Sila-bac, Cold-flo, and Sodium Hydroxide for Forage Sorghum Silage[1,2]

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Summary

Inoculant (Sila-bac), non-protein nitrogen (Cold-flo), and alkali (NaOH) silage additives were evaluated with whole-plant forage sorghum silage. All three additives decreased ensiling temperatures. Calves fed Sila-bac or NaOH silages gained 12.0% faster but calves fed Cold-flo silage gained 7.7% slower than those fed control silage. NaOH silage was consumed in the greatest amount; Cold-flo silage, in the least. Calves fed Sila-bac silage were more efficient than calves fed any of the other silages.

Cold-flo silage was the most stable when exposed to air; control silage heated after 5, Sila-bac silage after 6, and NaOH silage after 9 days. Dry matter removed from the silos and fed was similar for control (91.0%) and Sila-bac (90.7%) silages, but lower for Cold-flo (84.6%) and NaOH (78.9%) silages. When fermentation, storage, and feedout losses were combined with calf performance, pounds of gain per ton of silage were 74.0 for Sila-bac, 64.0 for control, 62.2 for Cold-flo, and 57.8 for NaOH silages.

Experimental Procedure

Four concrete stave silos (10 ft. x 50 ft.) were filled with 5 to 7 loads (approximately 6 tons each) of direct-cut, whole-plant sorghum (dough stage) containing 32 to 35% dry matter. Silage treatments were: 1) control (no additive); 2) Sila-bac applied at 1.0 lb./ton of fresh crop; 3) sodium hydroxide (NaOH) applied at 24.5 lbs./ton of fresh crop; (about 3.8% of the crop on a DM basis); 4) Cold-flo applied at 11.05 lbs./ton of fresh crop. Harvest and filling dates were October 8 and 9, 1979. The forage sorghum was DeKalb FS 25a+ hybrid, grown on nonirrigated land near Manhattan.

Silos were opened November 15, 1979, and silages fed to 72 heifer calves allotted by breed and weight to 12 pens (3 per silage) of six heifers each. Calves were Hereford and Hereford x Simmental with an average weight of 414 lbs. at the start of the 84-day trial. Rations were a full-feed of sorghum silage plus 2.0 lbs. of supplement (Table 23.1) mixed and fed twice daily. All rations contained about 12% crude protein and supplied equal amounts of calcium, phosphorus, vitamin A, and aureomycin. The NaOH silage supplement also contained 8.35% potassium chloride. Sorghum grain replaced SBM in the Cold-flo silage supplement. All calves were fed a full-feed of prairie hay plus 2.0 lbs. of supplement for 4 weeks before the trial started.

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[1]Sila-bac[R] is a lactobacillus inoculant product of Pioneer Hi-Bred International, Inc., Microbial Products Division, 3930 SW Macadams, Portland, OR 97201.

[2]Cold-flo[R] is a non-protein nitrogen product of USS Agri-Chemicals, Division of United States Steel, P. O. Box 1605, Atlanta, GA 30301.

All heifers were weighed individually after 16 hrs without feed or water at the start and end of the feeding trial. Intermediate weights were taken before the a.m. feeding on days 28 and 56.

Silage samples were collected weekly from the silos. Feed consumed was recorded daily. Silage fed to each pen daily was regulated by the amount the heifers would consume with silage always available in the feed bunks. Silage not consumed was removed, weighed and discarded every 7 days.

Dry matter losses during fermentation, storage, and feedout were measured by accurately weighing and sampling all loads of fresh crop put in the silos and later weighing and sampling all silage removed from the silos. Ensiling temperatures during the first 4 weeks were monitored with five thermocouples evenly spaced in each silo.

Aerobic stability (bunk life) of each silage was determined. Approximately 60 lbs. of fresh silage was obtained from each silo January 21, 1980, and divided into 12 equal lots of 4.0 lbs. and each lot was placed in an expanded polystyrene container lined with plastic. A thermocouple was placed in the center of the silage and cheesecloth stretched across the top of the container. Containers were stored at 65°F and temperature was recorded twice daily. After 2, 4, 7, and 14 days of air exposure, triplicate containers of each silage were weighed, mixed, and sampled, and dry matter loss was determined.

Results

Chemical analyses of the four silages are shown in Table 23.2. Both control and Sila-bac silages had undergone normal fermentations as evidenced by low pH, low NH_3-N, trace amount of butyric acid, and predominance of lactic acid. Both Cold-flo and NaOH resulted in distinctly different and more extensive fermentations than the control. NaOH silage contained more lactic (5.22 vs. 2.85%) and acetic (2.24 vs. 1.46%) acids and had a higher pH (4.24 vs. 3.98) than the control. Cold-flo silage had a higher pH (4.62 vs. 3.98) than the control and excessive butyric acid (3.99 vs. .03%).

For the Cold-flo silage, the fresh forage sorghum was 6.42% crude protein; the silage, 12.99% (DM basis). Calculations show the 11.05 lbs. of Cold-flo added per ton should have yielded 15.03% CP silage. Thus, 76.3% of the Cold-flo added was recovered. Ammonia accounted for 39.3% of the total nitrogen.

Ensiling temperatures are shown in Figure 1. All three silage additives lowered ensiling temperatures. Cold-flo and NaOH had the greatest effect: 7 to 19°F cooler than the control during the first 2 weeks. Sila-bac silage averaged 4 to 6°F cooler than control.

Heifer performances are shown in Table 23.3. Sila-bac and NaOH silages supported 12.0% faster daily gains than control silage and 21.3% faster daily gains than Cold-flo silage ($P<.05$). Feed intake was highest ($P<.05$) for NaOH silage and lowest ($P<.05$) for the Cold-flo silage. Feed required per lb. of gain was 12 to 13% lower for heifers fed Sila-bac silage than for heifers fed any of the other three silages ($P<.05$). Cold-flo silage was used 3% more efficiently than control silage.

Presented in Table23.4 are silage fermentation, storage, and feedout losses. Control and Sila-bac silages had large advantage over Cold-flo and NaOH silages.

Aerobic stabilities of the four sorghum silages are shown in Table 23.5. Cold-flo silage showed no signs of spoilage during the 14 days. The control and Sila-bac silages were moderately stable in air, with initial temperature rise on day 5 for control and day 6 for Sila-bac. NaOH silage heated on day 9. Dry matter losses were not excessive, ranging from 4.3 to 9.5% after 7 days and 6.6 to 12.4% after 14 days. When the three silages (control, Sila-bac, and NaOH) deteriorated in air; temperature, pH, and dry matter loss increased sharply, followed by decreases in lactic and acetic acids.

Table 23.1. Composition of the supplements fed with the sorghum silages.

Ingredient	Silage: Control and Sila-bac	Silage: NaOH	Silage: Cold-flo
	lbs./ton		
Rolled milo	---	---	1787
Soybean meal	1815	1642	---
Tallow	20	20	20
Salt	42	42	42
Dicalcium phosphate	80	86	120
Limestone	28	28	16
Potassium chloride	---	167	---
Trace minerals	5	5	5
Vitamin A*	2.6	2.6	2.6
Aurofac-10**	7.4	7.4	7.4
	%, dry matter basis		
Calculated crude protein	45.0	41.0	9.0

*Added to supply 30,000 IU of vitamin A/heifer daily.

**Added to supply 70 mg of chlortetracycline/heifer daily.

Table 23.2. Chemical analyses of control, Sila-bac, Cold-flo, and NaOH sorghum silages.[1]

Silage	Dry matter	pH	Starch	NFE[2]	Crude protein	Crude fiber	Lactic acid	Acetic acid	Propionic acid	Butytic acid	NH_3-N*
	%		% of the DM								
Control	34.04	3.98	19.34	57.6	7.5	24.5	2.85	1.46	.26	.03	4.21
Sila-bac	34.91	3.96	20.56	59.1	7.7	23.5	2.75	1.20	.22	.05	3.53
Cold-flo	31.13	4.62	20.59	54.3	13.0	23.5	3.21	1.31	.32	3.99	39.25
NaOH	30.64	4.24	22.43	59.4	6.4	22.2	5.22	2.24	.26	.13	3.63

[1]Each value is the mean of 8 samples.

[2]NFE means nitrogen-free-extract.

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

Table 23.3. Performances by heifer calves fed control, Sila-bac, Cold-flo, and NaOH sorghum silage rations.[1]

Item	Sorghum silage Control	Sila-bac	Cold-flo	NaOH
No. of heifers	18	18	18	18
Initial wt., lbs	415	415	413	415
Final wt., lbs.	513	524	504	525
Avg. total gain, lbs.	98	110	91	110
Avg. daily gain, lbs.	1.17^{ab}	1.31^{a}	1.08^{b}	1.31^{a}
Avg. daily feed, lbs.[2]				
sorghum silage	10.65	10.27	9.40	11.43
supplement	1.82	1.82	1.77	1.84
total	12.47^{b}	12.09^{b}	11.17^{c}	13.24^{a}
Feed/lb. of gain, lbs.[2]	10.66^{b}	9.23^{a}	10.34^{b}	10.19^{b}

[1]84-day trial; November 11, 1979 to February 7, 1980.

[2]100% dry matter basis.

[abc]Values with different superscripts differ significantly (P<.05).

Table 23.4. Sorghum silage fermentation, storage, and feedout losses.[1]

	DM put into the silo	DM taken out of the silo and fed	DM lost during fermentation, storage, and feedout
	lbs.	% of the DM put into the silo	
Control	20,979	90.98	9.02
Sila-bac	21,792	90.65	9.35
Cold-flo	23,829	84.86	15.14
NaOH	29.244	78.89	21.11

[1]Dry matter percentages of the forages when ensiled were: control, 34.97; Sila-bac, 35.69; Cold-flo, 32.20; and NaOH, 31.94.

Table 23.5. Changes in temperature and losses of dry matter and nutrients during air exposure by the four sorghum silages.

Sorghum silage	Day of initial rise above ambient temp.*	Maximum temp.	days exposed to air 0	2	4	7	14
		^{o}F	Accumulated temp. above ambient ^{o}F				
Control	5.2	119	--	**	7.7	81.4	102.2
Sila-bac	6.2	116	--	**	1.2	50.9	135.3
Cold-flo	**	**	--	**	**	**	**
NaOH	9.6	89	--	**	**	**	84.3
			Loss of DM (% of DM exposed to air)				
Control			--	<1.0	3.5	9.5	12.4
Sila-bac			--	<1.0	<1.0	4.6	10.9
Cold-flo			--	<1.0	<1.0	4.3	6.6
NaOH			--	<1.0	1.0	7.2	9.2
			pH				
Control			3.75	3.85	3.95	7.42	8.25
Sila-bac			3.88	3.95	3.94	5.36	7.89
Cold-flo			4.36	4.50	4.48	4.45	4.44
NaOH			4.22	4.32	4.34	4.33	7.40
			Lactic acid (% of the DM)				
Control			4.18	3.92	2.85	.34	.27
Sila-bac			3.34	3.49	3.18	1.41	.36
Cold-flo			4.82	4.67	4.29	4.26	4.84
NaOH			6.28	6.40	6.36	6.12	6.09
			Acetic acid (% of the DM)				
Control			1.49	1.37	.76	.28	.20
Sila-bac			1.20	1.24	1.10	.33	.33
Cold-flo			1.71	2.06	2.00	2.27	1.93
NaOH			2.77	2.66	2.82	3.19	.45

*3.0 ^{o}F rise above ambient temperature (65 ^{o}F).

**No rise in temperature.

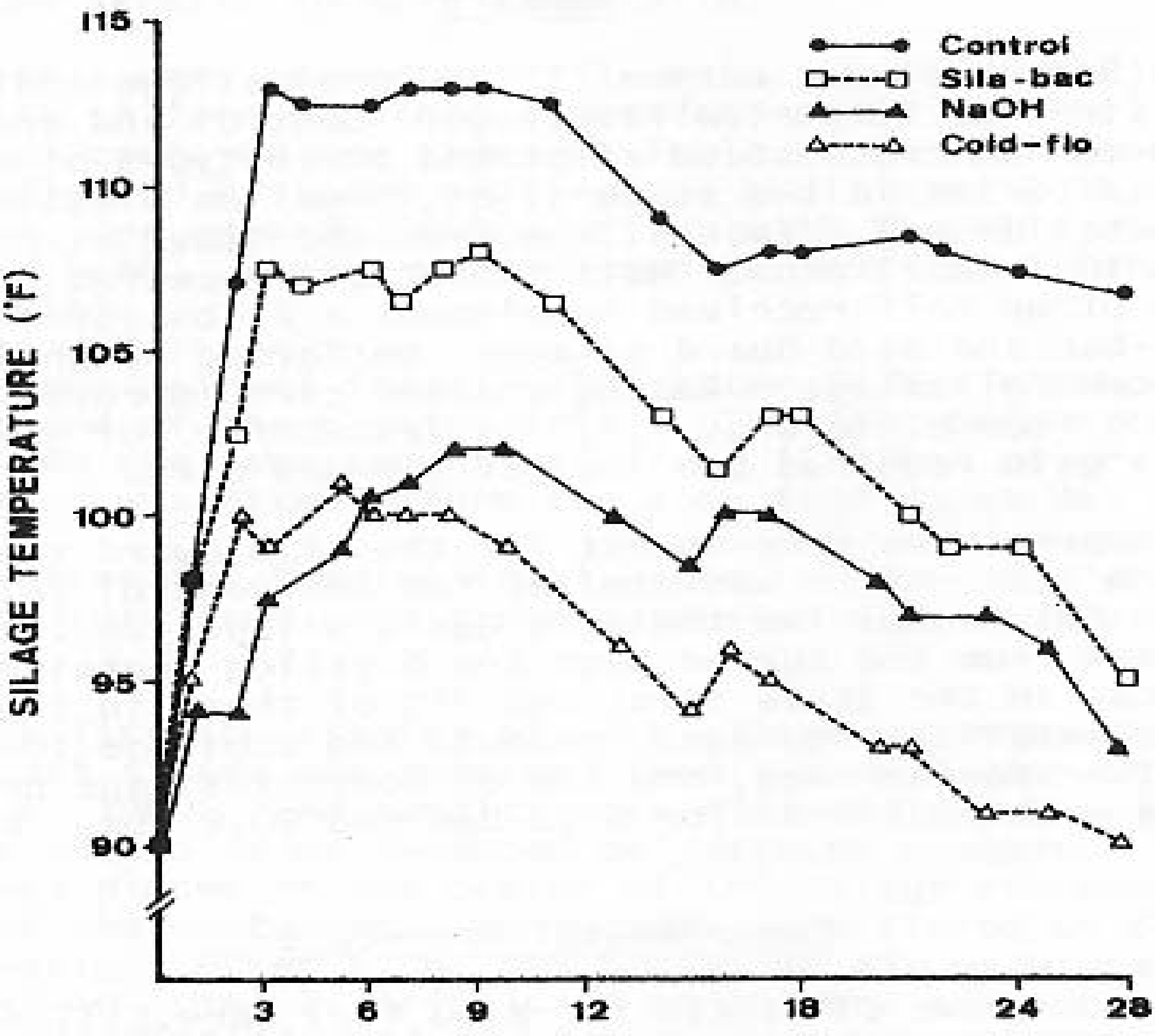

Figure 1. Ensiling temperatures for control, Sila-bac, Cold-flo, and NaOH sorghum silages (October 8-9 to November 5, 1979).