB can grow and carry out the fermentation process efficiently. Density is used as a way to gauge how well a silage is packed, this measures pounds of forage per cubic foot. Density depends on a number of factors including crop type, chop length, dry matter content, type of structure, delivery rate, packing weight and time. Average density for bunker silo are around 40 - 45 lbs of fresh forage per cubic foot, if the crop is harvested at 35% DM, this roughly translates to 14 - 16 lbs of dry matter per cubic foot. It is recommended to calculate the capacity for packing prior to harvesting to ensure that enough weight is available or that fresh forage is delivered at the appropriate rate to achieve the desired density. Researchers at the University of Wisconsin-Madison have developed a spreadsheet calculator to estimate silage density, the calculator is available at here: [Density Calculator]

## 5. Sealing and covering

After filling the silo, one of the most if not the most important action is to seal and cover it. Sealing ensures that anaerobic conditions are maintained by preventing the entrance of oxygen into the silage pile and also keeps rain from infiltrating and washing away some nutrients. Plastic films with thickness of at least 4 mil are recommended because they offer more resistance to physical damage and also prevent or slow down the infiltration of oxygen. There are plastic films specifically made for silage covers that include tear resistant designs and ultraviolet light blocking compounds to increase durability. In addition, there is a special kind of film called oxygen barrier; these plastics are thin films with extremely high oxygen impermeability. The film can be incorporated into a single plastic layer of silage cover or sold separately. The picture shows a silage covered with 2 layers, the clear layer is the oxygen barrier which is used first and then black and white layer is a common silage cover film that goes on top.

Finally, some weight is needed to keep the plastic covers down and prevent infiltration of air. The most common method to cover silage is to put tires on top of the plastic cover. A concern with tires is that they can accumulate water and become breeding grounds for mosquitoes, using sidewalls or perforated tires reduces this risk. This is a labor intensive task but the benefits are much greater because well preserved silage means greater recovery of dry matter, less nutrient loss and overall better feed for the cows. The ideal silage should be covered with tires touching each other as shown in the picture.