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Effects of Rapid and Delay Silo Filling and
1177[®] Silage Inoculant on Performance of
Growing Cattle Fed Corn and Sorghum Silages¹

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Summary

Eight concrete stave silos (10 x 50 ft) were used in two trials to evaluate rapid (24 to 36 hr) and delay (15 days) filling, each with or without 1177[®] silage inoculant. Corn silage was used in Trial 1; forage sorghum in Trial 2. The delay-fill silages had a dry matter (DM) range of 34.4 to 39.9% in Trial 1 and 24.2 to 29.6% in Trial 2.

All eight silages were well preserved with the four delay-fill silos having lower total fermentation acids than their rapid-fill counterparts. With corn silage, the rapid-fill silos had higher silage DM recoveries than the delay-fill silos. 1177[®] improved DM recovery in the rapid-fill silo but not in the delay-fill silo.

With forage sorghum silage, the rapid-fill silos lost effluent, which contributed to lower DM recoveries than in the delay-fill silos. 1177[®] improved DM recoveries with both fill procedures for the wetter sorghums. Steer performance was similar ($P > .05$) for all four treatments within each silage. When silage recovery and steer performance were combined, the 1177[®] treated silages produced more pounds of beef than their respective controls. When corn and forage sorghum silages were averaged, 1177[®] produced 3.3 lb more beef gain per ton of crop ensiled than uninoculated controls.

Experimental Procedures

Trial 1: Four concrete stave silos (10 x 50 ft) were filled with whole-plant corn in the late summer, 1981. The treatments were: (1) rapid-fill (filled during 24 to 36 hr) without inoculant (control-rapid); (2) delay-fill (filled over 15 days) without inoculant (control-delay); (3) rapid-fill with 1177[®] Silage Inoculant (1177-rapid); and (4) delay-fill with 1177[®] Silage Inoculant (1177-delay). The 1177[®], 1.0 lb/ton of fresh crop, was applied by hand at the blower. Harvest and fill dates and crop dry matters (DM) are shown in Table 10.1.

¹Pioneer 1177[®] Silage Inoculant contains dried *Lactobacillus plantarum* and dried *Streptococcus faecium* fermentation products and is produced by Pioneer Hi-Bred International, Inc., Des Moines, IA 50308. 1177[®] and partial financial assistance were provided by Pioneer.

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The corn, Ferry-Morse 3020, grown under irrigation near Manhattan, yielded approximately 153 bushels per acre. On each of the silo filling dates, a similar number of rows was harvested from each of two pre-selected areas in the field. When the harvest began on August 14th, the kernels were in the dent stage and the whole-plant corn averaged 34.3% dry matter. At the last harvest on August 27th, the kernels were in the hard-dent stage and the whole-plant was 39.9% dry matter.

For each delay-fill silo, two loads of crop were ensiled on each of the 4 filling days, except on August 24th, when three loads were ensiled. In each rapid fill silo, seven loads were ensiled by the alternate load method between 8 a.m. and 6 p.m. on August 17th; and the final two loads, between 11 a.m. and 2 p.m. on August 18th. Five thermocouple wires were spaced evenly in each of the four silos and ensiling temperatures were monitored for 8 weeks.

Each silage was fed to 24 Hereford and Simmental steer and heifer calves (four pens of six calves) that weighed 511 lb initially. All calves received a full-feed of silage and 2.0 lb of supplement daily. Rations were fed twice daily, with silage and supplement mixed in the bunk. Rations were formulated to contain 12.5% crude protein (DM basis), .50% calcium, .35% phosphorus, and to supply 150 mg of monensin and 30,000 IU of supplemental vitamin A per calf daily.

All calves were weighed individually after 16 hr without feed or water on 2 consecutive days at the start and at the end of the trial. Intermediate weights were taken before the a.m. feeding on days 28, 56, and 84. Silage samples were collected twice weekly from the silos. Feed intake was recorded daily for each of the 16 pens and silage not consumed was removed, weighed, and discarded every 7 days.

Twice during the feeding trial, silage from each silo was removed from three feet below the surface and aerobic stability measured by procedures described on page 28 of this report.

Trial 2: Four concrete stave silos (10 x 50 ft) were filled with whole-plant forage sorghum in the early autumn, 1982. The treatments were the same as for Trial 1. Harvest and fill dates and crop dry matters are shown in Table 10.1.

The forage sorghum, Asgrow Titan R, grown under dryland conditions near Manhattan, yielded approximately 60 bushels per acre. On each of the silo filling dates, a similar number of rows was harvested from a pre-selected area in the field. When the harvest began on September 20th, the grain sorghum grains were in the soft-dough stage and the whole-plant forage sorghum averaged 24.3% dry matter. At the last harvest on October 5th, the grain sorghum grains were in the hard-dough stage and the whole-plant was 29.5% dry matter.

For each delay-fill silo, two loads of crop were ensiled on each of the 4 filling days, except on September 24th and October 5th, when three loads were ensiled. In each rapid fill silo, six loads of crop were ensiled by the alternate load method between 1 p.m. and 6:30 p.m. on September 28th; and the final three loads between 11 a.m. and 1:30 p.m. on September 29th. Four thermocouple wires were evenly spaced in each of the four silos and ensiling temperatures were monitored for 40 days.

Each silage was fed to 18 Hereford and Simmental steer and heifer calves (three pens of six calves) that weighed 435 lb initially. All calves received a full-feed of silage and 2.0 lb of supplement daily. Rations were fed twice daily, with silage and supplement mixed in the bunk. Rations were formulated as in Trial 1. Calf weights, silage sampling, feed recording, and aerobic stability measures were similar to those in Trial 1.

Results and Discussion

Chemical analyses of the four corn silages are shown in Table 10.2 and for the four forage sorghum silages, in Table 10.3. The DM content of both crops entering the silos was increased by delay-filling over a 15-day period. The delay-fill silos had a DM range of 34.4 to 39.9% in Trial 1 and 24.2 to 29.6% in Trial 2. All eight silages were well preserved and had undergone predominantly lactic acid fermentations. In the first 10 days to 2 weeks after the rapid-fill sorghum silages were made, effluent was produced from both silos. As will be discussed later, the effluent had a detrimental effect on the quality of each silage.

For both corn and sorghum, the slightly higher DM content of the delay-fill forages gave silages with lower total fermentation acids than their rapid-fill counterparts. In Trial 1, the 1177 rapid-fill silage had the highest lactic acid content and the highest lactic to acetic acid ratio, which suggests this silage had the most efficient fermentation. The other three corn silages had similar chemical compositions. In Trial 2, the two delay-fill sorghum silages underwent more efficient fermentations than the two rapid-fill silages, as indicated by the higher lactic to acetic acid ratios. 1177 did not affect the chemical composition of either the rapid- or delay-fill sorghum silages.

Temperature rises above initial forage temperatures are shown in Figure 10.1 and 10.2. In both trials, the delay-fill silages had greater average temperature rises during the first week than the rapid-fill silages, peaking at 16 C vs 9 C in Trial 1 and 13 C vs. 8 C in Trial 2. This increased heat production was due, in part, to the prolonged surface exposure over the 15 days and less total compaction and density in the delay-fill silages.

The dry matter lost during fermentation, storage, and feedout from the concrete stave silos in Trial 1 was lowest for 1177-rapid (6.7%) but highest for 1177-delay (10.8%) while the control-rapid and control-delay had similar losses (Table 10.4). In Trial 2, both rapid-fill silos lost more dry matter than the two delay-fill silos. The lower DM content of the rapid-fill forages likely explains these higher losses; soluble nutrients needed for fermentation are lost in the effluent and the higher moisture allows a prolonged and less efficient fermentation. In both trials, approximately 1.5 to 3.0% of the recovered dry matter was discarded as non-feedable spoilage when the silos were opened. This spoilage was not influenced by silage treatment and was normal for silage surfaces sealed with black plastic.

Steer performances are shown in Table 10.5 and 10.6 for Trials 1 and 2, respectively. All four treatments within each silage produced statistically similar daily gains, feed intakes, and feed conversions. The two delay-fill corn silages, which were slightly drier, had numerically higher intakes than the two rapid-fill silages, however sorghum silage results were reversed, with delay-fill silages having lower intakes than rapid-fill silages.

Shown in Table 10.7 are steer gains per ton of crop ensiled. These data combine silage recovery from the concrete stave silos (Table 10.4) and feedlot performance (Tables 10.5 and 10.6) results. When averaged across fill procedures, the 1177 silages produced more steer gain than the control silages in both trials; 2.8 pounds per ton of corn ensiled and 3.8 pounds per ton of forage sorghum. When averaged for fill procedures, rapid-fill corn silages produced 5.7 pounds more gain than delay-fill silages, but the delay-fill sorghum silages produced 5.0 pounds more gain than rapid-fill silages. In both trials, the gain-producing potential of each silage was determined largely by its relative silage recovery.

Table 10.1. Harvest and Fill Dates for the Silages in Trial 1 and Trial 2.

Treatment	Corn harvest and fill dates (1981)	Forage sorghum harvest and fill dates (1982)
Control-rapid	August 17 and 18	September 28 and 29
Control-delay	August 14, 18, 24, and 27	September 20, 24, 30, October 5
1177®-rapid	August 17 and 18	September 28 and 29
1177®-delay	August 14, 18, 24, and 27	September 20, 24, 30, October 5

Table 10.2. Chemical Analyses of the Four Corn Silages in Trial 1^a.

Item	Silage treatment and fill procedure			
	Control		1177	
	Rapid	Delay	Rapid	Delay
Dry matter, %:				
pre-ensiled, avg.	35.8	37.2	35.3	37.6
pre-ensiled, range	—	34.1-40.3	—	34.7-39.4
silage	34.7	36.3	35.1	36.4
	% of the DM			
Lactic acid	4.94	4.40	6.33	4.88
Acetic acid	4.08	3.14	2.63	3.20
Propionic acid	.10	.10	.09	.14
Butyric acid	.03	.07	.06	.03
Total fermentation acids	9.42	7.92	9.33	8.57
Crude protein	7.62	7.47	7.45	7.56
Hot water insoluble - nitrogen	.53	.51	.44	.50
	% of total N			
Ammonia-N	10.1	8.1	10.6	8.8
pH	3.75	3.73	3.69	3.77
Ratio: lactic:acetic ^b	1.68	1.86	3.23	1.95

^aEach value is the mean of 18 samples taken during the feeding trial.

^bLactic acid (% of the DM) to acetic acid (% of the DM).

Table 10.3. Chemical Analyses of the Four Forage Sorghum Silages in Trial 2^a.

Item	Silage treatment and fill procedure			
	Control		1177	
	Rapid	Delay	Rapid	Delay
Dry matter, %:				
pre-ensiled, avg.	25.9	26.5	25.5	26.0
pre-ensiled, range	—	24.3-29.8	—	24.1-29.5
silage	24.4	25.4	24.0	24.8
	% of the DM			
Lactic acid	6.30	5.19	5.76	6.12
Acetic acid	4.56	3.20	5.17	3.50
Propionic acid	.52	.20	.75	.32
Butyric acid	.06	.03	.05	.11
Total fermentation acids	11.11	8.34	11.76	9.54
Crude protein	7.24	7.06	7.38	7.13
Hot water insoluble - nitrogen	.75	.76	.79	.68
pH	3.77	3.99	3.85	3.88
Ratio:				
Lactic:acetic ^b	2.07	3.12	2.18	2.72

^aEach value is the mean of 19 samples taken during the feeding trial.

^bLactic acid (% of the DM) to acetic acid (% of the DM).

Table 10.4. Silage Recoveries and Losses From the Concrete Stave Silos for the Four Corn Silages (Trial 1) and Four Forage Sorghum Silages (Trial 2).

Trial, silage treatment, and fill procedure	DM recovery		DM lost during fermentation, storage, and feedout
	Feedable	Non-feedable (spoilage)	
<u>Trial 1: corn silage</u>			
control-rapid	89.0	1.6	9.4
control-delay	88.0	2.7	9.3
1177 - rapid	91.9	1.4	6.7
1177 - delay	86.4	2.8	10.8
<u>Trial 2: sorghum silage</u>			
control-rapid	77.2	2.0	20.8
control-delay	81.1	1.9	17.0
1177-rapid	79.1	1.4	19.5
1177-delay	85.5	1.9	12.6

Table 10.5. Performance by Calves Fed the Four Corn Silages in Trial 1 (110 Days: December 9, 1981 to March 28, 1982).

Item	Silage treatment and fill procedure			
	Control		1177	
	Rapid	Delay	Rapid	Delay
No. of calves	24	24	24	24
Initial wt., lb	509	512	510	511
Avg. daily gain, lb ¹	2.18	2.22	2.22	2.20
Avg. daily feed, lb ¹	14.67	15.24	14.57	14.84
Feed/lb of gain, lb ¹	6.75	6.86	6.56	6.73

¹100% dry matter basis.

Table 10.6. Performance by Calves Fed the Four Sorghum Silages in Trial 2 (94 Days: December 22, 1982 to March 25, 1983).

Item	Silage treatment and fill procedure			
	Control		1177	
	Rapid	Delay	Rapid	Delay
No. of calves	18	18	18	18
Initial wt., lb	435	432	434	434
Avg. daily gain, lb ¹	1.18	1.18	1.20	1.16
Avg. daily feed, lb ¹	10.96	10.67	10.76	10.61
Feed/lb of gain, lb ¹	9.33	9.02	9.02	9.16

¹100% dry matter basis.

Table 10.7. Steer Gain Per Ton of Crop Ensiled in Trial 1 and Trial 2.*

Item	Silage treatment and fill procedure			
	Control		1177	
	Rapid	Delay	Rapid	Delay
<u>Trial 1: corn silage</u>				
Silage fed, lb/ton	1780	1760	1838	1728
Silage/lb of gain, lb	19.67	20.17	19.29	19.74
Steer gain/ton of corn crop ensiled, lb	90.5	87.3	95.8	87.5
<u>Trial 2: sorghum silage</u>				
Silage fed, lb/ton	1544	1622	1582	1710
Silage/lb of gain, lb	25.28	24.46	24.31	24.50
Steer gain/ton of sorghum crop ensiled, lb	61.1	66.3	65.1	69.8

*Values are adjusted to same dry matter content for each silage, 30 percent.

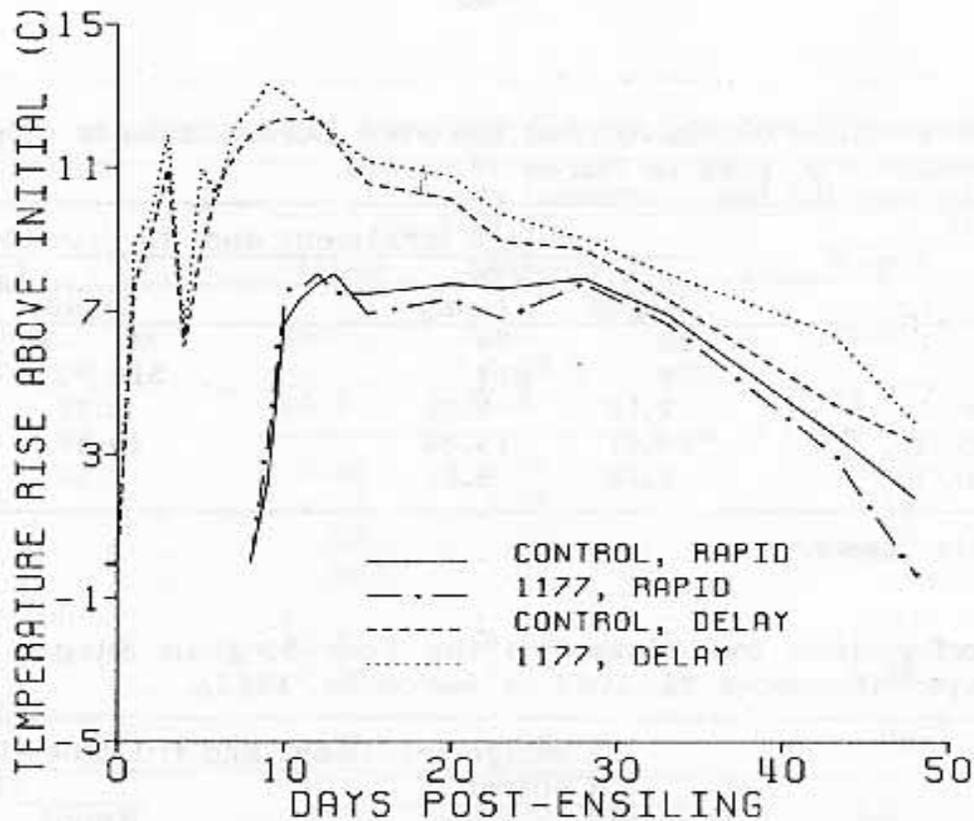


Figure 10.1. Adjusted ensiling temperature rise above the initial forage temperatures for the four corn silages in Trial 1.

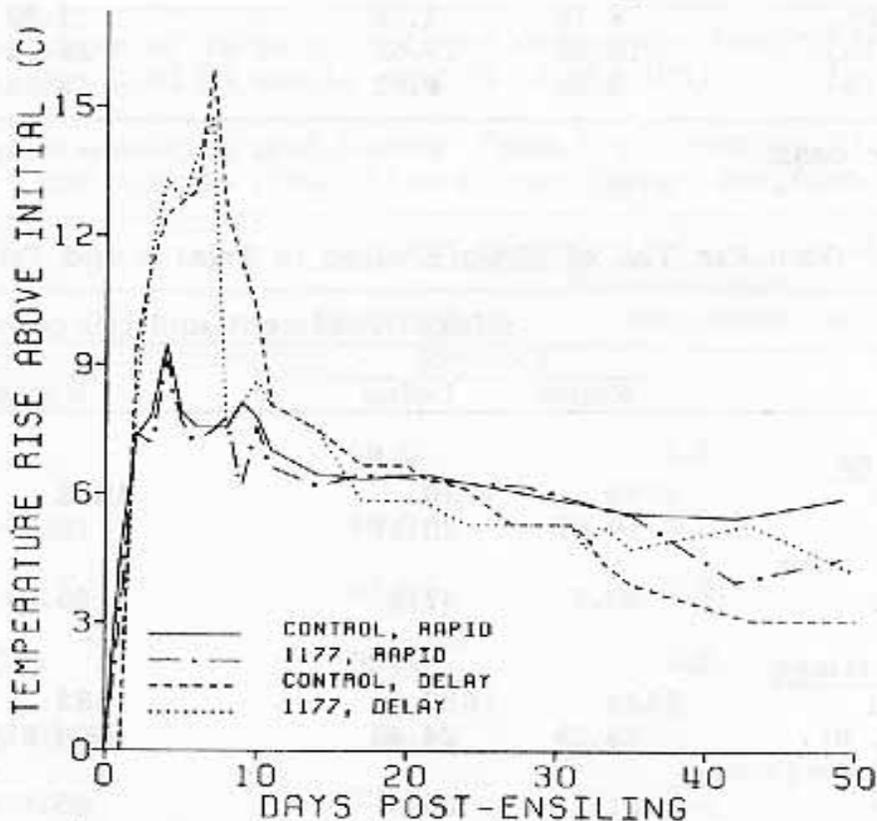


Figure 10.2. Adjusted ensiling temperature rise above the initial forage temperatures for the four forage sorghum silages in Trial 2.