CORN SILAGE MANAGEMENT IN BAG AND BUNKER SILOS

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Introduction

Forages (hay and silage) represent ~ 20-30 % of input costs for the production of milk and therefore should be considered a valuable resource. The discussion herein will focus on bag and bunker silage as they are the most predominant silo types in the Northwest. Previous research has well documented the wide range in management of ensiled forages and the resulting wide range in recovery of DM and variable nutritive value of ensiled forages in bunker silos. "The most important single factor influencing preservation efficiency of ensiled forages is the degree of anaerobiosis that is achieved in the completed silo" (Bolsen et al., 1993). Bolsen et al. (1993) demonstrated in pilot-scale and farm-scale silos the value of covering a wide variety of ensiled forages. Ruppel et al. (1995) quantitated numerous management factors that can impact the recovery of ensiled forage, particularly the need to pack silage to create a dense and "air-free" environment. Limited data exist from controlled studies that document the recovery of forage from bag silage systems (Harrison, 2001; Wallentine, 1993).

Numerous economic studies have been conducted that indicate that bags and bunkers are the least expensive silo options (Holmes, 1998). These comparisons have been made when the bunkers were constructed of concrete. In the more arid parts of the Northwest it is common to see "bunker" silo constructed by digging a silo back into a well packed soil bank. The evaluations done by Holmes (1998) would not consider these type of silos.

Factors Affecting Anaerobiosis

Figure 1 summarizes the major factors that affect anaerobiosis in the silo. I will attempt to provide some examples of each factor to help emphasize their importance as it relates to developing an "air free" silage in both bags and bunkers. Crop characteristics such as hollow stems or mature forage stems can result in forage that is more difficult to compress and pack densely. These crop characteristics can be overcome by adjusting chop length and mechanical processing at the time of harvest. Packing time and the thickness of the silage as it

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is layered interact to affect silage density. It is desirable to layer the forage into a bunker silo at depths of 6 inches or less and pack to a rate of 2-3 minutes per ton of forage or 600-800 hr-lbs/ton of wet forage. When forage delivery to the silo is in the range of 40 tons per hour these rates are achievable and realistic. At delivery rates greater than 40 tons per hour, it will require large packing tractors and likely multiple packing tractors. The top surface of the forage should be covered entirely with plastic (preferably white plastic) and covered with tires (tire to tire) to keep wind from whipping air into the top of the silage mass. It is important to monitor the integrity of the plastic on top of the silo or in the case of bags, the integrity of the bag. Holes should be promptly patched with tape to minimize infiltration of air and water. The silo integrity should be checked each year to insure that sidewalls are well sealed to prevent infiltration of air and water. Common recommended feed-out rates are 6 inches per day, but more is recommended in hotter weather. It is best not to "buck" into the silage mass when removing silage as this allows channels for the entry of air back into the silage mass. When bagging there are some special considerations to make. They include having a good solid and well-drained surface to place the bags during the bagging operation as well as during feed out. The forage mass needs to be packed tightly to avoid slumps and lumps in the bag as this can then result in air infiltration in and around the silage during feed out. Check the integrity of the bag surface for damage from birds and rodents. If birds are a particular nuisance, bird netting is simple to use and quite effective.

Don't over fill bunkers. At last years conference Keith Bolsen presented information about the hazards of overfilling bunker silos and the potential there is for caving of bunker silos that are over filled. Please be mindful that farming can be hazardous and be realistic about the height that you fill your bunkers.

Tools for Estimating Bunker Characteristics

A number of publications and computer software based tools for silage storage are available at the following website:
http://www.uwex.edu/ces/crops/uwforage/storage.htm.
In particular look for two spreadsheets that are entiltled "Bunker Silo Density Calculator" and "Bunker Silo Sizing Spreadsheet". In addition to these spreadsheets, Bolsen (Bolsen et al., 1993; and Bolsen, 1995) reported the use of an equation that allows one to predict organic matter losses in the silo from differences in ash content. In addition to these software tools, DAFOSYM, a whole farm economic model is available at the following website:
http://pswmru.arsup.psu. A free of charge copy of DAFOSYM can be

downloaded. This model was developed with a particular emphasis on forage management technology.

The Werkhoven Case Study

I have had the opportunity during this past year to work with Jim, Andy, and Steve Werkhoven in Monroe, WA to evaluate the storage and feeding characteristics of corn silage that has been stored in bags vs a bunker on a commercial dairy. This research was a follow-up to research we had previously conducted at the WSU Dairy Forage Facility in Buckley, WA. In the WSU Dairy Forage facility trial we compared high DM corn silage (~38 % DM or 62 % moisture) that had been stored in bags and bunkers (Harrison et al. 2001). In our previous work we had demonstrated that with high DM corn silage one could expect to see an improvement in nutritive value when corn silage was stored in an Ag Bag silo system. Cows produced 2.7 pounds more 3.5 % FCM when fed corn silage stored in an Ag Bag system. Our interest with the Werkhoven study was to look at silage that had a more typical DM (~28 % DM) content for Western WA.

Corn silage was harvested with mechanical processing and ensiled in a new bunker silo of dimensions 112.5 ft wide x 151 ft deep. The bunker had sidewalls of 5 ft in height and a back wall of 10 ft. The bunker contained 4453 wet tons of silage at completion of harvesting. In addition, corn silage was ensiled in six Ag Bag silos in quantities of ~100 tons each, except for one bag of ~239 tons. A sample was obtained of each load of silage when at the silo. Each load weight was measured with load cells mounted on the dump box behind the chopper. Harvesting occurred from September 29 through October 6, 2000.

During chopping two tractors with a combined weight of 25,300 pounds were used to pack the silage in the bunker. The accumulative hours of packing and tons of silage were recorded so the hour-lbs/ton of packing could be calculated. This value averaged 597 hr-lbs for the 4453 tons of corn silage (see Figure 2). The density of silage after 3+ months of storage was estimated on seven occasions and averaged 48 pounds per cubic foot. We used the equation of Ruppel et al. (1995) to estimate the packed density of silage based on the amount of tractor weight and the time that packing occurred.

The measurements obtained during packing, sealing, and silo storage are shown in Tables 1, 2, and 3. The cost to pack the silage was estimated to be $1.33 per wet ton while covering and silo structure costs were estimated at $0.33 and $1.01 per wet ton, respectively. The total cost to ensile in the bunker was ~$2.67

per wet ton ensiled. This value does not take into account storage losses since that data is continuing to be collected.

During ensiling and feed out we monitored the temperature of the silage mass or silo face. These data are shown in Figures 3 and 4. It was observed that the temperature of the ensiled forage remained ~25- 30 degrees warmer in the bunker silo and that this temperature difference was evident at the silo face during the feed out period.

The feed out data we have collected thus far would suggest that the bagged silage had an average wet recovery of ~99% for the five bags tested. At the ~44% point of feed out from the bunker silo, 38.7 % of wet silage placed in the silo had been fed. We will not have a final number for total feed out from the bunker until early 2002.

We conducted a group feeding trial beginning in February of 2001 with 180 high producing cows (two groups of 90 cows). The trial lasted for ~86 days and utilized a switch back design where all cows received both silages. The milk production performance is shown in Table 4. When cows were fed bagged corn silage they produced ~0.4 to 0.7 pounds more milk (not statistically different). This difference disappeared when milk production was expressed on a FCM basis. The average DM intake of cows fed bagged and bunker stored corn silage was 57.7 and 58 pounds per day, respectively. It should be noted that both silages were well preserved.

Summary

Forages represent a key piece to the nutritional backbone of all dairy enterprises. Their harvest and storage management can play a large role in the nutrient recovery and nutritive value. Real cost savings and therefore improved whole farm economics can be realized by adopting practices that exclude air from the silage during packing, storage and feed out.

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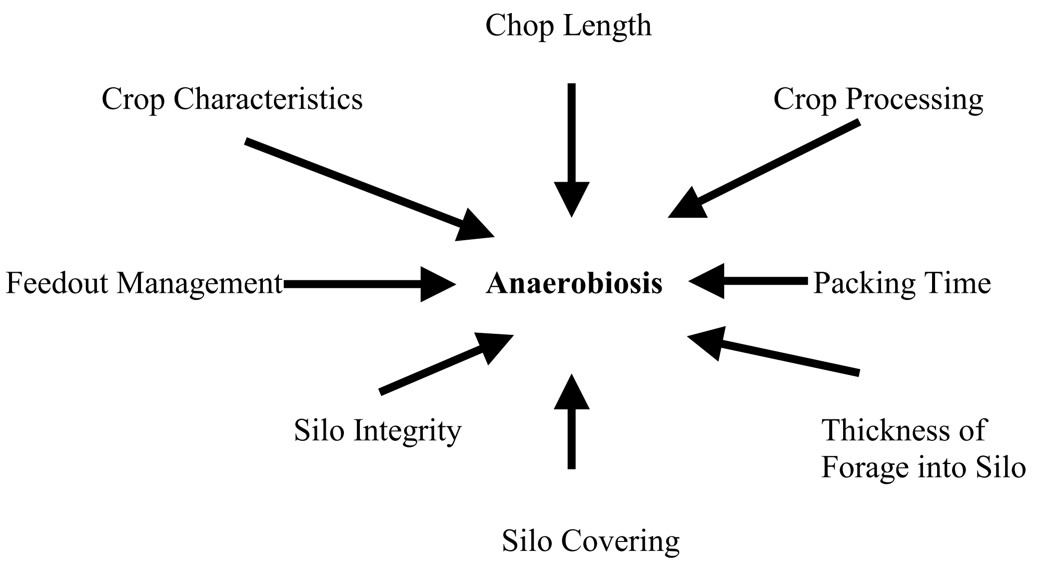

Figure 1. Factors affecting anaerobiosis in the silo.

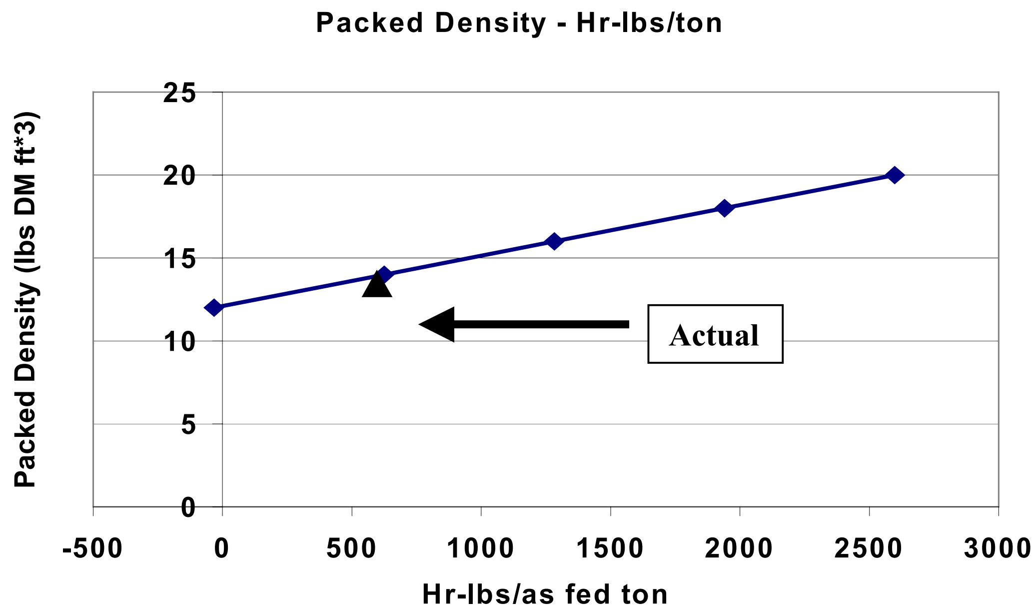

Figure 2. Relationship between packing intensity and packed density.

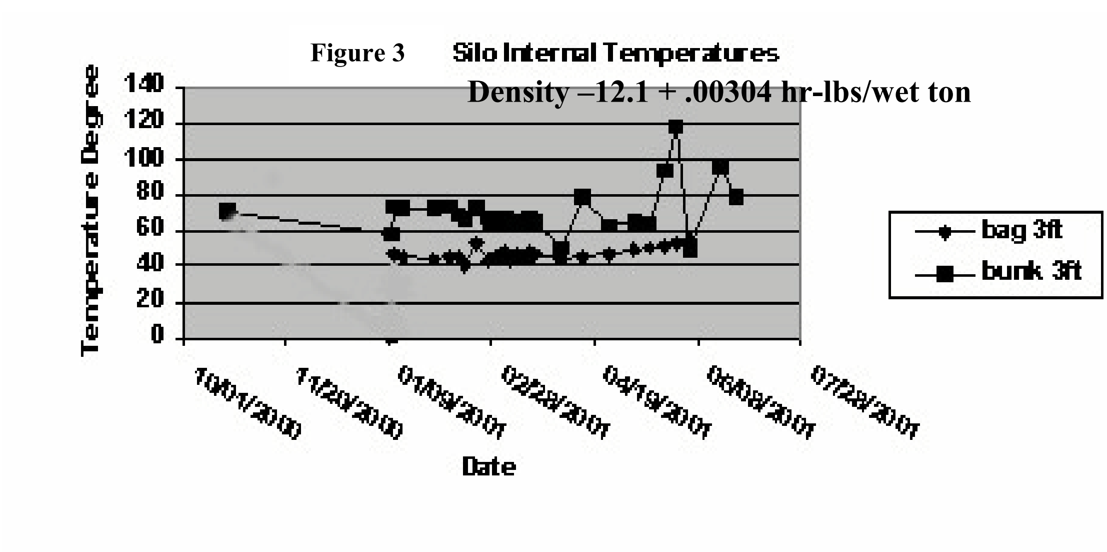

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Figure 4 - Siloface Temperature

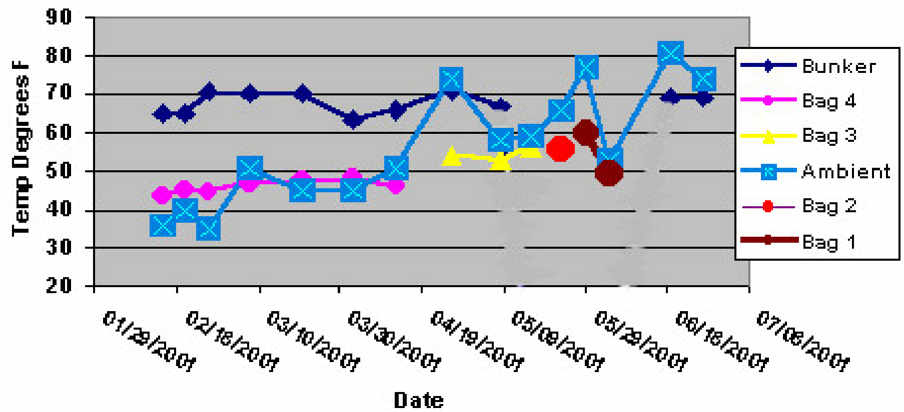

Table 1. Factors related to calculating packing density.

Date	Hours packed	Tons	Tractor weight, lbs	Tractor time, hours	hr-lbs/ton
9/29/00	2.5	237	13000	2.5	137
10/01/00	6.75	610	25300	13.5	560
10/02/00	14.75	1040	25300	29.5	718
10/03/00	15	874	25300	30	868
10/04/00	14.5	989	25300	29	741
10/05/00	10	703	25300	15.5	558
10/06/00	2		13300	2	
Sum or Average	63.5	4453		122	597

Table 2. Economic factors related to packing cost.

Tractor rental	Labor	Fuel use and cost	Total Cost	Cost/ton
$25 and $ 40/hr	$10/hr	4 gal/hr and $1.50/gal	$5927	$1.33

Table 3. Economics of covering the bunker silo and bunker storage.

Covering time, hr	Cost of plastic	Silo cost	Total cost	Cost per wet ton ensiled (includes packing – see table 2)
20 person hrs @ $200	$1281	$1.01/wet ton	$11,889	$2.67

Table 4. Milk production response to Ag Bag or bunker stored corn silage.

Group	Milk, lb	Milk fat, %	4 % FCM, lb
High			
Bag	125.8	3.10	117.7
Bunker	125.2	3.14	117.9
Low			
Bag	101.4	3.25	97.0
Bunker	101.0	3.30	97.5
All Cows			
Bag	114.4	3.17	108.0
Bunker	113.7	3.21	108.5

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