Dairy Research, Teaching, and Extension
UNIVERSITY OF DELAWARE

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DELAWARE DAIRY NEWSLETTER

Crop Soil News

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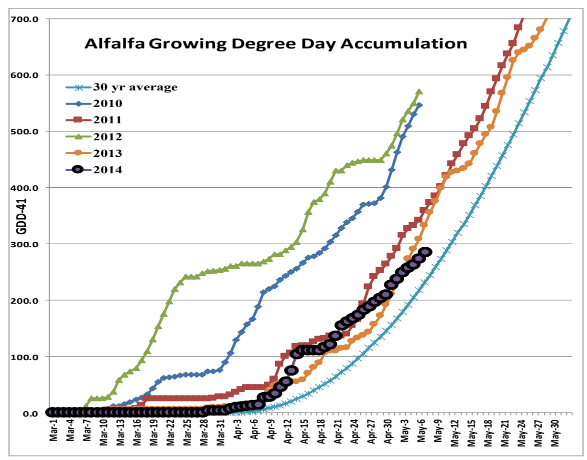
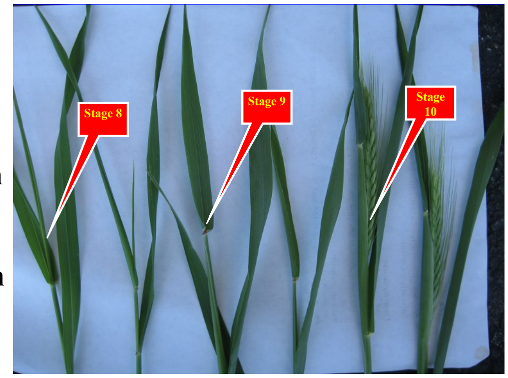
The Un-Spring



The Northeast, and North central U.S. and Canada are still in the center of much below normal temperatures and now, considerable rainfall. Farms who in the past several years had seedings and corn in the ground, are just getting started – and the cold keeps returning. The good news is that this pattern is starting to break with warmer temperatures creeping in. Unfortunately, what I pointed out in the March newsletter is coming true – areas around the Great Lakes and immediately to the west of them will continue below normal temperatures. Hopefully our warmer conditions will move that direction.

It is not the end of the world (in spite of Al Gore & the UN). As you can see by the graph above for Cornell's Valatie Research Farm in NY, we had been spoiled in 2010 and 2012 (and for a number of years before). With the switch in the temperature oscillation of the Pacific and Atlantic oceans (Pacific has switched cooler and Atlantic warmer), the earlier than normal springs we had been getting, are now reverting to what we used to have a number of years ago. This year is approaching the 30 year average of 1965—1995. We survived then and will survive now if you adjust to the new (old) normal spring.

There are a number of key steps that can be taken. The more successful farms are using one pass minimum tillage or one pass deep zone tillage (set zone for shallow 6 inch if soils are wet deep). That allowed them to slip in acreage on well drained fields the few sunny days. Those who took advantage of fall killing their sods are going in and successfully no till planting. The biggest "mistake" is to mud in a crop in a desperate attempt to "plant something somewhere." I have seen many examples of this and they are all disasters. The yield loss in corn for being slightly late is far less than the 14 – 27% yield loss from soil compaction. There is even greater loss from squishing the seed in instead of placing it in an optimum soil condition. With duals you can get over soils that **should not be driven on**. That compaction yield loss will stay for this and many seasons after.



When life gives you lemons, make lemonade. We have cool and moist conditions. Capitalize on crops that give peak quality in cool moist conditions. Winter forages, although starting slow because of the cold temperatures, are producing more high quality forage than any yield of mudded in early corn. 50 F has occurred very frequently this spring – too cold for corn – but winter triticale is growing deceptively fast. **Wait until stage 9 for harvest** (see photo previous page). **Don't rush in an erroneous decision to get the corn in sooner.** Last year stage 8 occurred on a Thursday. Stage 9 occurred on the following Tuesday. In that time frame yield went from 8 tons of 35% dry matter silage to over 10.5 tons – **a 32% yield increase**. There was no change in feed quality. Stop planting corn to take time to get in the best forage you can grow this season. You may give up a ton or two of corn silage, but you are gaining 8 – 10 tons of high quality forage. We learned last year that if temperatures drop to the **low 30's** at night you might be able to leave winter grains in a swath overnight with very little loss of sugars. If it only cools to the 40"s or more it is critical to make haylage in a day to preserve the energy. Regardless of the moisture, with the high sugars and homolactic bacteria, we have been able to get perfect fermentation. We suggest **increasing the length of cut to an inch at least**. This dramatically **reduces the leachate** from the silos and, like bmr products, gives **more effective rumen fiber** for this rapidly digestible product.

The other cool season forage is your first cutting haycrop. Every analysis I have seen shows significant profit advantage to stopping corn planting and get the first cutting in at peak quality. **YOUR INDIVIDUAL FIELDS SHOULD DETERMINE WHEN YOU SHOULD START HARVEST,** using **YOUR alfalfa as a predictor**. The height of alfalfa can predict when it and grass fields, in your local climate, condition, and individual field, should be cut. It simply

Alfalfa near a Grass field is 13 inches tall	Start to Cut Your Pure Grass Stands
Alfalfa in 50% Alfalfa 50% Grass Stands is 23 inches tall	Cut Your Mixed Stands
Alfalfa is 30 inches tall in > 80% Alfalfa	Cut Your Mostly Alfalfa Stands

involves using a ruler and the following table:

A better system is to go to http://www.forages.org/index.php/tools-grassman Dr. Cherney of Cornell developed this slick, accurate system. Click on the grass, alfalfa-grass, or the alfalfa estimator. For the latter two insert the alfalfa height, percent grass, NDF target, and the weather (normal, hot, cool) and **it will tell you how many days until that field on your farm under your conditions is at peak quality** for harvest. Using the predictor system to determine what fields to harvest first, allows you to harvest early fields and later fields at peak quality. Thus you have high quality forage from **ALL** fields, even though the harvest may have started a week or more later for some fields. If you have fields that are in a low, warm, sheltered location, they **are ready earlier** than the rest of the farm. A well drained soil will have forage ahead of a poor drained soil. A north facing slope will be further behind a south or south east facing slope (especially after this winter). For some farms, their clear alfalfa on well drained south facing field may be ready before a mostly grass field on a wet north facing slope.

Finally, going back to the old style weather will hit farms who are pushing the envelope for long season corn. Farms in our area who are normally the first to plant, have started 10 or more days behind. The long term forecast is for a more normal summer. Even if the El Nino kicks in, temperature above 85 is not going to help because the corn stops growing at that temperature. Corn of optimum maturity will make more milk than longer season corn that "*might*?" make more tons of wet material. You still have to pay for the corn even if it doesn't mature. So to aggravate the seed sales people I am standing by my March suggestion of trading in your very long season for something shorter to bring the **average maturity of your corn down to normal.**

How Much Water Should Dairy Calves Drink?

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(Originally published in the March 10, 2014 issue of Feedstuffs.)

Table 1. Performance difference due to lack of physical separation of starter and water containers for calves during the month after weaned.

Month after weaned	Separation	Adjacent
Weight gain, lb/day	1.86	1.58
Starter intake, lb/day	5.03	4.44
Water intake, lb/day	18.0	13.6

SOMETIMES, I think producers don't place a high enough value on water for dairy cattle because it seems to be "free" or costs little compared to other feedstuffs.

If that is the reason, then there is no excuse for not providing clean water for dairy animals.

It all begins with calves. Why is water so critical? It is the nutrient needed in the greatest quantity — much more so than other nutrients such as protein and energy.

When a calf is born, its body content is around 70% water. That is the greatest it will ever be. In addition, its body content of fat is also the lowest it should ever be, at about 3-5%.

There is a classic paper (Reid et al., 1955) by my former professor at Cornell University that establishes that there is an inverse relationship between body water and body fat. So, as an animal grows and deposits more fat, the fat displaces body water.

Another critical factor for young calves is that if they get diarrhea, they lose body water. If they lose about 4%, increased water consumption can make up that difference as osmo-receptors then cause the calf to drink more water. However, if that body water loss increases to 8-10%, the calf also loses electrolytes, and an electrolyte solution and further treatment may be needed to keep the calf alive during a major health problem.

So, why is providing water for young calves such an issue? Here are reasons why others have told me they do not feed water to calves: it causes diarrhea, calves don't need it, calves get it through their milk replacer, it freezes in the winter, calves don't need it in the winter and it's a hassle.

Those reasons do not really "hold water." When calves begin to have diarrhea, they will begin to drink more water — not the other way around (Kertz et al., 1984). Yes, they get water through their milk replacer, but that is not enough to fully facilitate calf starter intake. Calves do need water in wintertime because when you can see their breath, it means they are exhaling more moisture into the drier, colder winter air than they inhaled and are losing more body water with each breath.

Dry matter intake is directly related to water intake. Limit water intake, and you also limit calves' dry matter intake. Calves need four times more water than dry matter intake — a 4:1 ratio.

If the water is dirty, calves will drink less water and eat less too. Perhaps the water was clean when fed to calves, but if there is not a physical separation between the water and starter containers, calves will dribble water into the starter and starter into the water. This makes for wet starter and dirty water, which will lead calves to consume less of both.

More than 30 years ago, when I was at Ralston Purina, I had an "aha" moment that led to a study (Table) that found that calves drank less water, ate less starter and decreased daily gain by 0.28 lb. when their starter and water containers were not separated to keep calves from dribbling back and forth.

Those numbers may not, at first glance, look like that 4:1 ratio, but remember, it is 4 lb. of water per 1 lb. of dry matter starter intake, and it was 4:1 when separation was provided.

In a study and Figure 1 by Quigley et al. (2006), note that while the ratio of water to dry matter intake was only about 2:1 before weaning (which included water intake from milk replacer), by the end of 35 days, the ratio increased to 4:1 after full weaning. The different colors represent three milk replacer treatments.

Note that there is considerable variation in these data, which is typical in studies of young calves. This indicates the need for a large number of calves per treatment in a study. There were 40 calves per treatment in this study, which is two to three times more than used in most calf studies (Kertz and Chester-Jones, 2004).

Another factor is that calves like warm water, especially in the wintertime. Cows even preferred warm ambient water (50°F versus 86°F) in the hot summertime based on a study done at Texas A&M University (Wilks et al., 1990). This fits well with many dairies that place a water trough at the milking parlor exit using the warm water from the milk plate-coolers.

The main reason I think cows prefer warm water is because the water does not perturb the rumen fermentation temperature and function.

In a study done at South Dakota State University (Dracy and Kurtenbach, 1968), it took around an hour for the rumen temperature of calves to return to near normal following a 20°F drop after calves drank 46°F water (Figure 2). Drinking water at temperatures of 63, 81 or 99°F produced progressively lesser rumen temperature drops, but it still took about an hour for rumen temperatures to return to near normal.

Another benefit of feeding warm water is that during winter, calves will not need to use additional energy to warm colder water to their rumen temperature.

What's interesting, heifers and cows also drink about four times more water than dry matter intake. There are not many heifer studies that measure water intake, but the ratio of water to dry matter intake was about 4:1 in a Pennsylvania State University study (Lascano and Heinrichs, 2011) in which heifers were fed two different levels of forage and four different levels of corn stover.

Nearly 23,000 cow observations were accumulated over a one-year period from 193 Holsteins, with cows ranging from one to nine lactations and from six to 230 days in milk and on three different experiments (Kramer et al., 2009). In this German research herd database, the overall ratio of water to dry matter intake was about 4:1.

In an Illinois study (Murphy et al., 1983), the best estimate of water intake was related to dry matter intake, milk production, sodium intake and minimum ambient temperature. This formula was used to calculate water intakes at 45°F for six different milk production levels. The ratio of water to dry matter intake was 4:1 (Van Amburgh, 2011).

As ambient temperatures increased to 65°F and 85°F, predicted water intake increased by 13% and 26%, respectively, and this percentage increase was lesser within each water temperature increase when cows were producing more milk and, of course, eating more dry matter.

Why this ratio of 4:1? It may be as simple as the fact that the water-to-dry matter ratio in the rumen is even a bit greater than this — at between 6:1 and 7:1. Rumen liquid turnover rates are about 6-12% per hour (Hartnell and Satter, 1979). Thus, cows cycle a lot of water through their system. They produce much urine — an average of 5 gal. daily, with a range of 2-12 gal., as reported in an extensive Ohio State University summary (Weiss, 2004).

The Bottom Line

Cows, as ruminants, consume about four times more water than dry matter. This begins as calves are weaned and extends through the heifer growing period.

This 4:1 ratio provides a simple reference point to estimate the dietary water needs of dairy animals. We know, especially from calf studies, that limiting water intake will limit dry matter intake and resultant performance.

Also, to help increase intake, make the water warm for calves, especially in colder weather.

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Managing the Aerobic Stability of Silages and Why You Should Care!

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Aerobic Spoilage of Silages

When the active stage of ensiling is complete the remaining microorganisms in the mass are relatively dormant because of the low pH and absence of oxygen. However, if silage is exposed to air, the result can be a chain reaction resulting in aerobic spoilage (Figure 1). Specifically, yeasts that are able to degrade lactic acid in the presence of air usually initiate this process. Examples of these organisms include *Candida krusei (Issatchenkia orientalis)* and *Pichia membranifaciens (C. valida)*. Yeasts able to metabolize sugars (e.g. *Saccharomyces*) are also active and can add to the spoilage process. Aerobic microbial activity causes oxidation of nutrients resulting in the production of heat. Degradation of lactic acid specifically causes an increase in pH of the silage to a level that allows opportunistic bacteria (e.g. *Bacilli)* and molds (e.g. *Aspergillus*, *Fusarium*, and *Pencillium*) to then become active, furthering the spoilage process. Of particular concern is the development of pathogenic bacteria and molds in aerobic spoiling silages because of their potential for producing mycotoxins and causing other detrimental effects. For example, silages sampled from the top layers of silos (where pack density was poor) and silage that was loose on the bunker floor had higher levels of *A. fumigatus* than silage sampled from the intact silo face. This is of particular concern because this organism has been linked with hemorraghic bowel syndrome in ruminants.

Grain crops (e.g. whole crop barley silages, corn silages, high moisture corn-grain silage) are very prone to aerobic spoilage. Epiphytic populations of yeasts are found on all forage crops in the field. However, their numbers are not well correlated to aerobic stability because there is a mix of non-fermentative and fermentative species present. The ensuing fermentation and level of silage management ultimately determine the number of lactate-assimilating yeasts that may survive ensiling. A list of some factors affecting the aerobic stability of silages is shown in Table 1. Porous silage masses, breaks in integrity of plastic and the amount of antifungal compounds added at ensiling, or produced during fermentation have profound effects the number of yeasts in silages. High concentrations of lactic acid and/or a low pH have minor affects on the numbers of yeasts in silages as these organisms are relatively acid tolerant and lactic acid has poor antifungal characteristics. In contrast, relatively high concentrations of acetic and/or propionic acids usually reduces the numbers of yeasts in silages because of their antifungal properties. The concentration of acetic acid in silages can be especially high in silages with high moisture contents because the microorganisms that can produce this acid in silages (e.g. enterobacteria and heterolactic acid bacteria) thrive in wet conditions (more than 70% moisture). Thus, wet silages with high concentrations of antifungal organic acids tend to have low numbers of yeasts and are relatively stable when exposed to air. Ironically, one of the most antifungal acids sometimes produced in high moisture silages is butyric acid. This end product of clostridial fermentation is very active in inhibiting the growth of yeasts but is certainly undesirable because of the other detrimental factors associated with this type of fermentation (i.e. large dry matter loss and degradation of protein). Conversely, low moisture silages (less than 60% moisture) undergo restricted fermentations and thus produce low concentrations of organic acids and also pack poorly, often resulting in high numbers of yeasts. Ammonia also has good antifungal activity but it is doubtful that natural concentrations of this compound effects populations of yeasts in silages (see later discussion on ammonia additives). Numbers of yeasts can be reduced in silages via the direct addition of antifungal compounds (e.g., blends of buffered organic acids) or from microbial inoculation (to be discussed later).

The ambient temperature around the silage mass profoundly affects the rate of aerobic spoilage. When temperatures are very cold, microbial activity is slowed or even stopped (e.g. in freezing weather). Warm temperatures stimulate microbial activity and thus, aerobic spoilage and it is the primary reason that more spoilage typically occurs in the summer than in the winter. High concentrations of residual sugars in silage can also lead to a higher probability of aerobic spoilage.

Impact of Feeding Spoiled Silages to Ruminants

Few studies have been conducted evaluating the effects of feeding aerobically spoiled silages to ruminants. Kansas researchers reported that feeding spoiled corn silage from the surface of a bunker silo depressed DM intake as the level of spoiled feed in the diet increased from 0 to 16% of the ration dry matter. Dry matter intake for steers was reduced even when spoiled silage only was 5% of the dietary dry matter. Recently, we reported that heifers fed a spoiling TMR consumed less dry matter than those fed a fresh total mixed ration (TMR). In contrast Wisconsin researchers reported the intake of cows that were fed a TMR containing aerobically spoiling high moisture corn was unaffected when compared to those cows fed fresh corn but the former produced less milk per cow. When animals consume spoiled silages, the exact causes of reduced intake and/or performance are not fully understood. In the Kansas study, reduced dry matter intake probably occurred because of lower nutrient digestibility of the silage. However, in our study the nutrient composition of the diets was very similar and could not obviously explain the differences in observed intake. One major difference between diets was that the fresh TMR contained 5.0 log yeasts/g whereas the spoiled diet contained 7.8 log cfu of yeasts/g. A graduate student in my lab conducted research by adding various levels of a pure culture of a spoilage yeast to *in vitro* ruminal fermentations and reported lower NDF digestibility as the amount of yeast in the culture increased suggesting that undesirable spoilage yeasts may have direct effects on ruminal fermentation. European researchers reported negative correlations between ethyl lactate and ethanol with dry matter intake in goats but the strongest negative relationship with intake was from silage temperature (as difference to ambient). Other variables that may contribute to depressions in intake include the growth of molds in spoiled silage that may result in the production of mycotoxins and effects of microbes or compounds on immune functions. Organoleptic properties (e.g., taste and smell) of spoiled feeds on intake have not been well studied. In addition to negative of effects on animal performance, spoiled silages also potentially present a contaminant to the environment if the feed is spoiled to the extent that it must be discarded.

Improving the Aerobic Stability of Silages Through Management

Filling silos quickly with sufficient pack weight to maximize silage density and minimize porosity can minimize oxygen in a silo. Even distribution of forage in the storage structure, chopping to a correct length and ensiling at recommended dry matters (DM) for specific storage structures aids in this process. After filling, silage should be covered with plastic as soon as possible and weighted down with tires (tires should be touching) or gravel bags to exclude air. Split tires are good alternative because they are easier to handle, do not accumulate water (thus less breeding grounds for mosquitoes that could carry the West Nile Virus), and are undesirable for animals to nest in. The return on investment (labor and plastic) is extremely high for covering bunk and pile silos. Oxygen barrier plastics with low transmission rates for oxygen appear to be useful in minimizing the loss of nutrients at the silage/plastic interface. This practice can also reduce the number of yeasts in silages and improve aerobic stability.

Proper management for removal of silage from silos at the feed bunk with the use of mechanical equipment (e.g., block cutters and silo facers) can help producers to maximize profits and production. Enough silage should be removed between facing to minimize aerobic spoilage. Lesser amounts may be removed in areas where ambient temperatures remain cool during the winter months. Removal of silage should be such to minimize disruption of the silage face and loose silage on the ground between feedings. Extreme care should be taken to prevent air from penetrating between the plastic and reaching the silage mass during feed out and storage and this can be accomplished by stacking tires, or lining gravel bags on the plastic at the leading edge of the feeding face.

Improving the Aerobic Stability of Silages With Additives

Chemical additives. Various chemical additives with antifungal properties have been used to enhance the aerobic stability of silages. The most common are the organic acids. For example, buffered propionic acid-based products are commonly used in North America because of they are less corrosive and safer to handle than the straight acid. It is the undissociated (protonated) form of organic acids that is responsible for their antifungal properties and its prevalence is dependent on pH. This fact unfortunately means that more acid is needed to be effective in crops that are naturally limiting in acids from silage fermentation (e.g. crops with more than 40% DM). At the pH of a standing crop of lucerne (about 6) only about 1% of propionic acid is in the undissociated form whereas, at a pH of 4.8, about 50% of the acid is undissociated. The undissociated acid functions both by being able to penetrate into microbial cells and disrupt cytosolic functions because of the release of H^+. Undissociated acids also remain active on the surface of microorganisms and compete with amino acids for space on active sites of enzymes and by altering the cell permeability of microbes. Application of buffered propionic acid-based products in North America ranges from about 1 to 4 lb of product per ton of wet forage depending on the specific situation. In previous studies, we have found that, as expected, the effectiveness of propionic acid based additives increases with higher application rates. Potassium sorbate and sodium benzoate have also been used to improve the aerobic stability of corn silages. For example, in studies at the University of Delaware, we reported that 0.1% potassium sorbate-EDTA and 0.1% sodium benzoate were as effective in increasing the aerobic stability of corn silage as treatment with *Lactobacillus buchneri* 40788 applied at 400,000 cfu/g of forage. Treatment with 0.1% potassium sorbate also improved dry matter recovery and aerobic stability and lowered the final concentration of ethanol in corn silage.

Table 1. Some factors that may make silages more prone to aerobic spoilage.

Factor	Effects	Examples
High sugar content or high natural population of yeasts	Yeast use sugars as energy sources during fermentation	a) sugarcane
High DM content	High DM restricts fermentation and reduces acids that could minimize the numbers of yeasts High DM crops are more difficult to pack and allow infiltration of air into the mass	Alfalfa ensiled > 45 to 50% DM Corn silage ensiled > 40% DM
Poor pack density/porosity	Allows penetration of air into the silage mass	Fill rate too fast Insufficient tractor weight
Poor feeding management	Allows penetration of air into the silage mass	Slow silage removal Loose silage Uneven silage face Intermediate feeding piles Moved silage
Poor management of plastic and weights	Allows penetration of air into the silage mass	Torn bag silos Torn silo covers Insufficient weight on plastic Plastic pulled back too far in advance
High ambient temperatures	Spoilage organisms grow faster in warmer weather	More spoilage in the summer than winter months
Addition of spoiled feeds to a TMR	Spoiled feeds bring spoilage organisms to the TMR	Spoiled wet distillers grains
Overly dominant homolactic acid fermentation	Limited production of organic acids that have antifungal properties	An extremely dominant homolactic acid fermentation caused by microbial inoculation

Microbial inoculants. Bacterial inoculants, based on homofermentative lactic acid bacteria are commonly added to silages to improve fermentation and increase DM and energy recovery. However, most of these inoculants are not very effective in inhibiting the growth of yeasts because they tend to maximize the production of lactic acid (poor antifungal activity) and decrease the accumulation of other organic acids that have good antifungal activity. The summarized literature found that treatment with classical homolactic acid-based inoculants improved aerobic stability about one third of the time, had no effect about one third of the time but made aerobic stability worse about one third of the time.

Lactobacillus buchneri, an obligate heterolactic acid bacterium, has been used as a silage inoculant to specifically enhance the aerobic stability by converting moderates amount of lactic acid to acetic acid in a variety of silages (e.g. corn silage, sorghum silage, barley silage, lucerne silage, ryegrass silage, orchard grass silage, etc.). We have conducted extensive research on the strain *Lactobacillus buchneri 40788* and have found it to be very effective and consistent in its effects. *Lactobacillus buchneri 40788* is applied to achieve a final application rate of 400,000 cfu/g of wet forage and we believe that this high application rate is crucial for the beneficial effects of this organism.

Concerns relative to the potential of large losses of DM from silages treated with *L. buchneri* because of its heterolactic nature have not been substantiated. Although some have suggested that high levels of acetic acid in silages may depress intake, research studies have shown that ruminants fed silages treated with *L. buchneri* consume the same amount of DM when compared to counterparts fed untreated silages. Most research on improving the aerobic stability of silages has dealt with the stability of the silages alone. However, there is good evidence that if silages are stable this benefit is transferred to the TMR. In two studies, TMR that were made with silages treated with *L. buchneri* were more stable than TMR made from untreated silages.

When Should Additives Be Used? A question that is often asked is when should products that specifically provide enhanced aerobic stability be used in silages? Such additives may be used to treat historic problems of silages heating in the silos (over sizing, slow feed out rate, poor packing and filling). Corn silages or high moisture corn that will be stored for prolonged periods of time (more than 6-9 months) or be fed during warm weather are other good candidates for treatment. Drier silages that may be challenged because of restricted fermentations and poor packing density may be candidates for additives that improve aerobic stability. Consider treating specific silos or parts of a silo relative to summer feeding. Although some may argue that treating an entire silo may not be justifiable if the problem occurs for only a few weeks out of the year, it is extremely difficult to predict in advance the feeding challenges from a specific silo.

Improving Aerobic Stability in Moved Silage. In certain areas of North America, silages are moved between storage structures because of the need to mix silage in a feeding center. In addition, on many large dairies it is now common to find several days worth of silage fed from temporary piles (brought in from other farms or silos and stored at a staging area). In both of these instances, the chance of aerobic spoilage is increased especially in warm weather. Moving silages quickly and in cool weather minimizes the potential for aerobic spoilage. For moved silage and feeding piles, addition of chemical preservatives that contain antifungal compounds (e.g., buffered propionic acid, sorbates, benzoates, acetic acid, etc.) can be added at the time of moving to enhance stability (0.1 to 0.2%). A better practice would be to consider treating these silages at the time of ensiling with an additive to enhance aerobic stability (e.g. chemical additives or *L. buchneri*). Microbial-based additives and ammonia are ineffective on forages that have already fermented.

Conclusions

Aerobically spoiled silage is undesirable because of losses in nutrients and potential negative effects on animal performance and health. Good silo management and the use of various additives can help to minimize the incidence of aerobically spoiled silage.

(References can be provided upon request.)

Figure 1. The process of aerobic spoilage in silages.

Silage is exposed to air
↓
Lactate assimilating yeasts are revived
↓
Silage begins to heat
↓
Degradation of lactic acid results in an increase in silage pH
↓
Readily digestible nutrients are destroyed
↓
Molds and bacteria continue the spoilage process
↓
Massive nutrient losses

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