Silo and Silage Management for High-Producing Cows

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INTRODUCTION

Silage losses are much higher than most farmers and others in the dairy industry probably realize. According to Bill Stone (Diamond V Mills), even with top-notch silo/silage management, farmers incur about $19,000 in silage quantity and quality losses per 100 dairy cows and their associated young stock. With poor silo/silage management the figure is much worse—$59,000. While a $40,000 difference between *best and worst* management is the extreme, most dairies can save $15,000 to $20,000 per 100 cows and young stock by reducing silage losses. Much of this can be accomplished by tightening up management from harvest through feedout; while several new products may make the job a bit easier.

HARVEST MANAGEMENT: HAY CROP SILAGE

Plant sugars are the food of silage bacteria. Alfalfa has lower sugar concentrations than do most other forage crops and high protein crops are often more challenging to successfully ensile. The shorter the time between mowing and ensiling, the more plant sugars are retained. Therefore, harvest management is particularly critical with alfalfa and other forage legumes. Windrow management is one of the keys to high quality, ensuring that the crop dries as quickly as possible from a typical on-the-stem dry matter **(DM)** of approximately 15 % to the desired ensiling DM content. Alfalfa has a high number of stomata, which are the lungs of a plant. As long as these stomata are exposed to sunlight they remain open, increasing the rate of moisture loss. But as soon as the plant is shaded—as in a narrow windrow—the stomata close and the rate of moisture loss declines. That's one reason why wide windrows dry much faster than do narrow ones. A greater proportion of the mowed crop is exposed to sunlight. An additional reason for more rapid moisture loss is the insulating effect of narrow windrows. Water evaporation from the forage on the bottom of a narrow windrow is very slow. To reach an intended DM of 30 % or higher for the entire windrow, the top of the windrow must get very dry since the forage on the bottom of the windrow is still very wet--often not much more than the *on the stem* DM. The very dry alfalfa at the top of the windrow often results in excessive leaf loss during field chopping. The cloud of dust following choppers in these situations often is not soil particles, but shattered alfalfa leaflets.

Most mower-conditioners don't spread the harvested swath to more than approximately two-thirds of cutterbar width. This isn't ideal, and is the reason recent Cornell University research has been evaluating whether conditioning is necessary for hay crops harvested for silage. Early results are promising. However, two-thirds of cutterbar width is better than a narrow, 3- or 4-ft wide windrow. Research at the University of Delaware found that wide-windrow first and second cut alfalfa reached 45 % DM in half the time as alfalfa from the same field managed in narrow windrows. Third cut alfalfa, harvested under almost ideal weather conditions, took only one-fourth as long - 6 vs. 25 h - to reach 45 % DM when allowed to dry in wide windrows.

Research in Eastern N.Y. by Cornell University Cooperative Extension (Kilcer, 2006) involved wide windrows (75-85 % of cutterbar width) vs. narrow windrows about 3 ft wide. High-yielding first cut alfalfa from wide windrows resulted in 20 % higher milk production than the same forage managed in narrow windrows. A similar study, with second cut grass, found an 11 % milk production advantage to wide windrows.

There's renewed interest in the ideal mowing height for alfalfa and forage grasses, in part because of the greatly increased use of disk mowers vs. sicklebar mowers in recent years. Disk mowers (or more commonly, mower-conditioners) permit forages to be mowed at a shorter stubble height, because they are much less susceptible to mechanical damage if close mowing results in hitting a stone or scalping the soil surface. Mowing height decisions are a trade-off between yield and quality. Mowing alfalfa at 2" vs. 4" results in about 10 % higher DM yields, with only a small negative impact on forage quality. However, cool-season forage

grasses should be mowed at 3-4" stubble height because the nutrients for the succeeding crop are stored in the bottom few inches of the grass plant.

HARVEST MANAGEMENT: CORN SILAGE

Most large dairies harvest corn for silage using silage processors, but this doesn't always mean that the crop is properly processed. Recommended processor roll clearance normally ranges from 1 to 3 mm, but it's not unusual to find corn silage that was inadequately processed. This can be the result of not checking post-processing kernel status, including between fields and between hybrids; but worn processor rollers can also result in poor processor effectiveness. As silage processors age, this becomes a more commonly-encountered problem. Occasionally the problem of inadequate kernel breakage is due to a custom operator increasing processor roller clearance to 6 mm or more in an attempt to increase harvest efficiency; for custom operators time is money, and never more so than during corn harvest. In properly processed corn silage, at least 95 % of the kernels will be broken.

Both opinions and research results vary considerably on the milk response from processed corn silage. The response varies in part depending upon lactating cow rations (more vs. less corn silage in the ration) and how well the kernels are processed, but also on the DM of the silage. Immature corn silage—less than 30 % DM--should not be processed, in part because of the potential for greatly increased amounts of silage effluent. Corn that is overly mature may benefit to a greater extent from silage processing, as also may corn hybrids with high *stay green* ratings or with insect resistance traits. In a corn hybrid with a high stay green rating, the plant remains green and healthy while the kernels continue to develop and add DM. That's one reason why the kernel milk line has been discounted as a guide to the proper time to harvest corn for silage. Also, corn with the Bt trait for corn borer resistance often remains healthy (incurring less stalk rot) later into the season. It's not uncommon for a hybrid with the corn borer resistance trait to be several points **lower** in whole plant DM at harvest than its non-traited isoline hybrid.

The influence of silage processing on milk response may also depend on the length of time the crop has been ensiled. The starch in corn silage becomes more available over time, so the positive effect of processing corn may be greater 2 mo after ensiling than after 6 or 8 mo. (This is true for both processed and unprocessed corn silage.) In a European study involving 15 bunker silos, each containing a single corn hybrid, Newbold et al. (2006) found that starch degradability increased for every 2 mo period beginning 4 mo after ensiling (Table 1). Furthermore, these changes were not small and would almost certainly affect ration formulation and/or lactational performance.

Table 1. Effect of storage time on corn silage starch degradability (Newbold et al. 2006).

Months after ensiling	Starch degradability, %
2	53.2
4	53.5
6	58.9
8	63.9
10	69.0

SILO MANAGEMENT

Drive-over silage piles, also called stack silos, have become increasingly popular; especially in the Western and Southwestern U.S. And with good reason, since they represent somewhat less capital investment compared to other methods of silage storage and silage capacity is limited only by the available storage area. The silage can be shaved from the working face of drive-over piles from the side rather than from the front; resulting in a more uniform face, less surface heating, and reduced aerobic spoilage losses. Drive-over silos should be placed on an improved surface (usually concrete or asphalt) or on a very well-drained site. An improved surface is highly recommended except for a temporary (one-time) drive-over pile.

The biggest problem with drive-over piles begins with their construction. Properly made drive-over piles are packed both front-to-back and side-to-side, with side slopes no greater than 1 on 3 (1 ft of height/3 ft of length). Unfortunately, in some areas most drive-over piles are not constructed and packed properly. As they are formed, stacks are packed front-to-back but not side-to-side, with steep side slopes (many

times less than 1 on 2). For this reason spoilage losses are often excessive. Even the best-managed drive-over pile usually has a slightly higher spoilage loss than a bunker silo of similar capacity and management; but with proper construction and packing this difference can be kept to a minimum.

BUNKER AND DRIVE-OVER PILE FLOORS

Concrete was once the standard material for horizontal silo floors, but an increasing percentage of bunker and drive-over silo floors are using asphalt (Thomas, 2006). While silo acids deteriorate concrete, they have no effect on asphalt. Many asphalt floors over 20 yr old are still in perfect condition. Contrary to what some may believe, the use of asphalt silo floors in hot climates is not posing any problems. Asphalt floors are lasting quite well in Mexico and in the Southwestern U.S. In most parts of the U.S. asphalt is less expensive than concrete, but this isn't the primary reason for the trend to asphalt. At Miner Institute, after 10 yr of use the original concrete floor in one of its bunker silos was badly eroded. A second concrete floor was poured in 1992, but by 2007 the concrete was so badly eroded that the gravel aggregate was coming loose. Asphalt floors installed in 1993 in 2 adjoining bunker silos at Miner Institute remain in almost perfect condition, with no surface erosion or other deterioration. During the summer of 2007, 2" (compacted depth) of asphalt was installed over the surface of the deteriorated concrete floor of the first silo. It is expected that this silo floor will remain in excellent condition for many years. Miner Institute has 7 bunker silos, all with asphalt floors.

SILAGE INOCULANTS

Research trial summaries have found that bacterial silage inoculants decrease fermentation losses and/or increase silage quality about three-fourths of the time. Seldom does a bacterial silage inoculant produce negative results; the 1 time in 4 that the inoculant doesn't result in a positive effect, it's probably because there were sufficient populations of naturally-occurring homofermentive silage bacteria present on the forage. The use of a silage inoculant should be based primarily on price. Is the cost of the product greater than the expected return? In almost all cases, the answer is yes. The silage inoculant business is highly competitive, and most commercial products are priced at a level that is cost-effective. Typical prices range from less than $0.50/treated T to over $3.00/T for one inoculant that's advertised to increase both fiber digestibility and milk production.

NEW SILO MANAGEMENT PRODUCTS

There are several new and fairly new types of plastic silo covers. These are three-ply products that sandwich a very high density film between 2 layers of plastic. To date, research results on these products have been generally positive. Cost per square foot is somewhat higher than for the normal two-ply plastic, but this appears to be more than offset by decreased aerobic losses (and therefore higher quality) in the top 3 ft of silage.

Silo bags, also called gravel bags and sand bags, consist of plastic fabric filled (usually at the farm) with a ballast. Sand can be used as a ballast in areas where freezing isn't a problem, while gravel is preferred elsewhere. Once filled, they typically weigh 40 to 50 pounds, providing a much tighter seal between silo plastic and the silage. For bunker silos, the bags are placed around the entire perimeter of the silo, tightly pressing the silo plastic to the silo walls. Then a row is placed across the width of the silo, with one row for approximately every 18 feet of silo length. During feedout the row of silo bags is rolled back until it meets the next row, at which point the first row is removed and placed on a pallet. Silo bags are heavy, and whenever possible should be moved on pallets. Retail cost is about $3.00/bag, not including the cost of sand or gravel, and expected life is 5-10 yr depending on how carefully they are handled. The fabric is quite resistant to normal wear, but dragging a silo bag across the asphalt or concrete silo floor will greatly reduce its useful life.

CONCLUSIONS

As milk production per cow continues to increase, forage quality becomes ever more important. Recent efforts at improving forage quality include better management of hay crop windrows to reduce respiration and leaf shattering losses, adjusting mowing height to attain the best combination of yield and quality,

proper adjustment of silage processors to achieve almost complete kernel breakage, and storing silage to minimize quality and quantity losses.

LITERATURE CITED

Kilcer, T. F. 2006. Silage for dairy farms: Growing, harvesting, storing, and feeding. Wide versus narrow-swath harvesting: Feed quality aspects. NRAES January 2006. 181. 206 – 213.

J. R. Newbold, E. A. Lewis, J. Lavrijssen, H. J. Brand, H. Vedder, and J. Bakker. 2006. Effect of storage time on ruminal starch degradability in corn silage. J. Anim. Sci. 84 (Suppl. 1)/J. Dairy Sci. 89 (Suppl. 1): T94.

Thomas, E.D. 2006. Asphalt floors for bunker and stack silos. William H. Miner Agricultural Research Institute website. *http://whminer.com/Outreach/Asphalt*