ENSILEABILITY OF ALFALFA: CUTTING, MATURITY, AND TREATMENT EFFECTS[1]

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Summary

Analysis of ensiling characteristics from late-bud, 10% bloom, and 50% bloom alfalfa, taken within each of four cuttings identified higher pre-ensiled dry matter (DM) content during the first two cuttings, whereas crop buffer capacity was weakest during the third cutting and subsequently strongest throughout the fourth cutting. Initial pH was lowest at the first cutting and increased with each cutting thereafter.

Dry matter increased linearly within maturity, whereas late-bud maturity had the highest buffer capacity and initial pH. From hr 24 until d 90, the pH values were consistently highest for late-bud and lowest for 50% bloom silage.

Treatments receiving 2% dextrose showed a slightly higher DM. At each of seven laboratory silo opening times, a combination of added dextrose and a lactic acid bacteria inoculant yielded the lowest pH; inoculant alone gave the next lowest pH values through hr 48. From d 3 to 90, pH's were consistently highest for control silages, followed by inoculant, dextrose, and dextrose + inoculant combined.

(Key Words: Alfalfa, Silage, Inoculant, Dextrose.)

Introduction

Alfalfa is usually harvested and stored either as hay or silage. Advantages for storing alfalfa as silage compared to hay include less field leaf loss, fewer weather delays at harvest, and adaptability to mechanized feeding in large-scale beef and dairy operations.

Considerable research effort has been devoted to improving yield and quality of alfalfa as a hay crop, as evidenced by over 200 new alfalfa cultivars certified for seed production in the U.S. and Canada since 1973. However, to our knowledge, no cultivars have been developed specifically for enhanced silage quality. Therefore, the major objective of this ongoing research is to identify basic biochemical and agronomic differences between acceptable and unacceptable alfalfa silages, with the ultimate goal of increasing animal production through better quality alfalfa silage.

[1]Partial financial assistance and the inoculant, Biomate®, were provided by Chr. Hansen's Bio Systems, Milwaukee, Wisconsin.

Experimental Procedures

This study examined the effects of cutting (2nd through 5th), maturity (late-bud, 10% bloom, and 50% bloom), and ensiling treatment (inoculant, dextrose, and inoculant + dextrose) on ensiling characteristics of alfalfa. A second-year stand of Cody alfalfa, established in August, 1987, near the Kansas State University campus, was harvested between June 20 and October 22, 1989. At each cutting and maturity, the crop was swathed at about 11 a.m., field-wilted for 3 to 6 hr, and then chopped with a Field Queen forage harvester. Within each cutting, the maturities were assigned in a randomized complete block design to three replicate 30 × 280 ft plots.

PVC laboratory silos, treatment methods, and silo-filling techniques were similar to those described on page 105 of this report. The Biomate® inoculant, which contains *Lactobacillus plantarum* and *Pediococcus cerevisiae*, was applied according to the manufacturer's recommendation and provided about 1.5×10^5 colony-forming units of lactic acid bacteria/g of crop. Dextrose was applied at 2% of the crop dry matter. Duplicate or triplicate laboratory silos were opened at 12, 24, and 48 hr and 3, 7, 42, and 90 d post-filling. Buffer capacity (BC) of pre-ensiled material was determined by homogenizing 15 g of fresh material in 250 ml of distilled water in a blender for 1.5 min, then lowering the pH to 3.0 with .1 N HCl, and raising it back to 4.0 with .1 N NaOH. Buffer capacity was defined as meq. of NaOH required to raise the pH of 100 g of crop DM from 4.0 to 6.0. Pre- and post-ensiled material was extracted for pH determination by placing 25 g into 250 ml of distilled water and recording the pH 2 hr later.

Information about the indigenous microflora on all 12 alfalfas and their development during the ensiling process for the second and fourth cutting silages is found on page 118 of this report.

Results and Discussion

Dry matter and BC of the pre-ensiled material and pH over time during the ensiling process are presented in Table 36.1. In several previous studies with alfalfa, rate of pH decline and end-product silage pH were closely related to the efficiency of the fermentation process (KAES Reports of Progress 514, 539, 567, and 568). There appeared to be enough fermentable carbohydrate available for the indigenous and added (inoculant) microbial populations to lower the pH (via acid production) to below 5.0 in the first 48 hr. However, from d 3 to 90 the dextrose-containing silages had significantly lower pH values than inoculated or control silages. The inoculant + dextrose treatment gave the lowest ($P<.05$) pH at all seven opening times, which clearly shows that supplemental lactic acid bacteria were needed to ferment the added substrate.

Stage of maturity significantly affected pre-ensiled crop DM content and BC and rate of pH decline from 24 hr to 90 d post-filling. The late-bud-stage alfalfa had the lowest DM content and highest BC and gave the highest silage pH values at every opening time after hr 12.

Cutting also influenced ($P<.05$) crop DM, BC, and silage pH — the fourth cutting was the wettest (26.1 % DM) and had the highest BC; the second cutting was the driest (37.5 %

DM); and the third cutting had the lowest BC. Although the fourth cutting silages had the lowest pH's at 12 and 24 hr post-filling, they were unstable and their pH values stayed above 5.0 through d 90.

Percent relative humidity and swath-level air temperature data were recorded during the field-wilting period for each of the 12 harvests. There were no significant differences in mean relative humidity between cuttings or maturities. However, the mean wilting-period temperature for the fifth cuttings (72°F) was lower than that for the previous three cuttings.

Table 36.1. Main Effects of Treatment, Maturity, and Cutting on the Composition of Pre-ensiled Alfalfa and pH during the Ensiling Process

Item and time post-filling	Treatment[1]				Maturity			Cutting[2]			
	Cont	Inoc	Dex	Dex+ Inoc	Late-bud	10% bloom	50% bloom	2nd	3rd	4th	5th
Dry matter, %	32.4^{b}	32.3^{b}	32.7^{a}	32.6^{a}	28.7^{c}	34.2^{b}	34.6^{a}	37.5^{a}	36.1^{b}	26.1^{d}	30.3^{c}
Buffer capacity[3]	40.5^{a}	39.0^{ab}	37.9^{b}	39.4^{ab}	45.3^{a}	36.6^{b}	35.7^{b}	43.2^{b}	30.7^{d}	48.0^{a}	35.1^{c}
	---------- pH ----------										
Initial	5.84^{ab}	5.85^{a}	5.84^{ab}	5.83^{b}	5.89^{a}	5.81^{c}	5.82^{b}	5.74^{d}	5.77^{c}	5.85^{b}	6.00^{a}
Hr 12	5.57^{a}	5.38^{c}	5.53^{b}	5.32^{d}	5.42^{b}	5.50^{a}	5.43^{b}	5.40^{c}	5.49^{b}	5.11^{d}	5.80^{a}
Hr 24	5.35^{a}	5.05^{c}	5.24^{b}	4.82^{d}	5.26^{a}	5.07^{b}	5.01^{c}	5.01^{c}	5.11^{b}	4.90^{d}	5.50^{a}
Hr 48	5.21^{a}	4.91^{c}	4.97^{b}	4.60^{d}	5.14^{a}	4.84^{b}	4.79^{c}	4.85^{b}	4.84^{b}	5.24^{a}	4.85^{b}
Day 3	5.16^{a}	4.94^{b}	4.86^{c}	4.58^{d}	5.16^{a}	4.80^{b}	4.69^{c}	4.82^{b}	4.83^{b}	5.26^{a}	4.67^{c}
Day 7	5.16^{a}	5.01^{b}	4.83^{c}	4.61^{d}	5.30^{a}	4.79^{b}	4.62^{c}	5.01^{b}	4.84^{c}	5.22^{a}	4.53^{d}
Day 42	4.97^{a}	4.92^{b}	4.72^{c}	4.64^{d}	5.18^{a}	4.71^{b}	4.54^{c}	4.85^{b}	4.69^{c}	5.11^{a}	4.65^{d}
Day 90	4.94^{a}	4.90^{b}	4.71^{c}	4.65^{d}	5.13^{a}	4.71^{b}	4.57^{c}	4.77^{b}	4.66^{d}	5.08^{a}	4.69^{c}

[1]Cont= control, Inoc = inoculant, and Dex = dextrose.
[2]Second cutting was taken between June 20 and July 7; third cutting, between July 21 and August 2; fourth cutting, between August 25 and September 1; and fifth cutting, between September 25 and October 22.
[3]Milliequivalents of NaOH per 100 g of crop DM required to raise the pH from 4.0 to 6.0.
[abcd]Means on a line within a treatment, maturity, and cutting with different superscripts differ ($P<.05$).