Inside the ZONE™

Improved Alfalfa Quality using Pioneer® Inoculant 11AFT

Summary of Findings

- Alfalfa silage inoculated with Pioneer® inoculant 11AFT increased the fiber (B3) digestion rate by 15% compared to the control inoculated with Pioneer® inoculant 11H50.
- Alfalfa silage inoculated with 11AFT achieved a 2-hour quicker time to maximum digestion rate for the fiber (B3) pool compared to control.
- The starch (B1) and soluble fiber (B2) digestion rates of the 11AFT were also increased by 25% over control.
- Alfalfa silage inoculated with 11AFT generated 5.5% higher production of rumen microbial biomass production and 9.7% higher organic matter disappearance when compared to the control.
- The increase in carbohydrate pool digestion rates are consistent with previous research on the effect of the enzyme-producing *L. buchneri* strain in 11AFT.
- Improved carbohydrate digestion rates should allow for more energy derived from alfalfa silage, especially in high producing animals with a rapid rate of feed passage. It may also allow for ration manipulation to lower protein levels due to increased rumen microbial biomass yields.

Trial Design

In 2013, a vacuum-bag field test was conducted on two central New York dairy farms to evaluate the effect of Pioneer® inoculant 11AFT on relatively high NDF/low quality 2nd cutting alfalfa compared to Pioneer ® inoculant 11H50.

On each of the two cooperative farms, 11H50 was applied to a windrow during harvest and a garbage bag was filled with (control) alfalfa from that windrow. An adjacent windrow was then chopped and inoculated with 11AFT and a garbage bag was filled with alfalfa from that (treatment) windrow. Using a FoodSaver® vacuum sealer, four 4-pound vacuum-sealed bags were made for each windrow from each farm. The mini silos were left to ferment for 90 days to fully allow for the enzymatic activity of the 11AFT to be completed. Treatment and control bags were sent for NIR analysis at Dairyland Laboratories, Inc. (Arcadia, WI) and for Fermentrics™ gas production analysis at RFS Technologies (Ottawa, Canada).

Results

Average nutritional, fermentation and digestion rate values from the two locations are shown in Table 1.

Table 1. Nutrition and Fermentation Averages from Two Cooperative Dairy Farm Alfalfa Silage Samples

	Pioneer® inoculant 11AFT	Pioneer® inoculant 11H50	Average Difference	% Increase
Nutritional – Dairyland NIR Analysis				
Moisture	61.5	58.4	3.07	
Dry Matter	38.5	41.6	-3.07	
Crude Protein, %DM	18.6	17.9	0.71	
Adj. Crude Protein, %DM	17.0	16.3	0.70	
Bound Protein %ADIN/%TN	8.7	9.1	-0.38	
Soluble Protein, %CP	55.4	52.2	3.22	
ADF, %DM	40.7	39.2	1.45	
NDF, %DM	48.9	48.3	0.59	
Lignin, %DM	8.7	8.2	0.49	
NE-L, (Mcal/lb DM)	0.56	0.57	-0.01	
Ash, %DM	9.9	9.7	0.19	
Fat, %DM	3.5	3.5	-0.03	
Sugar, %DM	2.2	2.4	-0.28	
NFC, %DM	21.1	22.5	-1.44	
RFV	109	112	-3.65	
RFQ	90	101	-11.06	
Digestion – Dairyland NIR Analysis				
% NDFD (24-hour, %NDF)	31.4	35.6	-4.27	
Digestion – Fermentrics™ Gas Fermentation Analysis				
Starch (C:B1) Pool Kd, %/h	16.7	12.6	4.10	25%
Soluble Fiber (C:B2) Pool Kd, %/h	35.5	26.8	8.73	25%
Slow (C:B3) Pool Kd, %/h	3.97	3.40	0.58	15%
Fast (C:B1) Pool, time to max rate, hrs	1.50	2.00	-0.50	30 min
Slow (C:B3) Pool, time to max rate, hrs	13.5	15.5	-2.00	2 hours
Organic Matter Disappearance, %	48.5	44.1	4.34	9.7%
Microbial Biomass Production, mg/g	152	144	8.00	5.5%
Fermentation – Dairyland NIR Analysis				
pH	4.53	4.40	0.13	
Lactic acid %DM	3.97	5.35	-1.38	
Acetic acid %DM	1.92	0.96	0.96	
Ammonia nitrogen, %CP	6.33	5.24	1.10	

Fermentation comparisons were as expected from silage inoculated with a more traditional homofermentative product (11H50) compared to the 11AFT treatment containing a proprietary enzyme-producing *L. buchneri* strain. Both treatments reached an efficient and acceptable terminal pH (< 4.6), evidenced by high lactic acid and low levels of ammonia nitrogen. The differences in fermentation profiles are due to the *L. buchneri* strain in the 11AFT converting lactic acid to acetic acid resulting in a slightly higher pH typical of a buchneri fermentation.

The 11H50 treatment did show a higher 24-hour NDFD as measured by NIR. This is not unexpected given the variability around NIR determination of NDFD (2-3 percentage points). Further, previous research with 11AFT has documented that current NIR calibrations and commonly available *in vitro* (test tube) methods do not have the sensitivity to predict the NDFD and digestion rate (Kd) improvements that have been proven with *in vivo* (live animal) feeding trials with the Fiber Technology portfolio of inoculants (Pioneer® inoculants 11AFT, 11CFT and 11GFT). These inoculants produce enzymes as the strains grow in the silage which cause physio-chemical changes in cell wall polysaccharide-lignin linkages, while not altering the quantity of lignin or fiber in the silage. Rumen bacteria recognize this change and digest the decoupled polysaccharides at a faster rate and often to a greater extent. Labs utilizing gas-production methods (e.g. Fermentrics™ analysis) have been able to detect the effects of these Fiber Technology products in modifying carbohydrate pool (e.g. B1, B2 and B3) digestion rates.

The Fermentrics analysis in Table 1 shows that 11AFT did numerically improve the rate of digestion for all three of the carbohydrate pools (B1, B2, B3), reduced the time it took to reach the maximum rate of digestion for the B1 and B3 pools, improved organic matter disappearance and improved rumen microbial biomass yields.

Potential Ration Impact of Pioneer® inoculant 11AFT

Direct measurement of digestion via Fermentrics analysis allows nutritionists to adjust rations and reduce concentrate and/orprotein supplementation based on altered, B-pool digestion rates.

More sophisticated ration software can be used to predict production increases from improved carbohydrate (B-pool) digestion rates in 11AFT inoculated silages.

Table 2 shows the results of a diet formulated in CNCPS (V 6.1.36.0) balanced for 90 pounds of milk and 3.6% fat with cows fed seven pounds DM from alfalfa silage entered into the feed library software with the digestion rates reported in Table 1 for the two treatments in this field trial.

Table 2. Ration Impact of Inoculating Alfalfa Silage with 11AFT Compared to 11H50

CNCPS (V. 6.1) Predictions from diet containing 7 lbs DM alfalfa silage 20 lbs DM corn silage	Balanced with 11H50 Alfalfa Silage Digestion Rates	Balanced with 11AFT Alfalfa Silage Digestion Rates
ME Milk (lb)	84.49	84.71 (+0.22 lb)
MP Milk (lb)	92.34	92.89 (+0.55 lb)
Microbial Protein (g)	1359	1370 (+11g)

Increasing the B1, B2 and B3 digestion rates due to the effect of 11AFT predicted a 0.2 lb increase in milk yield from a metabolizable energy (ME) perspective and 0.55 lbs more milk from a metabolizable protein (MP) perspective. This is the milk potential per cow for an additional investment of about three cents to inoculate the seven pounds DM (~20 lbs as fed) with 11AFT rather than a more conventional homofermentative inoculant.

Conclusion

Weather affecting growing conditions and possible harvest delay can prevent farmers from an ideal cutting schedule resulting in low forage quality. Increasing carbohydrate digestion rate and improving rumen microbial yields can be a possible benefit of inoculating with 11AFT, in addition to improved fermentation efficiency and bunklife.