ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS

MANAGEMENT TIP

Fermentation Shrink

Background
Feed shrink has become a hot topic as dairy and beef margins erode in the current agriculture industry setting. Using research estimates, forage shrink loss per year in harvested U.S. forages is 14%, which corresponds to approximately three billion dollars[1] of feed. Nevertheless, where there are challenges in farming, there is opportunity. The industry looks to management practices to lessen this burden on the growers' and producers' bottom line. Forage preservation and management factors are the best way to capture this opportunity, but accurately estimating shrink has proven difficult.

Ensiling or fermenting forages is an art that many producers learned at a young age – with the aim of feeding out every ton harvested. Shrink starts in the field, with feed losses happening via physical losses such as leaf shatter and damage. However, many people forget that the metabolic processes continue post-cutting in the field. After legumes or grasses are cut, they continue to live and will utilize sugars until effectively preserved. Hay that has been rained on or hay that takes longer to dry or cure is extending the sugar breakdown period - which contributes to greater forage shrink. Creating silage is no different than making hay in that the faster it is preserved, the better the chance of saving at least 1-3% forage shrink.

Deconstructing the art of fermentation
While quick forage turnaround in the field is important, shrink also happens during ensiling and feed out. During ensiling (fermentation), oxygen is removed and bacteria produce acids from sugar, which ultimately lowers forage pH to the point that microbial activity ceases and preservation takes full affect. The lack of oxygen slows aerobic yeast from procreating, while a low pH also inhibits microbial growth. A perfect fermentation would yield 100% energy conservation and no shrink would occur.

Unfortunately, as many have witnessed more than they'd like, imperfect fermentation, and shrink, happens when CO_2 gas or other compounds are produced instead of fermentation acid.

The science behind the fermentation shrink can be explained by outlining one chemical pathway to fermentation, with the equation appearing as: 1 Sugar (6 Carbons) -> 2 Acetic Acid (4 Carbons) + 2 CO2 (2 carbons: Gas lost as shrink)

Much like boiling water is dismissed as vapor to nothing tangible, this sugar energy and feed value is converted to carbon dioxide (CO2) and then gone. In this case, two carbons are lost out of the original six, which equates to 33% shrink.

Where opportunities lie
Sound management centers on sound measures. A specific forage management goal for producers should be creating benchmarks, building goals from these, and improving through specific management strategies every year and every cut. Measures exist for fermentation shrink. Following ensiling, forage dry matter losses can now be predicted through forage and fermentation parameters – opening more opportunities to enhance fermentation management and guide nutritionists and farm managers toward the right management tools to improve.

Nutritionists, growers, and producers can hone their forage management and reach the goal mentioned, including utilizing this shrink metric, in working to keep more feed in their silage storage:

1. **Create a timeline for regular benchmarking.**
   This should include running an initial fermentation shrink analysis[2] at least 2-3 weeks after feed is ensiled.

1 Using $152 per ton of dry forage, adapted from Cabrera et al. (2014).

2 The Fermentation Shrink analysis prediction is based on an equation, outlined in the The Professional Animal Scientist paper, "Forage fermentation product measures are related to dry matter loss through meta-analysis", from J.P. Goeser, C.R. Heuer, and P.M. Crump.

2. **Set benchmarks based on running a fermentation analysis.**
   Feed, and shrink, varies. Measuring throughout the year will help all parties understand variation within the feed. Just like forage nutritive analyses, assess feed shrink throughout the preservation and feed process. If the silage storage isn't a stable system, more shrink can occur throughout the year.

3. **Assess management practices based on how fermentation shrink changes within the pile, bunker, pit or silo throughout this season.**
   Producers and growers should discuss results with their nutritionist and agronomist, reviewing the fermentation changes through each silo feed out, to gather proper, specific management recommendations based on these results.

This fermentation shrink prediction provides a shrink measurement, expressed as a percentage of the original DM that went into the silo. While management changes have the greatest effect on lessening fermentation shrink, assessing how much feed on the farm is lost to fermentation shrink is an important first step. Moreover, watching shrink variability through the year can help gauge where management tools are working or specific items can be improved to reduce the losses from next year's forage harvest.

Find forage fermentation shrink goals and guidelines at: bit.ly/FermShrink.

References:

Cabrera et. al. 2012. FeedVal 2012. Decision support tool. University of Wisconsin-Madison Department of Dairy Science. University of Wisconsin-Extension. Dairy Management Tools Suite. Accessed online: http://www.dairymgt.info/tools.php.

J.P. Goeser, C.R. Heuer, and P.M. Crump. 2015. Forage fermentation product measures are related to dry matter loss through meta-analysis. The Professional Animal Scientiust 31: pg. 137-144.