September 2010 – RENAISSANCE NUTRITION

THE FORAGER

Agronomics with livestock in mind!

Corn Silage Harvest Techniques…

The goal in making corn silage is to efficiently harvest and store the maximum amount of digestible nutrients per unit of land area. This requires that dry matter losses due to harvest and storage be minimized. The end result, high quality silage, is readily consumed by livestock and is capable (with proper supplementation) of improving their productivity and profitability.

WHEN TO HARVEST: How Plant Moisture Influences Storage Characteristics

Excessively wet silage (>70% moisture) may result in fermentation dominated by undesirable butyric acid-forming bacteria, the loss of large volumes of highly digestible nutrients through seepage, and poor animal performance due to low consumption. On the other hand, overly dry forage is difficult to pack (especially in horizontal silos), resulting in mold and heating. The ideal moisture concentration (65 to 70%) for ensiling corn closely coincides with the stage of development that ensures near maximum production of total digestible nutrients (TND)/acre. Forage to be stored in horizontal silos should be between 63-68% moisture in order to facilitate tight packing and air exclusion. Most upright silos should be filled with 62 to 66% moisture forage to avoid seepage; however, this will vary somewhat depending on the height and diameter of the silo, since packing is achieved due to the height of the column of forage. Nevertheless, factors such as degree of packing, type of silo, and presence of additives (research-tested inoculants and preservatives) can influence how wet the silage may be in order to ferment and store successfully.

There is a direct relationship between the moisture content of the silage and the amount of seepage produced. For example, based on data from bunker silos collected over many years, it appears that no seepage will occur if silage is less than 71% moisture. In tower silos, 70% moisture corn silage will not seep if silo height does not exceed 40 feet. For each additional 10 feet of silo height, moisture concentration should be decreased by 1% to avoid seepage.

In addition to problems with seepage, excessively wet forage (>70% moisture) may decrease the maximum capacity of the silo because a large amount of water versus dry matter is stored. Maximum silo capacity may also decrease with excessively dry forage (< 50% moisture) due to failure to achieve a tight pack in the silo. If 50% moisture forage is used, the silo capacity has been estimated to decrease by about 5%. The maximum capacity of a tower silo filled with corn silage is achieved when the moisture is between 60 and 65%.

Managing the Moisture Content of Silage

The best way to manage moisture content of corn silage is to harvest at the proper stage of plant development. However, there are some other management practices that may help solve unfavorable moisture problems with silage. One of the most practical ways to reduce seepage from high moisture forage is to add an absorbent to the silage. Ground grain or straw can be used to reduce moisture by 1% for each 30 lb of dry material applied/ton of silage. Straw is capable of absorbing 3-4 lb of water/lb of dry matter (DM). Silage that is harvested too dry can undergo serious storage losses (especially if stored

(Continued in next column)

(Continued from previous column)

in a horizontal silo) due to failure to exclude air from the silage mass. This allows molding and heating of the forage to take place, which may greatly reduce silage quality. In such cases, water can be added to bring moisture concentration to at least 60%. Water uniformly mixed with the forage at roughly 7 gallons of water/ton prior to ensiling will increase the moisture content of silage by about 1%. Growing several varieties with differing maturities (early-mid-full season) will provide some flexibility in harvesting at the proper moisture content and extend the "safe" harvest period.

Estimating Whole Plant Moisture

Using a commercial moisture tester to accurately determine whole plant moisture is the best way to avoid variation in visual estimates of moisture content due to hybrid and season. The following procedure for determining silage moisture content requires an accurate scale (to 1 gram) and a microwave oven, and takes from 20-30 minutes (depending on the particular oven and the amount of moisture in the samples).

1. Obtain representative sample (whole plants).
2. Cut or chop into 1/2 inch pieces, keeping leaves and stems uniformly mixed.
3. Weigh a plate plus 100 grams of plant sample. It is best to spread sample as uniformly thin as possible. Put a paper towel between the sample and plate to minimize "sweat" from forming on the plate.
4. Put a 10-16 oz covered glass of water in the corner of oven to capture unabsorbed microwaves as the plant tissue dries.
5. Set oven to HIGH for 5 minutes.
6. Then weigh sample and plate and record weight of sample.
7. Change the water and insert sample into oven for 2 more minutes. Weigh and record sample weight.
8. Repeat steps 6 & 7 until sample weight does not change more than one gram. This is the final sample dry weight.
9. Subtract the dry weight in grams from 100 grams to determine percent moisture. Percent dry matter is the same as the final dry weight of the sample.

****See reverse side for the remainder of this article.**

(Edited from an article by J. P. Mueller & J. T. Green, NC State University; and W. L. Kjelgaard, Pennsylvania State University)

Please turn over.

(Continued from front page – 2nd column)
With experience, you can adjust the time periods and decide whether or not it is necessary to use the glass of water. Usually, the above method will give moisture content that is about 1-2% less than the true sample moisture content. Silage samples may take 20-30 minutes because of coarse particles and grain content which dry slowly.

General Physical Appearance - Because of variation among hybrids, it is wise to use several plant indicators when attempting to visually determine whether corn is ready for the silo. Under normal conditions, plants that are ready for harvest will exhibit some browning of the lower leaves while the upper ¾ of the plant will be green; husks will be dried to a tan color; ears will have fully dented and glazed kernels; and whole plant moisture will be in the range of 60-68%. Drought conditions may require that harvest management be altered to account for abnormal plant development. In drought years, plants will need to be harvested earlier than normal because of higher dry matter content. It is generally true that drought-damaged plants are usually wetter than they appear. Therefore, a preliminary moisture determination using a microwave oven or commercial moisture tester should be made before ensiling. In addition to the general physical appearance, there are two specific characteristics that have been used to estimate physiological plant maturity and grain moisture concentration. These characteristics, black layer formation and milk line position, are also related to whole plant moisture concentration. However, they are not always accurate indicators.

Black Layer Formation - The corn plant continues to increase in dry weight until it is physiologically mature. At maturity, black layer formation occurs when several layers of cells at the tip of the kernel die. When these cells die, dry matter accumulation ceases. The black layer may be used as an indication to begin harvesting, but whole plant moisture content is sometimes too low at this stage maturity. Although black layer formation can be a useful indicator of crop maturity, it is sometimes difficult to decide when the layer is truly “black.” Variability in the intensity of the black layer can be confusing to the inexperienced observer. Also, there seems to be some variation in the intensity of the black layer among hybrids.

Milk Line - It has been suggested by some researchers that the milk line may be a useful visual indicator of kernel maturity. If an ear of corn is broken, the tip portion of the ear will show the endosperm face of the kernels. It is here that the milk line can be observed. As the plant develops and the kernels mature to the full dent stage, a distinct line can be seen progressing from the kernel crown to the base. The milk line separates the solid from the liquid portion of the kernel. When the milk line is half way between the crown and the tip (half milk stage), kernel moisture is about 40%. At the half milk stage, over 90% of the “normal” yield of grain can be expected. When the milk line has reached the kernel base and becomes indistinct, the kernel base can be probed with a knife point to see if milk remains. Kernels containing no milk are physiologically mature and should contain a fully developed black layer. Although observing black layer development and milk line position may aid in estimating whole plant moisture percentage, it is apparent from that plants with a fully formed black layer or with little or no milk remaining in the kernel are too dry for optimum silage harvest. In most situations, silage harvest should begin prior to full black layer development after the milk line has descended to about 1/3 of the distance between the kernel crown and base.

HARVEST MANAGEMENT: Length of Cut

One of the most important harvest management considerations involves adjusting the particle size of the chopped forage to ensure a tight pack so that air is excluded from the silage mass. Particle size can be manipulated through machine adjustments involving the knives, or the shear bar setting on the silage harvester. Knives should always be kept sharp during harvesting. Some researchers have suggested that 1/4 to 3/8 inch theoretical length of cut is near ideal for minimizing storage losses. Extremely fine chopped corn silage (1/8 inch or less), such as that produced by using a recutter screen, is undesirable. Such fine chopped material is known to reduce milk fat test with dairy cows due to a decrease in “effective” fiber in the ration. A practical rule of thumb is that most of the silage particles should be about 1/2 inch long, with 15-20% of the particles being 1 inch in length. If the silage is too dry, i.e., below 60% moisture, the chop length should be reduced to near 1/4 inch so that the silage can be adequately packed. Reducing length of cut in this situation, however, will increase the power requirement and may slow harvesting.

Filling the Silo

Rapid filling, tight packing, and proper sealing are essential in order to exclude air from the silage mass. These three important tasks represent the last management opportunities before the actual ensiling process beings.

Untimely delays during silage harvest can be costly because such delays almost always favor undesirable fermentation leading to dry matter losses and reduced feed quality of the resulting silage. Silo size and/or fill capability should be such that a given silo can be filled in 1 to 3 days. Delaying from a one-day to a five-day fill rate has resulted in as much as a 50% reduction in lactic acid concentration and a twofold increase in fermentation-associated dry matter loss of the silage. Freshly cut forage must be physically packed into horizontal silos with tractors, trucks, or other equipment. Packing is needed between each load of silage. When the silo is full it should immediately be crowned in the center to shed water and be covered and sealed with 6 mil polyethylene. To maintain a tight seal during storage, tires or sand bags should be placed in adequate numbers on top of the plastic cover.