Harvesting, Storing Crops for Silage
Michigan State University
Extension Division
R. K. McGuffey and Don Hillman Department of Dairy Science
September 1976
2 Pages

COOPERATIVE MSU AG FACTS EXTENSION SERVICE

Harvesting, Storing Crops for Silage

No. 115 Extension Bulletin E-1029 September 1976

R. K. McGuffey and Don Hillman
Department of Dairy Science

Preserving crops by ensiling has gained in popularity among farmers in recent years. Many crops are ensiled (e.g. small grains, corn, sorghum, alfalfa or grasses) but all are preserved by a similar chemical process, fermentation. This bulletin describes the desired chemical changes due to fermentation and management factors that promote these changes.

What Happens in the Silo

During filling of the silo, oxygen is entrapped in the silage mass. Plant cells and aerobic micro-organisms use this oxygen to change water-soluble carbohydrates (WSC) to carbon dioxide and water, giving off heat. This process is known as respiration and continues until all oxygen is utilized. The more oxygen entrapped, the more WSC is degraded. This has four harmful effects on silage quality: a) less WSC is available for fermentation; b) onset of fermentation is delayed; c) excessive heating occurs resulting in lowered digestibility and d) the products of respiration are of no use to the animal for productive purposes.

Fermentation begins once oxygen is depleted from the silage mass. Fermentation is the result of an increase in numbers of anaerobic (not requiring oxygen) micro-organisms. Anaerobic micro-organisms convert WSC to lactic acid and other acid products thus lowering the pH (degree of acidity) of the silage mass. These fermentation end-products provide energy to ruminant animals. Thus, the energy lost during fermentation is much less than the energy lost during respiration. Management practices that exclude oxygen result in conservation of more of the original energy content of the feed.

Fermentation continues until the pH of the silage decreases to 4.0-4.5. At the low pH, all micro-organisms are killed and the silage is "pickled." A stable product is formed which, if left undisturbed, can be stored almost indefinitely. However, if air enters into the mass, refermentation can occur.

During refermentation, micro-organisms become active in the silage mass. The invading micro-organisms convert remaining WSC and lactic acid of silage to butyric acid resulting in an increase in pH. As pH increases, putrefactive micro-organisms change protein to ammonia and amines, mold growth begins and heating occurs. Energy and protein losses during refermentation are excessive. Butyric acid production may result in energy losses as high as 40% of the original energy of the feedstuff.

When to Harvest for Silage

During growth, chemical composition of plants changes rapidly. The best time to ensile depends upon the growth stage (maturity) of the plant. Forages such as alfalfa are best suited for ensiling at 10% bloom (middle of growth stage), corn should be near full maturity when harvested. The following section discusses the time crops should be harvested for silage to obtain maximum production (crop and animal).

CORN

Harvesting corn for silage should begin when corn is in the hard dent stage or about 30 to 36% dry matter. Harvesting at this time results in maximum dry matter yield per acre. Ensiling is relatively easy because WSC for lactic acid production is high, little or no seepage occurs (seepage removes WSC) and compaction is made easier due to the weight of the water. Highest silage intake and milk production occur at about 36% dry matter.

SORGHUM

Forage sorghum comprises an important roughage source in areas with low rainfall. Nebraska workers reported a 33% increase in dry matter yield from the milk to the mature seed stage. A further delay of 10 days increased the yield 57% over that at the milk stage. Like other row crops for silage, sorghum dry matter content increases with maturity. At the milk stage, sorghum averages 20 to 24% dry matter. Ensiling this wet material results in not only decreased yield but also increased seepage loss and decreased animal intake. Allowing sorghum to mature to the hard seed stage is more conducive to fermentation. Animal intake is greatest for the more mature silage with little difference in milk production. The increased yield of the more mature sorghum more than offsets any reduction in production efficiency. Because WSC of sorghums is about 25 to 40% of WSC of corn the opportunity for extensive fermentation during ensiling is less in sorghums. Danger of prussic acid poisoning is unlikely when sorghums are ensiled.

FORAGE CROPS

Because of the efficiency and costs, silage production from grasses and legumes has increased substantially during the past 10 to 15 years. For maximum yield of nutrients, forages should be harvested at the early bloom stage of growth. Water-soluble carbohydrates are relatively high and crude fiber is low. With advancing maturity, WSC decreases and crude fiber increases reducing the nutritive value. Legumes, especially, should be ensiled at early bloom because they are lower in WSC and contain buffering agents (chemicals that prevent changes in pH during acid production) making legumes somewhat more difficult to successfully ensile than grasses.

CEREAL GRAINS

The time to cut cereal grains for silage is more critical than for any other silage crop. Cereal grains mature rapidly after heading, declining in dry matter digestibility at a rate twice that of perennial forages. Data concerning stage of plant growth on voluntary intake and milk production are inconsistent. Recommendations vary from state to state. Generally, cereal grains give higher yields in later stages of maturity, seepage is not a problem and adequate WSC is available for fermentation.

Management Factors

1. ***Wilting and moisture content:*** The amount of moisture in the plant at the time of ensiling determines the extent of fermentation. Harvesting row crops at the correct stage of maturity insures adequate moisture for fermentation. For other crops, wilting is necessary to reduce the moisture in the crop. Forages can be ensiled at 30% dry matter, without seepage. Wilting to 50% dry matter before ensiling results in later loads being too dry to insure good packing; consequently, risk of heating will be greater.
2. ***Use the proper cut:*** Fine, uniform chopping aids in packing and exclusion of air. Recommended length of cut is 1/4 to 3/8 inch which allows for maximum compaction, greater silo density and a more uniform feed at feeding time. Chopping finer than 1/4 inch is undesirable if silage is the only roughage source.
3. ***Distribute evenly in the silo:*** Even distribution in the silo is necessary to avoid separation of the light from heavier material by the silage blower. Light material tends to land next to the wall. This lends to poor packing and easy air penetration. If the wall happens to leak air, or when the feeding door is opened in bottom-unloading silos, a chimney effect is produced. Also, the pumping action of changing temperatures and gas pressures at various locations in the silo causes air to move into and out of poorly packed silos.
4. ***Fill the silo rapidly—continuously if possible:*** Compaction of the forage requires considerable height of the material to provide the weight necessary to express air from the mass. Therefore,the upper portion will tend to be less dense and hold more air which causes heating. If filling is delayed over several days, the upper layer from each filling will be noticeably different in quality.
5. ***Apply a top seal:*** Sufficient moisture is necessary to supply weight for compaction. Forage in the upper one-third of the silo should contain 65 to 70% moisture. Forage should be leveled and tramped to express air.
6. ***Crown the center:*** Crown the center and cover with a plastic sheet if feeding is delayed for several weeks. Dig a trough around the silo wall and place the plastic down into the trough and up the silo wall.

When using a bunker silo, 65 to 72% moisture silage is best. Pack continuously with a wheel-type tractor while filling and periodically for 2 to 3 days after filling. Cover with a plastic sheet weighted down by a heavy material.

CROWN THE CENTER

This information is for educational purposes only. Reference to commercial products or trade names does not imply discrimination or endorsement by the Cooperative Extension Service. Cooperative Extension Service Programs are open to all without regard to race, color, creed, or national origin. Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824 *1P-9:76-25M-UP—Price 5 cents, Single Copy Free*

Michigan State University Printing