OVERVIEW OF SILAGE MANAGEMENT IN CALIFORNIA

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ABSTRACT

California is the number one dairy state in the nation, and California dairy rations rely heavily on the high quality forage produced in the state. A description of current silage management practices on California dairies will serve as background information to the other proceedings papers presented in this section. Due to environmental pressures, Central Valley dairies are subject to stringent water and air regulations. Discussion of silage management in California is not complete without this regulatory component.

Key Words: California, silage management, air and water regulations

INTRODUCTION

Ideal growing conditions combined with ample fertilizer (recycled manure) and irrigation infrastructure allow forages to be a major component of California dairy cattle rations. Corn silage and alfalfa hay are typical ingredients in California high producing dairy group rations (7). According to a feed management survey conducted in 2009, additional common forages found on California dairies include oat hay, cereal silages, wheat straw, and alfalfa silage (6).

The ability to grow and incorporate high quality forages into rations is a unique characteristic that contributes greatly to the success of the California dairy industry. California farmers have adopted best management practices to ensure silage quality is appropriate for the high producing cows they feed, as well as to decrease the need to purchase feedstuffs. Until recently, regulatory considerations were not a factor in the way dairy producers grew, harvested, stored and fed silage. Today, California dairy producers comply with some of the strictest air and water quality regulations in the nation. These regulations impact decisions made on the dairy, from how much fertilizer to apply to crops to the feeding management of animals. Any discussion on silage management in California must now include this regulatory component.

SNAPSHOT OF SILAGE MANAGEMENT IN CALIFORNIA

In summer 2009, a feed management survey was mailed to dairy producers in Tulare, Stanislaus, and San Joaquin Counties; the first, third and seventh largest dairy counties in California, respectively (5, 6). The objective of this study was to describe current feed management practices, including silage management, on California's Central Valley dairies. Producers received an envelope containing an invitation letter to participate in the study, a two-page survey, and a pre-paid return envelope. Response rate was 16.9%; 120 of 710 dairy farms responded to

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the survey. Herd size ranged from 160 to 6,600 cows, with a median herd size of 950 lactating cows.

Figure one identifies the most commonly reported forages of the survey. Alfalfa hay and corn silage are the two most common forages fed to dairy cattle in California.

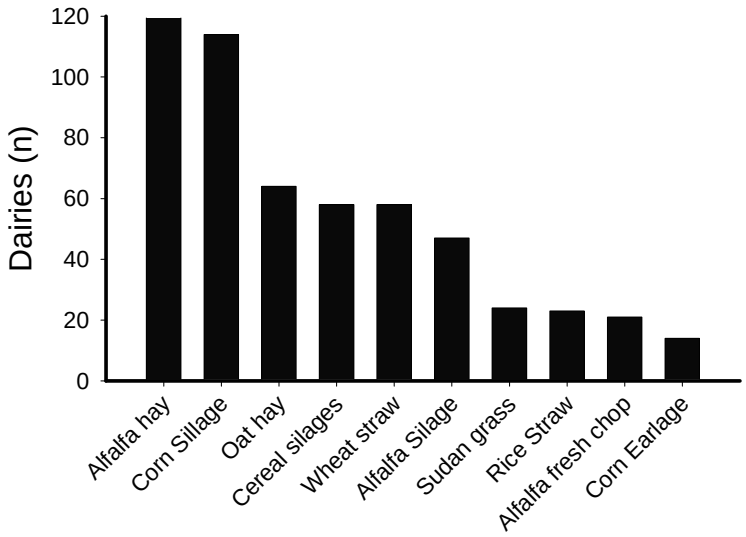

Figure 1. Reported forages fed to dairy cattle in California.

The survey included a series of questions related to silage management. While dairy owner and manager responses are subjective, results can help us to identify areas where educational opportunities can aid in improving management decisions.

Storing Silage

Silage in California is more frequently stored in piles (85.0%) and on concrete (75.0%), than in bunkers or on dirt. Dairies utilizing silage bags did so in conjunction with another type of storage. Reported top layer spoiled forage ranged from 0 to 20 inches. Twenty-five percent of dairies reported less than 3 inches of spoiled feed, 53.9 % reported 3 to less than 6 inches, 15.7 % reported 6 to less than 9 inches, and 4.9% reported at least 9 inches of spoiled feed. Of the 120 respondents, only one producer indicated that silage was not covered (20 inches of spoiled top layer forage). A total of 54.7% (n=55) of dairies covered silage with oxygen barrier (OB) technology. Top surface spoiled forage was reported to be less than 6 inches in 89.3% of silages covered with OB technology and in 64.0% of silages covered with conventional plastic material. Bacterial inoculants of various types were used in 54.0% of corn silages.

Feeding Silage

Most respondents (73.4%) considered that silage faces were maintained smooth. The entire width of the silage face was removed daily in 41.7% of dairies, while 58.3% of respondents removed one-half or less of the silage face daily. Of those dairies not removing the entire face of

silage, 24% of respondents removed one-half of the face, 26.9% removed one-third of the face, and 7.4% removed only one-fourth of the silage face daily. Determination of silage dry matter (DM) was conducted at least once a month in 52.3% of dairies. Only 8.3% of dairies determined DM weekly, or more often. Most dairies delegated DM determination to an outside nutrition consultant (86.6%). A total of 25.0% of dairies suspected mycotoxins in 2008. Top surface spoiled forage was discarded by 70.4% of dairies suspecting mycotoxins, and by 55.8% of those that did not suspect mycotoxins.

ENVIRONMENTAL REGULATIONS SPECIFIC TO SILAGE IN CALIFORNIA

Regional Water Quality Control Board – Region 5

In 2007, Waste Discharge Requirements (WDR) for Existing Milk Cow Dairies (Dairy General Order) was adopted by the Regional Water Quality Control Board - Region 5 (8). Region 5 covers the majority of dairy land in California, stretching from Kern County to the Oregon border. Dairies of all sizes are regulated under the WDR. The WDR places restrictions on the amount of nitrogen that can be applied to crops where manure is land applied. A producer may not apply more than 1.4 times the nitrogen harvested in plant tissue. This restriction created the need to track nitrogen placed on and removed from dairy fields, with the goal of protecting ground and surface waters of California.

Due to lack of field uniformity, representative samples from plant tissue must be analyzed to quantify nutrients removed for regulatory purposes. The section below titled "Variability in dry matter content of harvested corn for silage" is a result of the regulation's need for quantifying nutrients removed in plant tissue for silage. Dairy producers and crop consultants will find its contents useful to meet regulatory demands for sampling and reporting silage nutrients.

Variability in dry matter content of harvested corn for silage

The Dairy General Order requires dairy operators to document total weight of nutrients removed from fields where manure is applied. A detailed protocol requires sub-sampling (n=8) from each 40 acres, with additional composites made to represent morning and afternoon harvest periods for dry matter (DM). Analysis of forage DM forms the basis for all nutrient removal calculations. A single composite sample for each field is then prepared for nutrient analyses. Field observations indicated the detailed sampling protocol was not generally followed at dairies.

The objective of this study was to determine if differences exist in calculating DM removal based on various intensities of sub-sample and composite collection (2). Weights (TL) were obtained and samples collected for each truckload of forage harvested on a single corn field at three dairies. Truckloads were sampled by taking four grab samples across the pile of forage after unloading, but before being pushed up into the silage structure. Each sample was sealed in a plastic bag and placed on ice. Dry matter was determined by sub-sampling and drying 25-40 g, in triplicate, in a 55 □C oven for 24 hours, then weighing the dry residual. DM is dry weight divided by wet weight. Actual field DM removal was determined by summing TL*DM for all samples from the field.

Field DM removal totals were calculated using two composite sampling methods (sequence and interval). Sequence values are the average of sample DM within an hour of harvest; for example, forages from trucks that unloaded between 9a and 10a (see **Figure 2**). Interval values are the average of every 10th sample collected, for example, forage that was unloaded at 9a, 10a, 11a, etc.

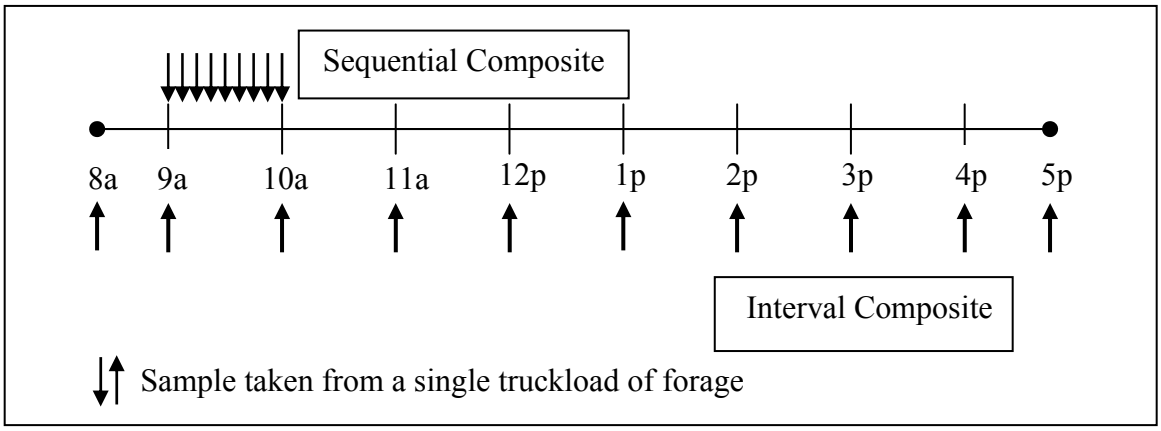

Figure 2. Example of truckload samples taken to create Sequential (top) and Interval (bottom) composites.

We found that taking a single sample of forage to estimate DM removal of an entire field yielded results that varied greatly from the actual DM removed. In the three cooperator dairies, using any one individual sample to estimate DM removal could underestimate harvested forage by 21.5% or overestimate forage removal by 20.4%. Sequential composites were less varied, and interval samples were the least varied of all methods tested (see **Table 1**).

Table 1. Differences between estimated field DM removal and actual field DM removal based on method of sampling on one cooperator dairy.

	Individual	**Sequential**	**Interval**
% difference	-21.5 to + 20.4	-5.14% to + 5.15	-2.71% to + 2.40
DM difference (lbs)	± 135,000	± 33,000	± 16,500

Determining accurate DM removal for harvested fields has many implications, including: cost of harvesting forage, maintaining accurate feed inventory as well as regulatory compliance. Through more intense sampling, it was found that under- and overestimations were reduced. Interval samples across all dairies were ± 3% of actual DM harvested.

Currently approved WDR sampling methods:

- http://www.waterboards.ca.gov/centralvalley/water_issues/dairies/general_order_guidance/sampling_analysis/sampling_and_analysis_21feb08.pdf
- http://www.cdqa.org/docs/Sampling_Forage_Plant_Tissue_Protocol-draft_2-25DM.doc

Stringent emission regulation aimed at confined animal facilities (CAF), Rule 4570 (4), was adopted in June, 2006 by the Governing Board of the San Joaquin Valley Air Pollution Control District (District). Initial regulations were focused towards housing and manure management systems of large (1000 cows) dairy operations. With the recently passed amendements to Rule 4570 (October, 2010), threshhold limits were lowered to apply to additional medium sized dairy operations (500 cows). With the lower threshold, 94% of dairies in the air district will now be covered under Rule 4570.

Special emphasis was placed upon silage mitigation measures in the ammended rule, due to recently completed emission studies indicating silages are the most significant source of volatile organic compound (VOC) emissions on dairies (1, 3). Compliance with Rule 4570 will be accomplished through a menu based approach, where dairy producers will choose mitigation measures that best fit management practices on the dairy. Mitigation measures focus on silage harvest, storage and feed management.

A full list of mitigation measures and requirements of Rule 4570 can be found on the District's website (www.valleyair.org). Mitigation measures apply to the following areas:

- Moisture, theoretical length of chop and delivery rate considerations at harvest
- Silage additives
- Achieving minimum bulk densities of silage
- Covering silage
- Managing exposed surface area of silage faces with no more than:
    - One silage pile = 2,150 square feet
    - Two or more piles = 4,300 square feet
- Maintaining smooth silage faces
- Leachate

SUMMARY

Knowing the current silage management practices of California dairy producers helps to identify areas where improvements in silage quality can be made. Historically, considerations for ensiling and feeding forage crops to dairy cattle focused solely on the plant, and management of the chopped material. Today, dairy producers in the Central Valley must also consider implementation of various management practices to achieve compliance with water and air quality regulations. In the future, every member of the silage team, from crop consultants in the field to feeders employed by the dairy producer, will be responsible for carrying out best management practices and/or mitigation measures to ensure quality feed and compliance with regulations.

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