Maximizing Forage Quality in Bunk Silos

Introduction

Proper storage of forages is key to both high quality and quantity of homegrown feeds. To produce high quality forages, best management practices (BMPs) must be applied from land preparation and planting of the crop through harvest, postharvest management, and feeding. In this agronomy fact sheet, we focus on factors that impact bunk storage performance and present pros and cons of storage density assessment tools.

Ideal Packing Density

High forage density is important because it results in an environment that reduces dry matter (DM) loss by minimizing the oxygen content. The minimum density required to achieve adequate fermentation is 14 lbs DM per cubic foot, although over 20 lbs per cubic foot is achievable and ultimately the higher density, the better.

Figure 1: Concrete blocks and an extra tractor are effective ways to increase packing weight and silage density.

Factors Influencing Density

The quality of stored forage depends on the initial quality at harvest. Harvesting at the proper maturity and DM content is key. For bunk silos, if forages are harvested with a %DM that is too high (>45% for haylage; >38% for corn silage), DM losses from spoilage due to oxygen exposure can be high. When forages are harvested at <35% DM for haylage or <32% for corn silage, there is a risk of clostridial fermentation (problematic when butyric acid levels are at least 0.1% of DM), resulting in a further depletion of nutrients and yield. Dry matter can be determined by chopping some plants and using a "Koster Tester" to determine moisture. Koster Testers can be purchased from many feed suppliers.

An additional factor of importance during harvest time is the forage chop length (particle size distribution). A short chop length minimizes air infiltration in a bunk silo, as it is easier to pack and condense, while long chop length increases effective fiber in a diet. Field chop length can be monitored using a forage particle separator to sieve/separate out the different sized particles. Consult with your nutritionist on factors influencing chop length in your herd.

The delivery rate of the forage while packing the bunk also impacts quality. The slower the delivery rate, the thinner the layer thickness across the bunk. This allows for more packing weight per amount of silage. The best way to estimate optimum maximum filling rate (tons per hour) is to use the "800 rule" where the packing tractor weight available (lbs) is divided by 800. Conversely, one can multiply the filling rate by 800 to estimate the minimum packing weight (lbs) needed.

Table 1: Optimum delivery rate and the total tractor packing weight needed to achieve a minimum density of 14 lbs DM per cubic foot as estimated using the "800 rule".

Total Tractor Weight	Optimum Deliveryl Rate
Tons	*Tons/hour*
5	13
8	19
10	25
13	31
15	38
18	44
20	50
30	75
40	100
50	125
60	150

Last but not least, it is recommended to cover the bunk. Even if the bunk is packed at the right density, storage losses can still be substantial if the storage is not properly covered. Options for horizontal bunk silos include polyethylene plastic, or dual layer oxygen-limiting plastic with a ballast system that prevents lifting of the air barrier from the silage surface. Tire-to-tire coverage is an often used and effective method (be aware of mosquitoes and rodents when using whole tires). Alternatives are available including gravel-filled bags or cut (half) tires. In recent years, much research has been conducted to find a more efficient method of covering bunks (in cost, ease of labor, and product-efficacy) but plastic weighted with tires or gravel bags continue to be the best option.

Density Assessment

Different methods can be used to determine if a bunk is packed properly. This includes core sampling as well as the use of spreadsheets.

Core Sampling

Density can be measured directly using a probe of known volume to core the face of a bunk. From the volume and mass of a core sample, along with DM content, density can be calculated. For example, if a sample is collected using the DairyOne probe (1.9 inch diameter), with a mass of 280 g (0.44 lbs), at a depth of 10 inches, and 46% DM, the density is 15.5 lbs DM per cubic feet. Although this core sampling method is commonly used, due to safety concerns associated with working around the face of a bunk silo, face sampling is not recommended. Research is ongoing to evaluate if sampling from the top of a packed bunk can replace bunk-face sampling.

Estimating Density

The University of Wisconsin has made available numerous spreadsheets to aid in maximizing forage quality. This is a safer approach and yet reliable approach. The spreadsheets can be accessed online via the web address listed under "Additional Resources" at the end of this factsheet. The calculators use i5nput data such as delivery rate, layer thickness, packing weight, bunk size, and DM to predict bunk density. These spreadsheets have the added benefit of allowing prediction of bunk density before a bunk is created and hence adjustment of the packing methodology.

Additives

Forage additives are often used to stimulate or ensure presence of fermentation acids, and as spoilage inhibitors. Three general categories of additives include: (1) living bacterial inoculants such as *L. buchneri,* which produces lactic and acetic acid during fermentation to control pH and reduce the growth of yeasts and molds, (2) enzymes, and (3) acids such as propionic or acetic acid to reduce pH. Additives are typically applied uniformly over a crop in the chopper box on the harvester, before being packed in a bunk silo. When interested in using an additive, evaluate the different products by requesting data that demonstrate the additives effectiveness for the specific crop of interest.

In Summary

Proper packing and coverage of the storage are essential for proper fermentation of forages in bunk storages. Density assessments can be done to gain knowledge about forage quality potential on an individual's farm. If core sampling is done, take extra care while sampling.

Additional Resources

- University of Wisconsin Extension Forage Resources: Harvesting and Storage (includes density calculator). http://www.uwex.edu/CES/crops/uwforage/storage.htm. http://www.uwex.edu/ces/crops/uwforage/dec_soft.htm
- From Harvest to Feed. Understanding Silage Management. Penn State University. http://pubs.cas.psu.edu/FreePubs/pdfs/ud016.pdf.

Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

Rebecca Harrison, Quirine Ketterings, Joe Lawrence, Frans Vokey, Ron Kuck, and Patty Ristow

2011