Silo Guard II® for Alfalfa, Corn, and Forage Sorghum Silages[1]

Keith Bolsen, Harvey Ilg, and Mark Hinds

Summary

In the first trial, calves fed Silo Guard II®-treated forage sorghum silage were 4.2% more efficient than those fed the control silage. Silo Guard II reduced the amount of heat produced during the ensiling process, and increased the dry matter recovered from the silo by nearly 7 percentage units (84.1 vs. 77.2%). The more efficient gain and reduced shrink loss for the treated silage gave 8.3 extra pounds of calf gain per ton of crop ensiled when compared with the control silage.

In the second trial, laboratory silos were used to evaluate three levels of Silo Guard II (.5, 1.0, and 2.0 lb per ton), with each of the following crops: direct-cut alfalfa, wilted alfalfa, corn, and forage sorghum. All levels of Silo Guard II improved dry matter recoveries and treated silages underwent more efficient fermentations. Adding Silo Guard II at .5 lb was as effective as the higher application rates.

Experimental Procedures

Trial 1. Two whole-plant forage sorghum silages were compared: control (no additive) and Silo Guard II applied at 1.0 lb per ton of fresh crop. The silages were made in 10 x 50 ft concrete stave silos on September 28 and 29, 1982 from Asgrow Titan R forage sorghum, harvested in the dough stage at 25 to 26% dry matter (DM). Ensiling temperatures were monitored for the first 42 days and nylon bags (6 per silo) were buried in each silo for additional observations of silage DM recoveries. The silos were opened on December 20 and 21.

Each silage was fed to 18 steer and heifer calves in three pens of six calves per silage. The calves were Hereford, Simmental, and Hereford x Angus and weighed 435 lb initially. The 94-day feeding trial began December 21, 1982 and ended March 25, 1983. Silages were full-fed and all calves received 2.0 lb of supplement daily. Rations were formulated to provide 12.5% crude protein (DM basis), 150 mg of monensin per calf daily, and equal amounts of calcium, phosphorus, and vitamin A.

All calves were weighed individually after 16 h without feed or water on 2 consecutive days at the start and again at the end of the trial. Intermediate weights were taken before the a.m. feeding on days 28 and 56.

---

[1]Silo Guard II contains an enzyme and its co-factors and is manufactured by International Stock Foods, Inc., Waverly, NY 14892. Partial financial assistance was provided by International Stock Foods.

Silage samples were taken twice weekly from each silo. Feed offered was recorded daily for each of the six pens and the quantity of silage fed was adjusted daily to assure that feed was always in the bunks. Feed not consumed was removed, weighed, and discarded every 7 days.

Three aerobic stability (bunk life) measurements were made on each silage. Approximately 60 lb of fresh silage was obtained from 3 ft below the surface in the center of each silo at three times that corresponded to the top, middle, and bottom thirds of the silos. These were divided into 4.0 lb lots and each lot was placed in an expanded polystyrene container lined with plastic. A thermocouple wire was placed in the center of each container and cheese cloth stretched across the top. Containers were stored at 18 to 20 C and the silage temperature was recorded twice daily. After a designated number of days of air exposure, replicated containers of each silage were weighed, mixed, and sampled and dry matter loss was determined.

Trial 2. Silages were made in 1982 from: third-cutting 1/4-bloom alfalfa that was (1) direct-harvested at 75% moisture (low DM) or (2) heavily wilted to 50% moisture (high DM); (3) whole-plant corn, harvested in the dent stage at 67% moisture; and (4) whole-plant forage sorghum, harvested in the dough stage at 73% moisture. Four treatments were compared: control (no additive) and Silo Guard II applied at .5, 1.0, or 2.0 lb per ton of fresh crop.

For each treatment an appropriate amount of crop was placed in a Harsh Mobile Mixer® and the additive applied. After mixing, about 28 to 34 lb of crop was packed tightly into the laboratory silos (five per treatment) and the filled silos weighed. Samples of pre-treated and post-treated, pre-ensiled crop were taken and frozen immediately in liquid nitrogen. For all crops, less than 2 hours elapsed from the time the harvested material left the field until the laboratory silos were sealed.

For each crop, at about 10 weeks post-ensiling, silos were weighed and the silage mixed in a cement mixer and sampled. Dry matter loss was determined for each silo. All silage samples were analyzed for DM, pH, lactic acid, volatile fatty acids, crude protein, ammonia-nitrogen, and hot water insoluble-nitrogen. All pre-ensiled crop samples were analyzed for DM, pH, crude protein, and hot water insoluble-nitrogen. Bunk life was measured by procedures similar to those described in Trial 1.

Results and Discussion

Trial 1. Visual appraisal indicated that both the control and Silo Guard II silages were well preserved. Chemical analyses are shown in Table 8.1. The DM content of the pre-ensiled forages and silages was rather low: 25.9 and 24.3% for the control; 25.4 and 24.4% for the Silo Guard II. In the first 10 days to 2 weeks after the silos were filled, effluent was produced from the control silo; none came from the Silo Guard II silo. The DM content of the final 4 to 5 tons of silage in the bottom of the silos was 21.0% for the control and 25.5% Silo Guard II silages. The slightly higher lactic acid to acetic acid ratio in the Silo Guard II silage suggests that it underwent a more efficient fermentation.

Adjusted ensiling temperatures are shown in Figure 8.1. Control silage reached a maximum temperature of 14.5 F above its initial forage temperature on day 6; Silo Guard II silage reached 10.5 F above initial on day 4. Silo Guard II silage returned to its initial temperature on day 17 post-ensiling; control silage was 13.5 F above its initial temperature on day 17 and was still above initial by 3.0 F on day 42. Thus, the treated silage probably underwent a more efficient fermentation, which was completed much sooner than that of the control.

Silage recovery and loss data are shown in Table 8.2. In the concrete stave silos, DM lost during fermentation, storage, and feedout was 30.4% less for the Silo Guard II silage (14.5%) than for the control silage (20.8%). The data from the buried nylon bags gave similar results—treated bags had 27.4% less DM loss than control bags (8.1 vs. 11.2%). Results of four previous trials showed similar improvements in DM recovery for Silo Guard silages (see page 26 of this report).

Performance by the calves fed the two forage sorghum silage rations is shown in Table 8.3. Calves fed control silage consumed slightly more feed than those fed Silo Guard II silage, but since rates of gain for the calves were similar, feed efficiency was 4.2% better for the calves fed Silo Guard II silage.

Also shown in Table 8.3 are calf gains per ton of forage sorghum ensiled. These data combine silage recovery (Table 8.2) and calf performance. Silo Guard II produced 8.3 extra pounds of calf gain per ton of crop ensiled. For the cattleman or farmer-feeder, this is a logical way to determine the overall effectiveness of a silage additive, as it expresses both forage preservation efficency and silage nutritive value. Three previous trials with Silo Guard and Silo Guard II have indicated that gain produced per ton of whole-plant corn or sorghum ensiled was increased by an average of 6.5 pounds when compared with control silages (Reports of Progress 377 and 427).

Aerobic stabilities of silage from the top, middle, and bottom thirds of each silo are shown in Table 8.4. Both silages were unstable near the top of the silos, heating after only 1 or 2 days of air exposure. However, silages from the middle and bottom thirds of each silo were extremely stable, with no heating or deterioration during 21 days of air exposure.

Trial 2. All four low DM alfalfa silages were of extremely poor quality—they contained almost no lactic acid and very high amounts of volatile fatty acids (including butyric) and ammonia-nitrogen. Although each level of Silo Guard II improved DM recovery over the control (83.9 vs. 82.2% of the DM ensiled), none of the treated silages were of acceptable quality. Making alfalfa silage at a moisture content above 72% is not recommended.

Dry matter recoveries and chemical analyses of the high DM alfalfa silages are shown in Table 8.5. Silage made with .5 lb of Silo Guard II had numerically higher DM recovery and ratios of lactic to acetic acid and lactic to DM loss than control silage.

All eight corn and forage sorghum silages were of very acceptable quality—they had low DM losses and high lactic acids (Table 8.6). In both crops, each level of Silo Guard II significantly ($P<.05$) improved silage DM recoveries over the controls.

Summarized in Table 8.7 are results for the high DM alfalfa, corn, and sorghum silages. All levels of Silo Guard II improved DM recoveries and treated silages underwent more efficient fermentations as indicated by their higher ratios of lactic to acetic acid and lactic to DM loss. Adding Silo Guard II at .5 lb per ton was as effective as the higher application rates.

Table 8.1. Chemical Analyses for the Control and Silo Guard II Silages Made in the Concrete Stave Silos.[1]

Item	Silage treatment	
	Control	Silo Guard II
Dry matter:		
pre-ensiled, %	25.9	25.4
silage, %	24.3	24.4
	——% of the DM——	
Lactic acid	6.30	6.50
Acetic acid	4.56	4.04
Propionic acid	.52	.33
Butyric acid	.06	.07
Total fermentation acids	11.11	10.60
Crude protein	7.24	7.63
Hot water insoluble-nitrogen	.75	.75
pH	3.77	3.89
Ratio: lactic:acetic	2.07	2.39

[1] Each value is the mean of 13 samples taken during the feeding trial.

Table 8.2. Forage Sorghum Silage Recoveries and Losses From the Concrete Stave Silos and Buried Bags for the Control and Silo Guard II Silages.

Item	DM recovery		DM lost during fermentation, storage, and feedout
	Feedable	Non-feedable (spoilage)	
	% of the DM ensiled		
Concrete stave silos			
control	77.2	2.0	20.8
Silo Guard II	84.1	1.4	14.5
Buried nylon bags[1]			
control	88.8	—	11.2
Silo Guard II	91.9	—	8.1

[1]Each value is the mean of six bags.

Table 8.3. Performance by Calves Fed the Control and Silo Guard II Treated Silages and Calf Gain Per Ton of Forage Sorghum Ensiled.

Item	Silage treatment	
	Control	Silo Guard II
No. of calves	18	18
Avg. daily gain, lb	1.18	1.19
Daily feed intake, lb[1]		
silage	9.15	8.81
supplement	1.80	1.80
total	10.95[a]	10.61[b]
Feed/lb of gain, lb[1]	9.33	8.94
Silage fed, lb/ton[2]	1545	1682
Silage/lb of gain, lb[2]	25.83	24.67
Calf gain/ton of crop ensiled, lb[2]	59.8	68.1

[ab]$P<.05$).

[1]100% dry matter basis.

[2]All values are adjusted to the same silage DM content, 30 percent.

Table 8.4. Aerobic Stabilities of the Control and Silo Guard II Forage Sorghum Silages.

Replication and silage	Days of initial temp. rise above ambient (64F)	Maximum temp. (F)
Replication 1[a]		
Control	2.0	111
Silo Guard II	3.0	95
Replication 2[b]		
Control	*	*
Silo Guard II	*	*
Replication 3[c]		
Control	*	*
Silo Guard II	*	*

[a]Silage removed from the top one-third of the silos (January 4, 1983).

[b]Silage removed from the middle one-third of the silos (March 11, 1983).

[c]Silage removed from the bottom one-third of the silos (April 5, 1983).

*No rise in temperature or visible aerobic deterioration occurred during 21 days of exposure to air.

Table 8.5. Dry Matter Recoveries and Chemical Analyses for the Control and Silo Guard II High Dry Matter Alfalfa Silages Made in Laboratory Silos.

		Silo Guard II (lb/ton)		
Item	Control	.5	1.0	2 .0
Dry matter:				
pre-ensiled, %	50.2	50.1	50.6	50.6
silage, %	48.7	49.3	49.4	49.6
		% of the DM ensiled		
Dry matter recovery	96.1[b]	97.2[a]	96.5[ab]	96.8[ab]
		% of the silage DM		
Lactic acid	5.8	5.8	5.7	5.5
Acetic acid	2.4[b]	2.1[a]	2.1[a]	2.4[b]
Propionic acid	.01[b]	.07[a]	.03[b]	.02[b]
Butyric acid	ND	ND	ND	ND
Total fermentation acids	8.3[a]	7.9[ab]	7.8[b]	7.9[ab]
Crude protein	19.7[b]	20.7[a]	20.6[a]	20.6[a]
Hot water insol. N	1.3[b]	1.3[b]	1.3[b]	1.4[a]
Ammonia-N	.2	.2	.2	.2
pH	4.73	4.70	4 .76	4.74
Ratios:				
Lactic:acetic	2.4[ab]	2.8[a]	2.8[a]	2.3[b]
Lactic:DM loss	1.6	2.1	1.8	1.8

[ab]Values within a crop with different superscripts differ (P<.05).
ND means none detected.

Table 8.6. Dry Matter Recoveries and Chemical Analyses for the Control and Silo Guard II Corn and Forage Sorghum Silages Made in Laboratory Silos.

	Corn silage				Forage sorghum silage			
		Silo Guard II (lb/ton)				Silo Guard II (lb/ton)		
Item	Control	.5	1.0	2.0	Control	.5	1.0	2.0
Dry matter:								
pre-ensiled, %	33.4	33.2	33.1	32.8	27.5	27.2	27.2	27.7
silage, %	31.9	32.0	32.0	31.7	25.3	25.4	25.4	25.7
	% of the DM ensiled							
Dry matter recovery	94.5^{b}	95.7^{a}	95.8^{a}	95.4^{a}	90.6^{b}	91.8^{a}	91.7^{a}	91.2^{ab}
	% of the silage DM							
Lactic acid	8.1	7.2	7.6	7.5	10.4_{b}	10.7_{ab}	10.5_{a}	11.4_{ab}
Acetic acid	6.6	6.9	5.7	5.8	3.0^{b}	2.7^{ab}	2.4^{a}	2.6^{ab}
Propionic acid	.3	.4	.2	.2	ND	ND	ND	ND
Total fermentation acids	15.0	14.5	13.5	13.2	13.4	13.4	12.9	14.0
Crude protein	7.7	7.7	7.7	7.8	—	—	—	—
Hot water insol. N	.67	.65	.62	.62	—	—	—	—
pH	3.65^{a}	3.68^{b}	3.69^{b}	3.70^{b}	3.73^{a}	3.80^{b}	3.77^{ab}	3.75^{ab}
Ratios:								
Lactic:acetic	1.2	1.1	1.4	1.4	3.5^{b}	4.2^{a}	4.4^{a}	4.5^{a}
Lactic:DM loss	1.5	1.7	1.8	1.7	1.1	1.3	1.3	1.3

^{ab}Values within a crop with different superscripts differ ($P<.05$).
ND means none detected.

Table 8.7. Summary of the Dry Matter Recoveries and Chemical Analyses for the Control and Silo Guard II High Dry Matter Alfalfa, Corn, and Forage Sorghum Silages Made in Laboratory Silos.

		Silo Guard II (lb/ton)		
	Control	.5	1.0	2.0
No. of silages	3	3	3	3
Silage DM, %	35.3^{b}	35.6^{a}	35.6^{a}	35.7^{a}
	% of the DM ensiled			
Dry matter recovery	93.73^{b}	94.91^{a}	94.69^{a}	94.48^{a}
	% of the silage DM			
Lactic acid	8.1_{c}	7.9_{bc}	7.9_{a}	8.1_{ab}
Acetic acid	4.0^{c}	3.9^{bc}	3.4^{a}	3.6^{ab}
Propionic acid	.12	.16	.06	.06
Total fermentation acids	12.2	11.9	11.4	11.7
pH	4.04^{a}	4.06^{b}	4.07^{b}	4.06^{b}
Ratios:				
Lactic:acetic	2.4^{b}	2.7^{a}	2.8^{a}	2.7^{a}
Lactic:DM loss	1.4^{b}	1.7^{a}	1.6^{ab}	1.6^{ab}

^{abc}Values with different superscripts differ ($P<.05$).

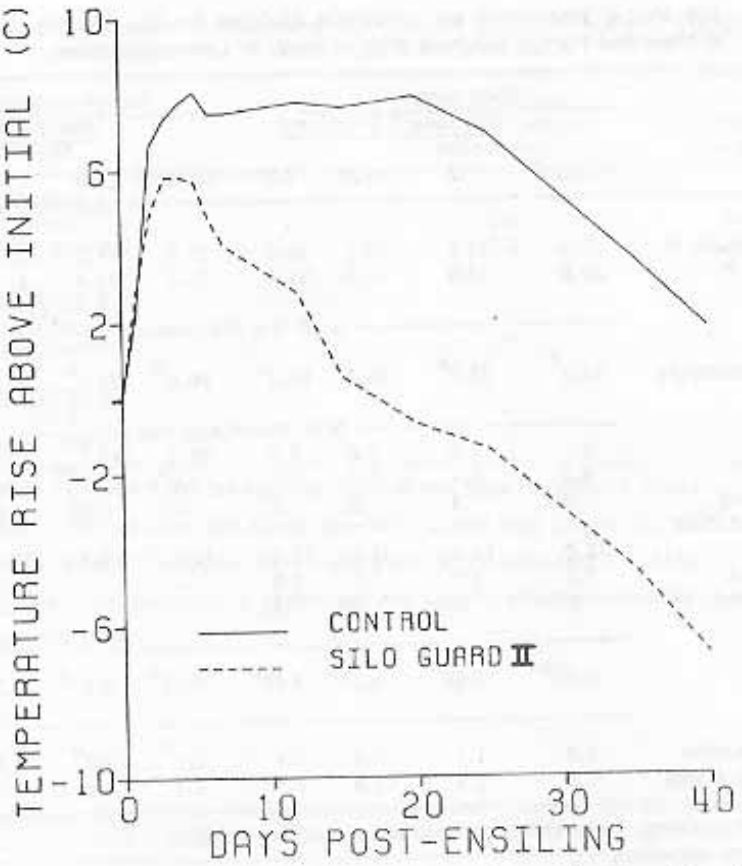

Figure 8.1. Adjusted ensiling temperature rise above the initial forage temperatures.