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Abstract

The inoculants, BioPower®, increased the rate and efficiency of ensiling in Acco Paymaster 351 forage sorghum regardless of storage temperature. The untreated, 60 F silage fermentated slower and had higher pH, lower lactic acid, and higher acetic acid values than its 90 F counterpart.

Keywords

Cattlemen's Day, 1987; Kansas Agricultural Experiment Station contribution; no. 87-309-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 514; Beef; Inoculant; Fermentation; Sorghum silage

Effect of Environmental Temperature and an Inoculant on the Fermentation of Forage Sorghum Silage[1]

Keith Bolsen

Summary

The inoculant, BioPower®, increased the rate and efficiency of ensiling in Acco Paymaster 351 forage sorghum regardless of storage temperature. The untreated, 60 F silage fermentated slower and had higher pH, lower lactic acid, and higher acetic acid values than its 90 F counterpart.

Introduction

Silage-making in Kansas begins in May with crops like alfalfa and winter cereals and ends in November with late-season forage sorghums. During these 7 months, minimum and maximum daytime temperatures will range from less than 32 F to over 100 F. How do the air temperature and the temperature of harvested forage as it enters the silo affect the ensiling process? Results from last year (Report of Progress 494) indicated that initial fermentation was delayed by a cool temperature and that a warm initial temperature produced silages with lower pH values and higher acid contents. In addition, a silage inoculant increased the fermentation rate of cool alfalfa but not forage sorghum.

The objective of this trial was to further document the effect of storage temperatures and inoculants on the rate and efficiency of fermentation in forage sorghum.

Experimental Procedures

The laboratory silo used in this trial, the treatment methods, and the silo-filling techniques were similar to those described in the article on page 107 of this report. The inoculant, BioPower®, was applied in liquid form, contained *Streptococcus faecium* and *Lactobacillus plantarum*, and supplied 2.1×10^5 colony-forming units of bacteria per gram of crop. Chemical composition and microbiology of the pre-ensiled crop are presented in Table 36.1.

The silages were made from late-dough stage hybrid forage sorghum (Acco Paymaster 351) during the second week of October. The direct-cut material contained 35.5% dry matter and was approximately 70 F when ensiled.

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[1]Partial financial assistance was provided by BioTechniques Laboratories, Inc., 15555 N.E. 33 Bio Tech Road, Redmond, WA 98052.

Four treatments were compared: (1) control (no inoculant), with the laboratory silos stored at 60 F (control-60); (2) control, with silos stored at 90 F (control-90); (3) BioPower-treated, with silos stored at 60 F (BioPower-60); and (4) BioPower-treated, with silos stored at 90 F (BioPower-90). Twenty-one laboratory silos were filled for each treatment, with three silos per treatment opened at 12, 24, and 48 hours and 4, 7, 14, and 42 days post-filling.

Results and Discussion

Presented in Table 36.2 are the fermentation dynamics of the four silages. At hours 12 and 24 post-filling, both 90 F silages had sharply lower pH values and higher lactic acid contents than the 60 F silages. Beginning at hour 48 at 90 F and day 4 at 60 F, the BioPower-treated silages had lower ($P<.05$) pH values and higher lactic acid contents than their counterpart control silages. These differences were maintained through day 42 post-filling. The BioPower-60 and control-90 silages had similar pH and acid profiles after 42 days. On day 42, the lower pH values and higher lactic to acetic acid ratios in the inoculated and higher temperature silages are evidence of the slower and less efficient fermentation in the cooler environment.

Table 36.1. Composition of the Pre-ensiled Forage Sorghum

Item	Acco 351
Dry Matter, %	35.5
pH	5.8
Water Soluble Carbohydrates[1]	12.2
Crude Protein[1]	5.63
Buffer Capacity[2]	19.9
Mesophilic[3]	9×10^6
Lactic Acid Bacteria[3]	1.2×10^4
Yeasts and Molds[3]	6×10^4

[1]Expressed as a percent of the dry matter.

[2]Milliequivalents NaOH per 100 grams of dry matter required to raise the pH of the fresh crop material to 6.0.

[3]Colony-forming units per gram of crop.

Table 36.2. Chemical Composition and pH Over Time for the Control and Inoculated Forage Sorghum Silages at Two Temperatures

Time Post-filling and Item		60 F Control	60 F BioPower	90 F Control	90 F BioPower	SE
Initial:	pH	5.74	5.82	5.74	5.82	--
	Lactic Acid[1]	.19	.21	.19	.21	--
Hour 12:	pH	5.70[b]	5.71[b]	4.63[a]	4.64[a]	.034
	Lactic Acid	.21[c]	.20[c]	.52[a]	.42[b]	.016
Hour 24:	pH	4.91[b]	4.90[b]	4.20[a]	4.21[a]	.013
	Lactic Acid	.26[b]	.35[b]	1.54[a]	1.47[a]	.038
Hour 48:	pH	4.25[b]	4.14[ab]	4.15[ab]	4.03[a]	.018
	Lactic Acid	1.63[b]	1.83[b]	2.47[a]	2.89[a]	.095
Day 4:	pH	4.20[c]	4.12[b]	4.09[b]	3.93[a]	.008
	Lactic Acid	1.89[c]	2.07[b]	2.16[b]	3.42[a]	.141
Day 7:	pH	4.21[c]	4.06[b]	4.04[b]	3.83[a]	.008
	Lactic Acid	2.52[c]	4.19[ab]	3.33[ab]	5.10[a]	.463
Day 14:	pH	4.22[d]	3.96[b]	4.00[c]	3.80[a]	.011
	Lactic Acid	2.27[c]	3.62[b]	3.36[b]	5.07[a]	.220
Day 42:	pH	3.96[c]	3.77[a]	3.86[b]	3.77[a]	.029
	Lactic Acid	3.64[b]	4.47[ab]	4.29[b]	5.23[a]	.309
	Acetic Acid[1]	2.64[a]	2.32[b]	2.23[b]	2.02[c]	.112

[1]Lactic and acetic acids expressed as a percent of the silage dry matter.

[abcd]Values on the same line not having the same superscript differ ($P<.05$).