MANAGING CORN SILAGE IN BUNKER SILOS INVOLVES PROPER PACKING AND SEALING

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Across the United States the cost of producing high quality corn silage has dramatically increased over the past 10 years. The cost of an acre of corn can be upwards of $600 by the time the corn is ready for chopping. And, that money can be lost through poor harvest and storage practices.

The key to producing and maintaining the highest quality silage, in any structure, is to limit exposure to air and water. The presence of air in the silage mass allows yeasts, molds, and other detrimental microbes to grow. These microbes consume nutrients producing heat and undesirable compounds such as ammonia, butyric acid, and ethanol, which reduce the feeding value and intake of the silage by the animal. Extraneous moisture infiltrating the silage mass will leach valuable nutrients and dilute acid levels allowing pH to rise, accelerating the growth of yeasts and molds. These effects of air and water are affected by ambient air temperature with greater silage shrink occurring in warmer weather.

To minimize air exposure and water infiltration in a silage piles or bunkers, chopped forage must be densely packed and properly sealed during filling, and the density of the silage and the integrity of the seal must be maintained throughout the feed-out. Research at Cornell University with haylage and Penn State University with corn silage has shown that DM loss (i.e., shrink) is inversely related to the DM density of the silage (Ruppel et al., 1995; Griswold et al. 2010b). Work on silage density and porosity (a term that describes oxygen infiltration in silage) at the University of Wisconsin by Dr. Brian Holmes, an agricultural engineer, has produced the recommendation that silage in bunker silos or piles needs to be packed to an average density ≥ 15 pounds of dry matter per cubic foot to minimize shrink (Holmes, 2006).



Silage Density Investigations

From 2004 to 2009, Craig et al. (2009) investigated the density of silage in 113 bunker silos and piles on 57 dairy farms across Pennsylvania. The silage densities for each silo were determined by averaging the densities from 12 individual sites across the silage feed-out face. In that study, less than 30% of the sampled bunks/piles measured attained or exceeded the goal of 15 lbs of DM/ft^3. Average values ranged from 8.6 to 17.2 lbs of DM/ft^3.

The density of silage across the feeding face of the silo varies dramatically. The greatest densities are always found in the bottom level with the silage density decreasing by 30% at top of the silage pile (Craig et al., 2009; Griswold et al., 2010b). In the study of Craig et al. (2009) the bottom level of the silo averaged 15.5 lbs of DM/ft^3 with a range from 7.1 to 21.7 lbs of DM/ft^3 while the top level had an average density of 11.2 lbs of DM/ft^3 and a range 5.9 to 16.1 lbs of DM/ft^3. The explanation for the differences from top to bottom are a combination of self-compaction as would be observed in an upright tower silo, and greater packing weight with the packing tractor(s) continually moving over the silage mass.

There is also a large fall off in density from the interior to the exterior of the feed-out face. The work of Craig et al. (2009) showed a change from 14.0 lbs of DM/ft^3 in the interior to 12.9 lbs of DM/ft3 along the exterior within 6' of the outside wall or edge. The reason offered for this change was the simple fact that only one set of tires from the packing tractor was able to drive over this portion of the silage mass compared to two sets of tires for the interior portions of the silo.

Dr. Brian Holmes at the University of Wisconsin has studied what factors affect silage density levels (Holmes, 2006). His research indicates that the key factors influencing silage density are delivery rate, packing layer thickness, packing equipment weight, packing time, and dry matter content. On his website http://www.uwex.edu/ces/crops/uwforages/Silage.htm is a prediction equation that producers can use to input their harvest and packing procedures to estimate their silage densities. There are several packing guidelines designed to produce greater density in silage bunkers/piles. First, the equipment used to pack the fresh chop should match the delivery rate of the fresh chop. Today, silage harvesting equipment has the capacity to deliver 150 - 200 tons of chopped corn per hour to a bunker or pile. Based on research from Cornell University, the packing equipment needed to match up with these high harvesting rates is to have 800 lbs of packing weight per ton of chopped corn delivered per hour. Therefore, a delivery rate of 200 tons/hour would require 200 x 800 = 160,000 lbs or 80 tons of packing equipment to achieve high density levels. Depending on the size of the tractors, that delivery rate would require 4 to 5 tractors running simultaneously across the silage mass. In addition to matching equipment to delivery rate, the tractors must be spreading thin layers of 6" or less on a continual basis as these high delivery rates limit the time for packing to < 25 seconds per delivered ton.

Covering and Sidewall Plastic

Because the top and the outside edges are the least packed area of a silage pile or bunk, these areas have the greatest risk for the introduction of air and moisture leading to DM loss or shrink. Ensuring a tight, well maintained oxygen-limiting barrier is required. On many farms, the use of sidewall plastic has been added to bunker management practices.

Producers drape plastic over the walls before filling, then lay this plastic toward the center of the pile and then cover the entire pile with a second layer of plastic to reduce air and moisture entry on the sides and the top of the bunk.

Griswold et al. (2010a) evaluated this usefulness of this practice by analyzing the density and nutrient content of silage samples collected from 10 bunkers with sidewall plastic and 10 bunkers without. Samples were collected along the edges of each silo and compared to samples collected at the same time at the center of each silo. The greatest effect found was related to NDF digestibility of the silage. Bunks without sidewall plastic had approximately 4 percentage units lower digestibility levels in the silage located along the wall area compared to silage from the center of the same pile. Bunks with sidewall plastic had no difference in digestibility along the wall compared to the center.

Additionally, sidewall plastic bunkers had, on average, higher dry matter levels and greater levels of acetic acid. Acetic acid is an important inhibitor of yeast and mold growth. On narrow bunkers or piles, DM losses on sides make a significantly larger proportion of the total silage stored. In the study of Griswold et al. (2010a), there were no silage density differences in the 20 silos. Frequently, producers comment that sidewall plastic limits them from packing close to the wall. As a packing tractor moves across a pile all four wheels can pack. However, along a wall only the outer wheels travel over this area, reducing by half, the packing effectiveness. A wall helps to limit silage movement outward but the benefit of axel load and contact pressure is greatly reduced along the top, outside areas. The work of Griswold et al. (2010a) found similar but lower densities in the outer areas in both sidewall and non-sidewall bunks indicating that using sidewall plastic does not limit packing in wall areas by traveling close but not too close to the walls.

Conclusions

Growing the most digestible, highest yielding corn silage crop is of limited value when harvest and storage practices significantly reduce the amount of milk yield or meat production potential of the silage crop. Proper packing and sealing of the silage mass will reduce DM losses and improve silage quality. Results from the studies indicate that managers can affect their silage packing densities and reduce forage shrinkage.

References

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