Sila-bac and Molasses Additives for High Moisture Sorghum Grain[1]

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Summary

Sila-bac, molasses, or both combined were evaluated as additives for ensiled high moisture sorghum grain. Control grain had the greatest increase in temperature during ensiling. Grain treated with Sila-bac had the highest lactobacilli count but control grain had the fastest drop in pH. Sila-bac grain was the most stable in air and remained stable for 30 days. Control grain was stable for 21 days; grain treated with molasses or molasses plus Sila-bac was stable until day 5.

Group-fed steers receiving Sila-bac grain gained faster and were more efficient than steers fed control or molasses-treated grain. Individually fed steers gained fastest when receiving molasses treated grain. Those receiving Sila-bac grain were the most efficient.

Introduction

Sorghum grain is increasingly used as an alternative to corn in cattle finishing rations. The production of sorghum grain requires less water and costs less per acre than corn. Mature sorghum grain, however, may need drying for safe storage and must be processed for efficient use by cattle. As energy costs increase, drying and processing become less desirable.

Previous Kansas research (Manhattan, Hays, and Garden City) has shown that although high moisture sorghum grain, rolled before ensiling, can be used efficiently by finishing cattle, the feeding value is not consistently equal or superior to dry rolled sorghum grain.

Our objective was to find if adding a lactobacillus inoculant or a readily available carbohydrate (dry cane molasses), or both, would improve the quality of the ensiled high moisture sorghum grain and its use by feedlot cattle.

Experimental Procedure

Four concrete stave silos (10 ft x 50 ft) were filled with approximately 22,000 lb of high moisture sorghum grain harvested at 23 to 27% moisture.

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[1]Sila-bac® is a lactobacillus inoculant product of Pioneer Hi-Bred International, Inc., Microbial Genetics Division, Portland, Oregon 97201.

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Treatments were: 1) control (no additive); 2) 0.1% Sila-bac (2 lb/ton); 3) 1.0% dry cane molasses; and 4) 1.0% dry cane molasses plus 0.1% Sila-bac. Additives were applied to the grain on an as-received weight basis. All grain was passed through a roller mill to lightly crack the kernels; then treated, mixed, and augered into one of the four silos.

Samples were taken from each load as it was augered into the silo. Representative 800-g samples of the grain being ensiled were placed in air-tight plastic bags. Three bags for each treatment were placed in 5-gallon containers and covered with sand. The containers were stored in a chamber where the temperature was adjusted to correspond to the temperature recorded in the concrete stave silos. Bags were removed at intervals, mixed, and analyzed for lactobacilli, pH, and fermentation acids.

Silos were opened after 18 days, and 12 yearling Hereford steers (two pens of four steers each and four individually fed steers) were fed each grain. Rations contained 83% high moisture sorghum grain, 12% corn silage, and 5% supplement on a 100% dry matter basis. Rations were formulated to 11.5% crude protein, .64% calcium, .34% phosphorus, and .66% potassium. The supplement supplied 200 mg of monensin per steer daily. Rations were fed ad libitum twice daily. Refused feed was removed, weighed, and discarded every 7 days. Grain samples were collected weekly from the silos.

All steers were weighed individually, after 16 hr without feed or water, at the start and at the end of the feeding trial. Intermediate weights were taken on days 28 and 56. Final weights were calculated from the average dressing percentage of all steers.

Grain dry matter losses during fermentation, storage, and feedout were measured for each treatment by accurately weighing and sampling each load as it was augered into the silo and, later, weighing and sampling the material as it was removed from the silos. Ensiling temperature was monitored for the first 28 days by four thermocouples evenly spaced in each silo.

To measure aerobic stability (bunk life), fresh ensiled grain was taken from each silo and divided into 15 lots; each lot was placed in a plastic-lined polystyrene container. A thermocouple was embedded in the center of each container, cheesecloth was stretched over the top and the containers were placed in a 20°C room. Temperature for each container was recorded twice daily. Triplicate containers were removed, weighed, mixed, and sampled after 3, 6, 9, and 12 days of exposure to air. Temperature for the control and Sila-bac treated grains was monitored for 30 days.

Results

Lactobacilli counts at different times post-ensiling are shown in Table 11.1. Grain entering the silos was used for initial counts. Sila-bac treated grain had the highest initial lactobacilli count; however, at the end of 48 hr, counts were similar for all grain treatments. Control grain had the most rapid pH decrease; the molasses plus Sila-bac grain had the slowest (Figure 11.1). The rate of decrease in pH was similar for Sila-bac and molasses grains. After 58 days, Sila-bac and molasses grains had the lowest pH; molasses plus Sila-bac, the highest.

Chemical analyses of the grains are shown in Table 11.2. Control, Sila-bac, and molasses grains all had similar pH values; molasses plus Sila-bac grain was slightly higher. Lactic acid was highest in the control and molasses grains. Acetic acid was highest in the Sila-bac grain and lowest in the molasses plus Sila-bac grain; the control and molasses grains were intermediate. Ammonia nitrogen was highest in the Sila-bac grain.

Actual ensiling temperatures are shown in Figure 11.2. Sila-bac grain had the highest ensiling temperature; control grain, the lowest. Grain treatments did not enter the silos at the same temperatures. For example Sila-bac grain was 5°C warmer than control grain. Shown in Figure 11.3 is ensiling temperature in degrees above initial temperature. The control had the highest rise (6.5 C); molasses grain, the lowest (4.5 C).

Steer performances are shown in Table 11.3. Gains and efficiencies were excellent for all treatments. Group-fed steers receiving Sila-bac grain gained faster and more efficiently ($P<.05$) than those receiving control or molasses grains. Individually fed steers receiving molasses grain gained faster ($P<.05$) than those receiving the control or molasses plus Sila-bac grains. Individual steers fed Sila-bac grain had the lowest ($P<.05$) daily feed intake but were the most efficient ($P<.05$).

Losses due to fermentation, storage, and feedout are presented in Table 11.4. The control and Sila-bac grains had similar losses (7.69 and 8.91%, respectively), which were higher than losses from the molasses and molasses plus Sila-bac grains (<1.0% and 1.8%, respectively). These differences may be due to a higher dry matter and therefore a less extensive fermentation in the molasses-treated grains.

Aerobic stabilities are presented in Table 11.5. Aerobic deterioration is characterized by increased temperature, increased pH, loss of dry matter, and loss of fermentation acids. The Sila-bac treated grain was very stable and showed no temperature rise during the 30 days. The control grain was stable until day 21, while the molasses and molasses plus Sila-bac grains were only stable until day 5.

Table 11.1. Lactobacilli concentration of the four high moisture sorghum grains at different intervals post-ensiling[1]

Time post-ensiling	Sorghum grain: Control	Sila-bac	Molasses	Molasses + Sila-bac
	lactobacilli/gram of grain			
0 hr	1.1×10^4	4.2×10^7	2.8×10^6	4.3×10^4
8 hr	2.1×10^7	2.5×10^7	5.2×10^6	4.3×10^5
16 hr	2.3×10^8	7.4×10^7	8.4×10^7	2.6×10^8
24 hr	2.6×10^8	1.6×10^8	1.8×10^8	1.7×10^7
48 hr	2.5×10^8	2.5×10^8	3.2×10^8	1.2×10^8
96 hr	3.0×10^8	2.9×10^8	3.9×10^8	8.0×10^8
7 days	1.8×10^8	2.1×10^8	1.9×10^8	2.3×10^8
14 days	7.8×10^7	8.6×10^7	1.3×10^8	1.3×10^8

[1]Concentrations are mean of three samples per interval for each grain.

Table 11.2. Chemical analyses of control, Sila-bac, molasses, and molasses + Sila-bac sorghum grain[1,2]

Sorghum grain	Dry matter	pH	Crude protein	Lactic acid	Acetic acid	Propionic acid	Butyric acid	Valeric acid	NH_3-N*
	%		% of the dry matter						
Control	73.33	4.42	10.77	.935	.280	.006	.058	<.001	3.529
Sila-bac	73.78	4.51	10.57	.838	.439	.018	.001	.001	3.941
Molasses	75.32	4.45	10.51	.885	.319	.012	.001	.001	2.983
Molasses + Sila-bac	77.14	4.69	10.46	.800	.178	.001	.000	.017	3.073

[1]Each value is the mean of 10 samples (except Sila-bac + molasses, which is the mean of 8).

[2]All analyses were determined by using wet samples.

*NH_3-N means ammonia-nitrogen expressed as % of total nitrogen.

Table 11.3. Performances by yearling steers fed the four sorghum grain rations[1]

Item	Sorghum grain: Control	Sila-bac	Molasses	Molasses + Sila-bac
Group-fed steers:				
Number	8	8	8	8
Initial wt., lb	799	790	792	794
Final wt., lb	1043	1078	1021	1065
Avg. total gain, lb	244	288	229	268
Avg. daily gain, lb	3.48[b,c]	4.09[a]	3.26[c]	3.87[a,b]
Avg. daily feed, lb[2]	23.1	24.2	23.3	24.6
Feed/lb of gain, lb[2]	6.16[b,c]	5.92[a]	7.15[c]	6.40[a,b]
Individually fed steers:				
Number	4	4	4	4
Initial wt., lb	838	840	838	843
Final wt., lb	1104	1140	1148	1102
Avg. total gain, lb	266	299	310	260
Avg. daily gain, lb	3.83[b]	4.29[a,b]	4.42[a]	3.74[b]
Avg. daily feed, lb[2]	23.5[a,b]	21.8[a]	25.1[b]	24.4[b]
Feed/lb of gain, lb[2]	6.16[b,c]	5.13[a]	5.72[a,b]	6.58[c]

[1]70-day trial: October 9, 1980 to December 19, 1980.

[2]100% DM basis

[a,b,c]Values with different superscripts differ significantly ($P<.05$).

Table 11.4. Sorghum grain fermentation, storage and feedlot losses in the silos

Sorghum grain	Dry matter at ensiling	Dry matter at feeding	DM Loss
	%	%	%
Control	73.16	73.63	7.69
Sila-bac	73.94	73.73	8.91
Molasses	76.05	75.50	<1.0
Molasses + Sila-bac	77.11	77.11	1.8

Table 11.5. Change in temperature and pH and loss of dry matter and nutrients during air exposure by the four sorghum grains.

Sorghum grain	Day of initial rise above ambient temperature*	Days exposed to air 0	3	6	9	12
		DM loss (%)				
Control	21	--	<l.0	1.02	1.62	1.97
Sila-bac	--	--	<l.0	<l.0	<l.0	<l.0
Molasses	5	--	<l.0	<l.0	6.22	12.89
Molasses + Sila-bac	5	--	<l.0	<l.0	2.52	3.38
		pH				
Control		4.40	4.37	4.44	4.56	4.72
Sila-bac		4.46	4.46	4.52	4.62	4.62
Molasses		4.19	4.48	5.85	5.58	5.65
Molasses + Sila-bac		4.76	5.25	5.92	6.02	5.92
		Lactic acid (% of the DM)				
Control		1.054	.765	.938	1.000	.908
Sila-bac		.764	.636	.522	.697	.657
Molasses		1.258	1.098	.542	--	.405
Molasses + Sila-bac		.792	.643	.460	.472	.476
		Acetic acid (% of the DM)				
Control		.640	.302	.464	.394	.327
Sila-bac		.880	.678	.602	.538	.626
Molasses		.164	.029	.030	.030	.043
Molasses + Sila-bac		.070	.018	.021	.011	.014
		NH_3-N (% of total nitrogen)				
Control		4.85	5.68	4.78	5.82	4.34
Sila-bac		5.19	7.12	5.20	6.67	5.86
Molasses		2.73	2.64	2.77	1.89	2.29
Molasses + Sila-bac		.93	1.12	.65	.58	.55

*Ambient temperature, 20° C.

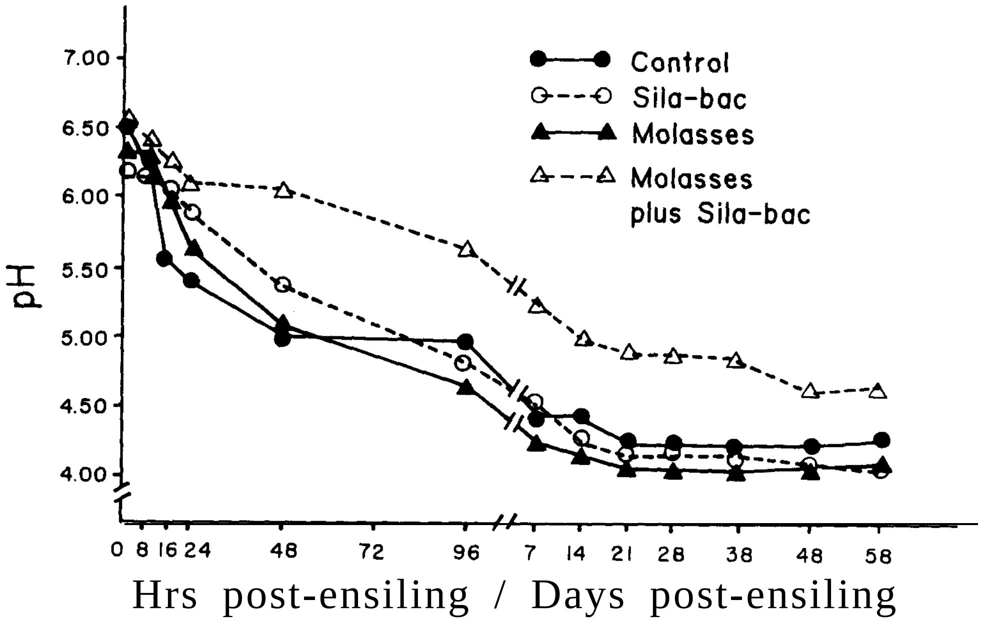

Figure 1. pH of the four sorghum grains at various time intervals post-ensiling. Each value represents the overage of triplicate samples.

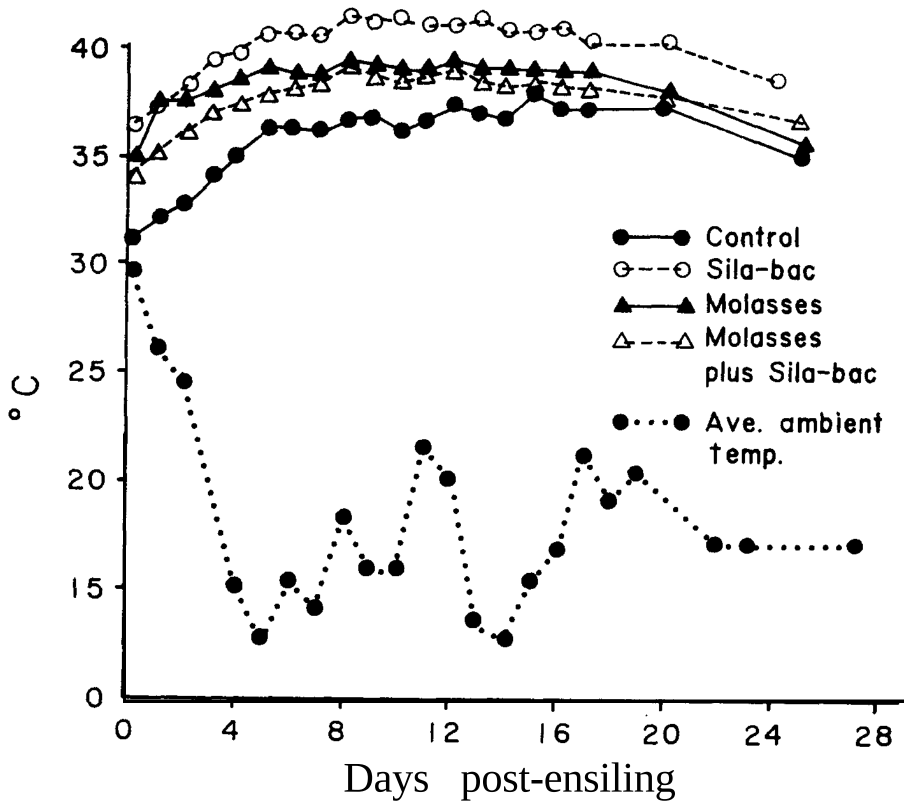

Figure 2. Ensiling temperature for the four sorghum grains at various days post-ensiling.

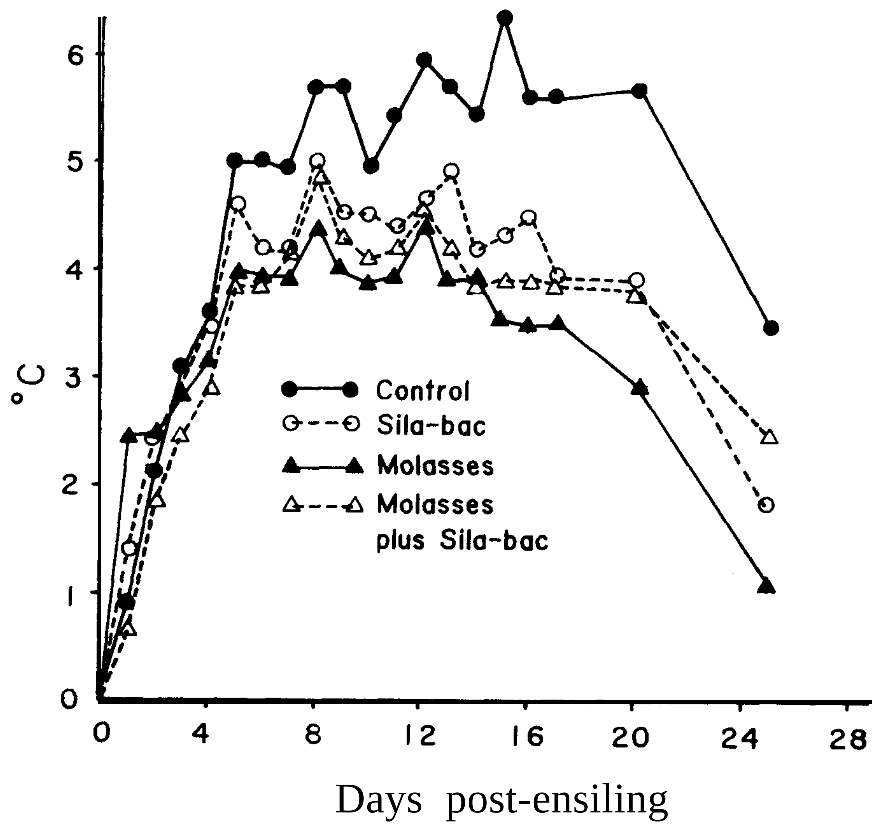

Figure 3. Ensiling temperature (degrees above initial temperature) for the four sorghum grains at various days post-ensiling.