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Abstract

Normal corn silage, with and without additives, and drought-stressed corn silage were evaluated in a 77-day growing trial using 64 steers. Steers fed drought silage had slowest and least efficient gains. Additive-treated silages were used more efficiently than the control silage. Dry matter recovery from the silos was consistently improved by the enzyme additive but not by the microbial inoculant additive. Steer gain per ton of corn crop ensiled was increased by 7.2 and 4.4 lb for enzyme and inoculant silages, respectively, compared with that for the control silage.

Keywords

Cattlemen's Day, 1982; Report of progress (Kansas State University. Agricultural Experiment Station); 413; Beef; Corn silage; Additive; Enzyme

Silo-Best and Sila-ferm Additives for Corn Silage and Drought-stressed Corn Silage for Yearling Steers[1,2]

Keith Bolsen and Harvey Ilg

Summary

Normal corn silage, with and without additives, and drought-stressed corn silage were evaluated in a 77-day growing trial using 64 steers. Steers fed drought silage had slowest and least efficient gains. Additive-treated silages were used more efficiently than the control silage. Dry matter recovery from the silos was consistently improved by the enzyme additive but not by the microbial inoculant additive. Steer gain per ton of corn crop ensiled was increased by 7.2 and 4.4 lb for enzyme and inoculant silages, respectively, compared with that for the control silage.

Introduction

In two previous trials, Silo-Best (an enzyme additive) improved dry matter recovery of corn silage; however, silage feeding value was variable (Progress Report 377, Kansas Agriculture Expt. Station). Commercial silage inoculants generally improved silage dry matter recovery and feeding value in our previous trials (Progress Reports 377 and 394, Kansas Agriculture Expt. Station).

This trial continued evaluation of commercial additives for corn silage.

Experimental Procedure

Three concrete stave silos (10 ft x 50 ft) were filled with whole-plant corn (dent stage) containing 31 to 33% dry matter (DM). Treatments were: 1) no additive (control); 2) Silo-Best applied as dry powder at 1.0 lb/ton of fresh crop; 3) Sila-ferm applied in a water solution at 1.0 liter of mixture/ton of fresh crop. Harvest was August 13 and 14, 1980. Corn was grown under irrigation near Manhattan and grain yield was approximately 80 bushels/acre. A fourth whole-plant corn containing 27 to 29% DM was ensiled August 1 and 2, 1980, in a 14 ft x 60 ft concrete stave silo. It was severely drought-stressed, yielding about 2 bushels/acre.

Silos were opened on October 13. Each silage was full-fed to 16 yearling Hereford steers (four pens of four steers) during a 77-day growing trial (October 14 to December 30, 1980). All steers received 2.0 lb of supplement daily[3]. Rations were formulated to provide 11.5% crude protein (DM basis), 200 mg of monensin/steer daily, and equal amounts of calcium, phosphorus, and vitamin A.

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[1]Silo-Best is an enzyme product of Cadco, Inc., Des Moines, Iowa.

[2]Sila-ferm is a microbial inoculant product of Medipharm, Engelholm, Sweden.

[3]lb/ton: soybean meal, 1630; rolled milo 185; dicalcium phosphate, 100; salt, 50; trace minerals, 10; tallow, 20; Rumensin-60, 3.3; and Vitamin A premix, 1.7

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

Silage samples were collected weekly from the silos. Feed intake was recorded daily for each of the 16 pens. Corn silage was full-fed and silage not consumed was removed, weighed, and discarded every 7 days.

Dry matter losses during fermentation, storage, and feedout were measured for each of the first three silages by accurately weighing and sampling all loads of fresh crop ensiled and later by weighing and sampling all silage removed from the silos. Thermocouple wires, soldered to 1/4-inch x 12-inch copper tubing, were evenly spaced in the center of these silos, and ensiling temperatures were monitored for the first 8 weeks.

About 1,600 lb of fresh crop was taken from each of the three 10 ft x 50 ft stave silos after loads 3 and 7 and used to fill 48 experimental silos. For each silage treatment, corn-plant material was tightly packed in four metal drums (55-gallon capacity) lined with polytheylene; six plastic containers (5-gallon capacity); and six nylon bags (30-lb capacity). Three nylon bags were buried in the fresh crop at two depths in each stave silo. The plastic containers were made air-tight with lids fitted with rubber O-ring seals and Bunson valves and the drums and containers were stored in a room at 25 C.

For aerobic stability (bunk life) measurement, 60 lb of fresh silage was obtained at a 3 ft depth below the surface in each silo on December 16, 1980. The samples were divided into 12 equal lots of 4.0 lb, and each lot was placed in an expanded polystyrene container lined with plastic. A thermocouple was placed in the center of each container and cheese cloth stretched across the top. Containers were stored at 18.3 C 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 and Discussion

Ensiling temperatures are shown in Figure 3.1. Treated silages were slightly warmer than the control during the first week; but treated silages were consistantly cooler from weeks 2 to 8. This may indicate that Silo-Best and Sila-ferm supported faster fermentation during initial ensiling.

Steer performances are shown in Table 3.1. Gain and efficiency were exceptionally good for all four silage rations, reflecting the high dry matter consumptions and mild weather. Silo-Best and Sila-ferm silages were utilized more efficiently ($P<.05$) than was control silage, and required an average of 5.4% less dry matter/lb of gain. Drought-stressed silage supported slower ($P<.01$) and less efficient ($P<.05$) gains than the three normal silages. The high fiber content (Table 3.3) and low grain yield indicated that drought silage was low in total digestible nutrients (TDN).

Presented in Table 3.2 are dry matter recoveries from the concrete stave and experimental silos for the normal corn silages. The dry matter lost during fermentation, storage, and feedout from the concrete staves was similar for the control, Silo-Best, and Sila-ferm (an average of 10.25%). In the experimental silos, Silo-Best and Sila-ferm appeared to reduce these losses, with Silo-Best giving the greater improvement: 5.5% loss for Silo-Best and 7.8% for Sila-ferm, compared with 9.3% for control. When dry matter recoveries are compared by averaging the values for the four types of silos, both silage additives increased DM recovery over that of the control (3.6 percentage units increase for Silo-Best; 1.3 percentage units for Sila-ferm).

For each of the three silages, losses from the buried bags were 9 to 34% less than losses from the concrete stave silos. We believe there are at least two reasons for that: 1) The bags were buried in the center of the silage, where density and compaction were greatest, while in the stave silos, a considerable amount of silage was in contact with the silo walls and doors; and 2) the silage surface of the stave silos was continuously exposed to air for the entire time of silage feeding, while the silage in the buried bags had not been exposed to air until removed from the silos.

Losses from the 5-gallon containers were 45 to 73% less than losses from the concrete stave silos, indicating that ensiling conditions are very favorable in this type of experimental silo.

In both the stave silos and the 55-gallon drums, a small percentage of the dry matter ensiled was removed from the surface and discarded as nonfeedable spoilage when the silos were opened. We believe these spoilage losses were not related to the corn silage treatments but rather to poor compaction near the top of the silos, where air penetrated the silage surface.

All four silages appeared well preserved. Chemical analyses are shown in Table 3.3. The pH values were relatively low and all silages had undergone normal lactic acid fermentations. Although there were no clostridial fermentations, as evidenced by low NH_3-N and butyric acid values, acetic acid was relatively high in all four silages. Silage composition was affected little by either of the additive treatments. Three types of experimental silos (buried bag, 5-gallon, and 55-gallon) all produced silages of exceptionally good quality. Compared with the stave silos, experimental silos resulted in higher lactic acid contents and, except for the buried bags, lower acetic acid values.

Aerobic stabilities of the four corn silages are shown in Table 3.4. Control and Silo-Best silages showed no spoilage during the 14 days; Sila-ferm silage heated on the 11th and 12th days; and drought-stressed silage was the least stable in air. Two additional aerobic stability determinations started January 16 and February 3, 1981, gave similar results.

Shown in Table 3.5 are steer gains per ton of corn crop ensiled for the normal corn silages. These data combine feedlot performance (Table 3.1) and silage recovery from the concrete stave silos (Table 3.2). Compared with the control, Silo-Best corn silage produced 7.2 extra pounds, and Sila-ferm 4.4 extra pounds, of steer gain/ton of silage.

Table 3.1. Performance by steers fed the four corn silages (77-day trial: October 14 to December 30, 1980).*

	Control	Silo-Best	Sila-ferm	Drought-stressed
Initial wt., lb	742	749	750	746
Final wt., lb	968	980	986	932
Avg. daily gain, lb	2.94[a]	3.00[a]	3.06[a]	2.42[b]
Avg. daily feed, lb**				
corn silage	19.29	18.48	19.13	16.93
supplement	1.80[a]	1.80[a]	1.80[a]	1.80[b]
total	21.09[a]	20.28[a]	20.93[a]	18.73[b]
Feed/lb of gain, lb**	7.17[d]	6.77[c]	6.80[c]	7.77[e]

*Each value is the mean of 4 pens of steers (4 steers/pen).

**100% dry matter basis.

a,b Values with different superscripts differ significantly (P<.01).

c,d,e Values with different superscripts differ significantly (P<.05).

Table 3.2. Corn silage fermentation, storage, spoilage, and feedout losses from the concrete stave and experimental silos.

Silo and silage treatment	DM recovered: Feedable	DM recovered: Non-feedable (spoilage)	DM lost during fermentation, storage, and feedout
	% of the DM put into the silo		
Concrete staves			
Control	87.34	2.14	10.52
Silo-Best	88.73	1.65	9.62
Sila-ferm	87.42	1.96	10.62
			x̄ = 10.25
Buried bags[1]			
Control	90.44	--	9.56
Silo-Best	93.62	--	6.38
Sila-ferm	92.04	--	7.96
			x̄ = 7.97
5-gallon containers[2]			
Control	94.02	--	5.98
Silo-Best	97.42	--	2.58
Sila-ferm	96.07	--	3.93
			x̄ = 4.16
55-gallon drums[3]			
Control	82.58	4.91	12.51
Silo-Best	87.51	4.89	7.60
Sila-ferm	83.33	5.15	11.52
			x̄ = 10.54
All silos			
Control	88.60	--	9.64
Silo-Best	91.82	--	6.54
Sila-ferm	89.72	--	8.51

1 Each value is the mean of 6 bags buried within the stave silos.

2 Each value is the mean of 6 containers.

3 Each value is the mean of 6 drums.

Table 3.3. Chemical analyses of control, Silo-Best, Sila-ferm and drought-stressed corn silages in the concrete stave and experimental silos.

	Dry matter: pre-ensiled	Dry matter: silage	pH	Crude protein	Crude fiber	Lactic acid	Acetic acid	Butyric acid	NH_3-N*
	%	%		% of the DM					
Concrete staves[a]									
Control	32.7	31.6	3.65	8.9	20.5	4.37	2.73	trace	--
Silo-Best	32.0	30.1	3.65	8.9	19.1	4.36	3.08	trace	--
Sila-ferm	31.0	30.8	3.68	9.6	18.7	4.29	3.20	trace	--
Drought	31.5	29.8	3.93	10.2	24.1	5.17	3.34	.05	--
Buried bags[b]									
Control	33.2	30.9	3.75	9.1	--	6.94	3.97	trace	4.44
Silo-Best	32.7	31.1	3.76	9.3	--	6.71	3.57	trace	4.14
Sila-ferm	30.7	28.2	3.75	9.5	--	5.84	3.80	trace	4.83
5-gallon containers[c]									
Control	33.1	31.7	3.73	--	--	6.83	1.93	trace	4.17
Silo-Best	32.6	32.0	3.74	--	--	6.32	1.87	trace	4.49
Sila-ferm	30.4	30.0	3.78	--	--	6.81	1.97	trace	5.68
55-gallon drums[d]									
Control	33.7	30.6	3.55	--	--	10.07	2.24	.08	5.61
Silo-best	34.5	30.7	3.47	--	--	7.49	2.05	.22	3.89
Sila-ferm	29.6	27.0	3.55	--	--	8.55	2.51	.24	3.70

*NH_3-N expressed as a percent of total N.

a,b,c,d Each value is the mean of 10, 6, 6, and 4 samples, respectively.

Table 3.4. Changes in temperature and losses of dry matter during air exposure by the four corn silages.

Corn silage	Day of initial rise above ambient temp.*	Maximum temp.	days exposed to air: 2	4	7	14
		C	loss of DM[1]			
Control	**	**	2.25	.84	1.88	3.15
Silo-Best	**	**	.48	2.00	1.78	1.57
Sila-ferm	11.7	38.9	1.10	5.46	4.88	10.59
Drought-stressed	5.4	51.5	3.10	2.94	7.22	32.57

*1.5 C rise above ambient temperature (18.3 C).

**No rise in temperature

1 % of the DM exposed to air.

Table 3.5. Steer gain per ton of corn crop ensiled*

Item	Control	Silo-Best	Sila-ferm
Silage fed, lb/ton of crop ensiled	1747	1775	1748
Silage/lb of gain, lb	19.88	18.67	18.94
Steer gain/ton of corn crop ensiled ensiled, lb	87.9	95.1	92.3

*Values are adjusted to the same DM content for each silage, 33%.

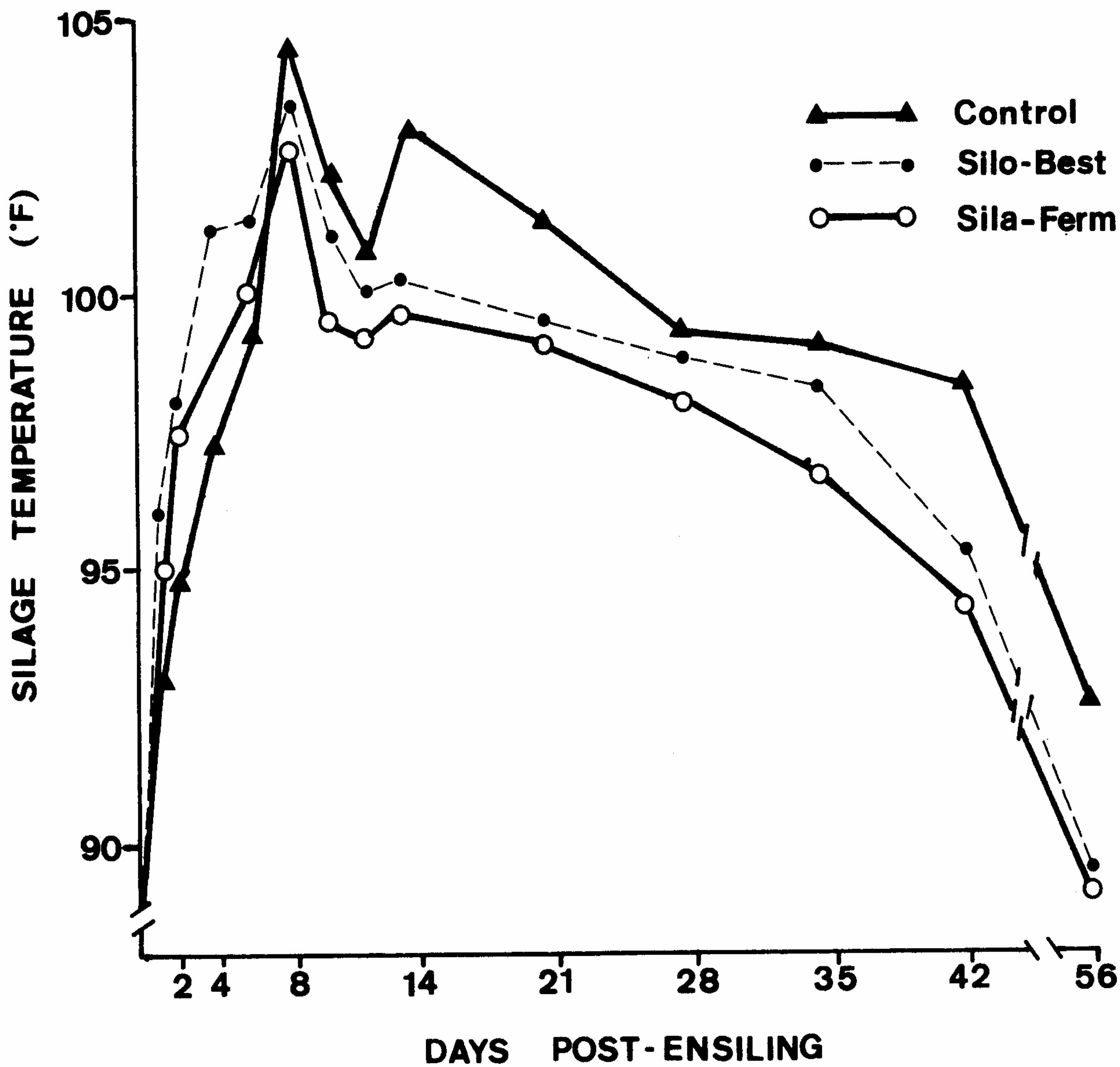

Figure 3.1. Ensiling temperatures for control, Silo-Best, and Sila-ferm corn silages (August 14 to October 9, 1980)