Effect of BioPreserve 2.0 silage inoculant on fermentation profile of corn silage

Erik Loe, PhD, Midwest PMS

A. Dykshorn, B. Hofmeyer, S. Stanley, M. Smolders, Advanced Crop Nutrition

Introduction

Previous research conducted in 2016 demonstrated that BioPreserve was affective at lowering silage shrink vs Control over a 60-day period (1.95 vs 2.32 for BioPreserve and Control, respectively). Extrapolating percent shrink from 60 days to 365 days would have shrink for BioPreserve at 11.5% and Control at 13.7%. The difference in shrink reported by Loe et al. (2017) over a 60-day period was due to loss of carbon due to volatilized compounds and moisture. Therefore, this theoretical shrink would likely be low since losses during loading did not occur and there was very low spoilage. In the first year of evaluating BioPreserve (the inoculant produced by Advanced Crop Nutrition), corn silage that was inoculated with BioPreserve had less shrink, NDF, ADF, ammonia, more starch, and increased digestibility vs Control. The package size of BioPreserve was decreased for use during the harvest of 2017. This product is named BioPreserve 2.0 and it was the ACN inoculant evaluated in the fall of 2017. To evaluate BioPreserve 2.0, the following treatments were evaluated: 1) No inoculant; 2) BioPreserve2.0; 3) another company's inoculant; and 4) Nature's Best 101.

Procedures

Corn silage was harvested near Sioux Center, IA, on September 20, 2017. One load of silage was unloaded on a concrete pad near the Advanced Crop Nutrition warehouse. Twelve polyethylene totes (40"L × 48"W × 46"H) had their top removed; their bottom valves closed; and were filled with corn silage using a skid steer loader. There were three totes per treatment with the treatments being: **1) No inoculant; 2) BioPreserve2.0; 3) Inoculant-X; and 4) Nature's Best 101 (NB101)**. The silage was sprayed with either 1) water; 2) BioPreserve2.0; 3) Inoculant-X; or 4) NB101. Care was taken to get all the silage sprayed with the treatment's additive (water for control or an inoculant). The control (no inoculant) silage was added to their respective totes first. Then the three totes were filled with corn silage as BioPreserve2.0 was sprayed onto the silage as it was loaded into each tote. The same procedure was used for Inoculant-X and Nature's Best 101. Each tote was weighed empty and again after it was filled with silage. A Prime Scales floor scale equipped with a Prime Scales Model PS-IN108M scale head was used to measure the weight of each tote. After the totes were weighed a concrete weight was applied to the top of each tote. There were two weights used with the weight ranging from 1100 to 1300 lb. The weights were placed on each tote for 10 minutes. The heavy weight was used on two out of the three totes for each treatment. After packing the silage, the totes were sealed with an 8mm reinforced Raven silage tarp. The tarp covering the silage in each tote was taped to the sidewall of each tote to prevent oxygen penetration.

BioPreserve 2.0 was inoculated at a rate of 2 ounces/ton of as is silage. Inoculant-X was added according at the manufacturer's labeled rates. Nature's Best 101 was added at a rate of 4 ounces/ton of as is silage. Each of the inoculants was diluted in 1 gallon of distilled water.

Measurements

Corn silage was weighed at initiation of the experiment and again, on November 29, 2017 (71 days later), when the totes were emptied out onto a concrete pad. Using those weights, shrink was calculated. The corn silage was removed from the tote by dumping each tote on a concrete surface where two composite samples of corn silage were obtained. Care was taken to not include silage from the top of the tote in any of the samples.

After corn silage samples were taken, they were frozen prior to being sent to Cumberland Valley Analytical Services Laboratory. Near infrared and wet chemistry laboratory procedures were used.

Results

The corn silage that was not inoculated had a higher percent shrink (Table 1) compared to the three corn silage treatments that received an inoculant. Among the inoculated silages, BioPreserve2.0 had the lowest shrink percentage which was 20.3% lower vs control and 10.8% lower vs Inoculant-X. When extrapolating the measured shrink during the 71-day period out to a 365-day period, non-inoculated corn silage would have shrunk 10.8% while inoculated corn silage would have shrunk 9.3% with BioPreserve2.0 having the lowest theoretical shrink over the extrapolated 365 days at 8.6%. An estimate of what the cost difference was between Control and BioPreserve2.0 shrink for 4000 tons of harvested silage was $3,115 ($15,120 for Control & $12,005 for BioPreserve2.0) where the control pile would theoretically have shrunk 432 tons and the BioPreserve2.0 pile would have shrunk 343 tons ($35/ton was used as the value of corn silage).

Table 2 contains the dry matter (DM) and nutrient profile of the corn silage treatments. There were a few points of DM difference among the treatments and since there should have been similar initial DM of the silage this is an important difference. The day-71 pH was similar among the treatments. Crude protein had a little variation though the percentage of ammonia on DM basis was similar. Due to this, the ammonia as a percentage of crude protein was lowest for Inoculant-X with NB101 being the highest. The NDF and ADF levels were a fewer percentage points higher for Control, which also had the lowest starch content. The inoculated corn silages were higher in starch vs the non-inoculated corn silage with BioPreserve2.0 having numerically higher starch than the other treatments. Acid detergent insoluble crude protein, an indirect measure of protein availability, was very close among all treatments as was the concentration of ash.

In addition to the nutrient profile, the fermentation profile was measured. Total VFA was higher for Inoculant-X and NB101 vs Control and BioPreserve2.0 (Table 3). This same result occurred for lactic acid as well, with acetic acid being higher for Control and BioPreserve2.0 vs the other two treatments. Inoculant-X had more lactic acid as a percentage of total VFA than the other treatments resulting in a higher lactic:acetic ratio for Inoculant-X vs the other treatments. Control had the lowest lactic:acetic ratio.

Digestibility of corn silage is paramount to get the most beef &/or milk per ton of silage or per acre of land. Starch and NDF digestibility were measured (Table 4). Whether at 30 hours or 120 hours, NDF digestibility was very similar among treatments. Undigestible NDF was slightly lower for the inoculated silages vs Control. There was a difference in starch digestion with NB101 having the lowest starch digestibility at 7 hours of fermentation, with Control and Inoculant-X having the highest 7-hour starch digestibility. However, by 12 hours there were similar starch digestibility among the inoculated corn silages with Control being the highest. Based on these digestibility values and the percent starch in each corn silage, the theoretical starch digestibility by 12 hours as far as total pounds of starch consumed would be approximately 4% higher for BioPreserve2.0 vs Control, Inoculant-X, or NB101 due to the difference between the 7-hour and 12-hour starch digestibility. The rate of starch digestion was highest for Control and Inoculant-X and lowest for NB101.

Table 5 contains lab calculated variables and estimates of the energy content of each silage. Milk per ton was highest for Inoculant-X. The RFC fill index is a ratio of the NDF-digestibility and starch content to uNDF or the potential that NDF has at limiting intake due to rumen fill. Having a higher RFC value is related to having more digestibility and allowing for higher DMI. The inoculated silages all had higher RFC vs Control. The lab calculated net energy values were all very similar among silage treatments.

Summary:

Inoculants lowered shrink, increased starch content, increased the ratio of lactic:acetic acid, and had a higher ratio of digestible NDF and starch content relative to undigestible NDF. The potential for quantity of starch digested by 12 hours was highest for BioPreserve2.0 vs Control or the other inoculants in this experiment.

Effect of BioPreserve 2.0 silage inoculant on fermentation profile, nutrient content, and digestibility of corn silage. 2018

Table 1. Initial and final silage weights and shrink.				
Item	Control	BioPreserve2.0	Inoculant-X	NB101
Initial silage weight, lb	581	610	628	588
Final silage weight, lb	569	600	616	577
Difference, lb	12.00	10.00	11.67	11.00
Shrink, %	2.07	1.65	1.85	1.87
Change from Control, %		-20.3	-10.6	-9.66
Change from Inoculant- X, %		-10.8	-	-
Shrink extrapolated to 365 d	10.79	8.58	9.64	9.77

Table 2. Dry matter and nutrient content of the corn silage after 71 days of fermentation.				
Item	Control	BioPreserve2.0	Inoculant-X	NB101
Dry matter, %	32.4	34.9	33.3	34.1
pH	3.94	3.90	3.86	3.90
Crude protein, %	9.07	8.77	9.13	8.60
Ammonia, % of DM	0.62	0.61	0.58	0.61
Ammonia, % of CP	6.75	6.90	6.40	7.13
ADF, %	22.2	20.7	20.6	21.3
NDF, %	36.9	34.9	35.2	36.3
Starch, %	33.70	36.77	35.83	35.53
ADICP, %	0.52	0.51	0.52	0.50
ADICP, % of CP	5.72	5.77	5.67	5.87
Ash, %	4.68	4.60	4.51	4.68

Table 3. Organic acid profile of corn silage after 71 days of fermentation.				
Item	Control	BioPreserve2.0	Inoculant-X	NB101
Total VFA, %	6.27	6.30	6.70	7.03
Lactic acid, %	4.40	4.50	5.10	5.13
Acetic acid, %	1.87	1.79	1.60	1.86
Lactic acid, % of VFA	69.7	71.5	76.1	73.6
Lactic:Acetic	2.34	2.87	3.20	2.92

Table 4. Organic acid profile of corn silage after 71 days of fermentation.				
Item	Control	BioPreserve2.0	Inoculant-X	NB101
NDF digestibility, % at 30h	21.2	20.3	20.1	21.3
NDF digestibility, % at 120h	66.2	66.0	66.9	68.1
uNDF, % at 30h	15.7	15.2	15.0	15.0
Starch digestibility, % at 7h	59.2	54.4	60.1	42.8
Starch digestibility, % at 12h	88.8	84.8	83.0	83.1
Starch digestibility, % at 30h	99.7	99.6	99.6	99.3
NDF digestibility rate, %/h	5.0	5.2	5.2	5.4
Starch digestibility rate, %/h	13.5	12.2	13.9	8.7

Table 5. Calculated milk production and net energy.				
Item	Control	BioPreserve2.0	Inoculant-X	NB101
Milk per ton, lb/ton	3380	3363	3465	3378
NSC, % of DM	45.7	48.7	48.6	47.8
RFC – Fill index	3.50	3.77	3.71	3.79
TDN, %	73.4	74.1	74.6	73.5
NEl, Mcal/lb	0.76	0.76	0.77	0.76
NEm, Mcal/lb	0.78	0.79	0.79	0.78
NEg, Mcal/lb	0.50	0.51	0.51	0.50