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K.K. Bolsen

R.N. Sonon

B.S. Dalke

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Effect of bacterial inoculants on the preservation of alfalfa and whole-plant corn silages

Abstract

Inoculated and control alfalfa and corn silages were compared in pilot-scale silos. Inoculated silages for both crops had higher lactic acid contents and DM recoveries and lower values for pH, acetic acid, ethanol, and ammonia-nitrogen than controls" evidence that the inoculants produced a more efficient fermentation. These results are consistent with numerous studies that compared untreated and inoculant-treated silages over a wide range of crops and ensiling conditions in our research during the past several years.

Keywords

Cattlemen's Day, 1993; Kansas Agricultural Experiment Station contribution; no. 93-318-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 678; Beef; Silage; Inoculant; Preservation; Alfalfa; Corn

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EFFECT OF BACTERIAL INOCULANTS ON THE PRESERVATION OF ALFALFA AND WHOLE-PLANT CORN SILAGES¹

K. K. Bolsen, R. N. Sonon, and B. S. Dalke

Summary

Inoculated and control alfalfa and corn silages were compared in pilot-scale silos. Inoculated silages for both crops had higher lactic acid contents and DM recoveries and lower values for pH, acetic acid, ethanol, and ammonia-nitrogen than controls—evidence that the inoculants produced a more efficient fermentation. These results are consistent with numerous studies that compared untreated and inoculant-treated silages over a wide range of crops and ensiling conditions in our research during the past several years.

(Key Words: Silage, Inoculant, Preservation, Alfalfa, Corn.)

Introduction

It has become common practice in silage-making to add selected strains of lactic acid bacteria (LAB). These are intended to dominate the initial phase of the ensiling process. However, numerous characteristics of the forage to be ensiled—species, DM content, water-soluble carbohydrate content, and buffering capacity—interact with epiphytic (natural occurring) and inoculant microbes to determine the outcome of the fermentation. The objective of this study was to continue to document the effect of commercial bacterial inoculants on the preservation of alfalfa and whole-plant corn silages.

Experimental Procedures

Second cutting, Cody alfalfa was mowed and swathed in the 10% bloom stage of maturity at 2:00 p.m. on June 5, 1990 and wilted in the windrow for 24 h prior to precision chopping with a FieldQueen forage harvester. Four, 5.0 ft diameter × 5.0 ft high, concrete, pilot-scale silos were filled with the chopped material within a 2 1/2 h period. Alternating, 400 lb lots of alfalfa were used in a random order to fill the four silos. For two of the silos, each 400 lb of alfalfa received Biomax[®] SI inoculant at a rate of 1.9 liters per ton, which supplied 1×10^5 colony-forming units (cfu) of LAB/g of crop. The alfalfa in the other two silos received an equivalent amount of distilled water. A 1.0 lb sample of each lot was taken for DM determination. All silos were sealed with weighted polyethylene sheeting and opened after 90 days; the silage was removed, weighed, mixed, and sampled (six samples per silo).

On August 27, 1990, irrigated whole-plant corn (Pioneer 3377) in the 90% milk line stage of kernel development was chopped with a FieldQueen forage harvester. Four, pilot-scale silos were filled with the chopped material. For two of the silos, each 400 lb of corn received Qwik-N-Sile[®] inoculant at a rate of 1.0 lb per ton, which supplied 1×10^5 cfu of LAB/g of crop. The chopped material in the other two silos

¹Financial assistance and the two inoculants were provided by Chr. Hansen's Bio Systems, Milwaukee, Wisconsin.

received ground grain sorghum at a rate of 1.0 lb per ton. All other procedures were similar to those described for the alfalfa trial.

Results and Discussion

Shown in Table 1 are the effects of the two inoculants on the DM recovery and fermentation characteristics of the alfalfa and whole-plant corn silages. The data for both crops are consistent with several of our previous inoculant studies using laboratory-scale, pilot-scale, and farm-scale silos. Biomax® SI-treated alfalfa silages had a significantly higher lactic acid content and significantly lower values for pH, acetic

acid, ethanol, and ammonia-nitrogen than controls—evidence that the inoculant produced a more efficient fermentation. Qwik-N-Sile®-treated corn silages had significantly higher lactic acid and lower acetic acid and ethanol values. Both inoculated silages had higher DM recoveries than their control counterparts; ($P < .06$) for alfalfa and ($P < .05$) for corn.

Based upon results from several earlier studies, we would expect the better preserved, inoculated silages in this study to have higher nutritive value than the untreated (control) silages (KAES Report of Progress 651, page 101).

Table 1. Effect of Biomax® SI and Qwik-N-Sile® Inoculants on Dry Matter (DM) Recovery and Fermentation Characteristics of the Alfalfa and Corn Silages

Item ^{1,2}	Alfalfa			Whole-plant corn		
	Control	Biomax SI	P	Control	Qwik-N-Sile	P
Dry matter, %	44.2	44.9	---	36.8	37.4	---
DM recovery, % of the DM ensiled	92.60	93.84	.06	91.80	92.70	.08
pH	4.67	4.55	.002	3.78	3.80	NS ³
)))))))))	% of the silage DM)))))))))		
Lactic acid	4.63	5.38	.001	6.45	7.08	.01
Acetic acid	2.82	2.20	.01	3.29	2.65	.07
Ethanol	.132	.080	.002	.369	.217	.03
Ammonia-nitrogen	.214	.158	.008	.143	.129	NS

¹The DM recovery values are the means of two, pilot-scale silos.

²Dry matter content and fermentation values are the mean of 12 samples (six per silo).

³NS = not significant.