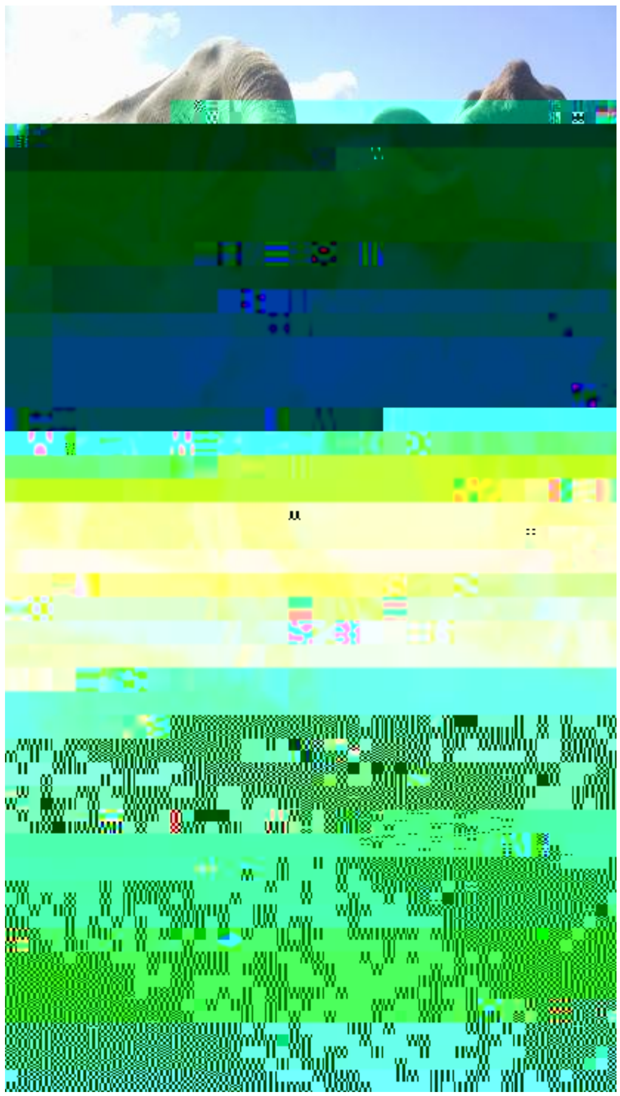
2016 Pasture Productivity Trial



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2016 PASTURE PRODUCTIVITY TRIAL

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Pasture is an essential component of the ration on organic dairy farms. Productivity of pastures is key to ensure the cattle have a plentiful source of high quality feed during the entire grazing season. Optimal management of pastures should include animal, plant, and soil factors. This project aims to identify weak links in the pasture system and evaluate the impact of adopting new strategies to overcome barriers to productivity. In this case, soil fertility was identified as the primary weak link to productivity.

The pasture where this research took place was seeded to grass about 30 years ago and prior to that had been used for corn silage

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Soil nitrate-N samples were taken prior to the first, fourth, and sixth grazing cycle. Rising plate meter measurements were recorded before and after each grazing cycle in order to evaluate the quantity of pasture grazed. Pasture plots were sampled by clipping the contents within two 0.5 m^2 quadrats per plot just before each grazing cycle to determine biomass yield and quality. Samples were dried until they reached a stable weight and then sent to Dairy One Forage Laboratory (Ithaca, NY) for wet chemistry analysis of crude protein (CP), net energy lactation (NE_L), relative feed value (RFV), and neutral detergent fiber (NDF), and calcium, phosphorus, magnesium, potassium, and sodium concentrations on a dry matter basis.

The bulky characteristics of forage come from fiber. Forage relative feeding values (RFV) are negatively associated with fiber since the less digestible portions of plants are contained in the fiber fraction. The detergent fiber analysis system separates forages into two parts: cell contents, which include sugars, starches, proteins, non-protein nitrogen, fats and other highly digestible compounds; and the less digestible components found in the fiber fraction. The total fiber content of forage is contained in the neutral detergent fiber (NDF). This fraction includes cellulose, hemicellulose, and lignin. Because these components are associated with the bulkiness of feeds, NDF is closely related to feed intake and rumen fill in cows.

Net energy of lactation (NE_L) is calculated based on concentrations of NDF and acid detergent fiber. NE_L can be used as a tool to determine the quality of a ration. However, it should not be considered the sole indicator of the quality of a feed as NE_L is affected by the quantity of a cow's dry matter intake, the speed at which her ration is consumed, the contents of the ration, feeding practices, the level of her production, and many other factors.

Results were analyzed with an analysis of variance in SAS (Cary, NC). The Least Significant Difference (LSD) procedure was used to separate cultivar means when the F-test was significant ($p < 0.10$).

Variations in yield and quality can occur because of variations in genetics, soil, weather and other growing conditions. Statistical analysis makes it possible to determine whether a difference among varieties is real, or whether it might have occurred due to other variations in the field. At the bottom of each table, a p-value is presented for each variable (i.e. yield). The p-value represents the probability that there was an effect from the treatment. The lower the p-value, the greater the probability that the treatment had an effect on the variable (i.e. yield).

Also at the bottom of each table, a LSD value is presented for each variable (i.e. yield). Least Significant differences (LSD's) at the 10% level of probability are shown. Where the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two varieties. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. In the following example, A is significantly different from C but not from B. The
/P <</MCID 6>BDC q0.00000912 0 612 792 re9bc2d/P <</MC,t not from B. The

LSD value of 2.0. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that B was not significantly lower than the top yielding variety.

Variety	**Yield**
A	6.0
B	7.5*
C	9.0*
LSD	**2.0**

RESULTS AND DISCUSSION

Seasonal precipitation and temperature were recorded with a Davis Instrument Vantage Pro2 weather

Table 5. Trial 1 Pasture yield and quality comparing fertilizer treatments, across all grazing cycles, St. Albans, Vermont, 2016.

Fertility treatment	Yield	CP		NDF	NE_L	RFV
	lbs ac^{-1}	% of DM	Rank	% of DM	Mcal lb^{-1}	

Table 7. Trial 1 Pasture nutrient concentration comparing fertilizer treatments, across all grazing cycles, St. Albans, VT, 2016.

Treatment	Calcium	Phosphorus	Magnesium	Potassium	Sodium	
	% of DM	% of DM	% of DM	% of DM	% of DM	Rank
SN	0.784	0.398	0.311	1.99		

Similarly, pasture nutrient concentration was generally best during the 5th

LSD	121	NS	2.11	NS	5.67
Trial mean	1240	21.6	49.7	0.623	120

*Treatments marked with an asterisk were not statistically different than the top performing treatment shown in **bold** (p=0.10).
Treatments with the same letter did not perform statistically different from each other
NS – There was no statistical difference between treatments in a particular column (p=0.10).

There was a significant interaction between treatment and grazing cycle for CP (p-value = 0.108) (Figure 1). The SN treatment alone was the top performer for the 3rd and 4th month of grazing, which was statistically significant. However, during the 3rd month of grazing, results were comparable to the control.

The SN and SN + PM treatments may have performed better than the control during the 4th month (26-Jul – 23-Aug) because fertilizer treatments were applied during that cycle, on 5-Aug. The month of August received 3.0 inches of rainfall and that additional moisture is needed by microbial communities for decomposing organic forms of fertilizer, such as the PM. The SN is already plant available, however, that fertilizer needs moisture to become accessible by plants. Therefore, the increased moisture in August may have aided in making the fertilizers more plant available and affected the CP quality. The fertilizers would have provided N, which is directly needed in protein.

Figure 1. Trial 2 The effect of fertilizer treatment and grazing cycle on crude protein (significantly different in July and August, p=0.10), St. Albans, VT, 2016.

It was possible that the dairy cattle would have preferentially grazed the plots containing SN, as they may have been attracted to the salt, however, there was no significant difference in quantity grazed between treatments (Table 11).

Table 11. Trial 2

SN + PM	466	1.96
Control	558	2.45
p-value	0.456	0.347
LSD	NS	NS
Trial mean	546	2.37

NS – There was no statistical difference between treatments in a particular column (p=0.10).
Quantity grazed refers to the amount of pasture consumed, measured before and after grazing.
Height difference refers to the difference in pasture height, measured before and after grazing.

The fertilizer treatments did not consistently outperform the control for pasture nutrient concentrations (Table 12). Again the treatments were primarily applied to meet N needs of the pasture so an increase in other nutrients would not be expected. Interestingly the sodium content of SN treatments was significantly higher than the other treatments.

Table 12. Trial 2 Pasture nutrient concentration comparing fertilizer treatments, across all grazing cycles,
StW* n nBF3 9.96 Tf1 0 0 1 150.74 490.15 Tma2a2a2a2a2ncentratncentra fertilizer 17.79 586.3 Tm0 gcycles,

NS

Table 13. Trial 2 Pasture yield and quality comparing grazing cycles, across all treatments, St. Albans, VT, 2016.

Grazing cycle	Yield	CP	NDF	NE_L	RFV
	lbs ac^{-1}	% of DM	% of DM	Mcal lb^{-1}	
1-May 1-Jun	1770	18.3	52.3	0.570	105
2-Jun 23-Jun	1190	18.9	54.8	0.593	105
24-Jun 25-Jul	876	20.4	50.3	0.625	121
26-Jul 23-Aug	1020	24.3*	48.5	0.639*	123
24-Aug 28-Sep	**2070***	**25.5***	46.8*	0.650*	129
29-Sep 30-Oct	567	22.5	**45.2***	**0.659***	**138***
p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

The crop nutrient recommendations based on the soil test appear in Table 15. In general, the highest amount of N applied came from the SN+PM treatment. It should be noted that although the PM application contained 71 lbs ac^{-1} of actual N, only roughly one third of that total would be plant available in the first year. Hence, the crop likely received approximately 60 additional lbs of N ac^{-1}. This was still double that applied as SN or PM alone. It makes sense that this combined treatment would likely provide a yield and quality boost to the pasture.

Table 15. Nutrient balance from the sodium nitrate treatment, St. Albans, Vermont, 2016.

		Nitrogen	Phosphorus	Potassium
		lbs ac^{-1}	**lbs ac^{-1}**	**lbs ac^{-1}**
Soil test recommendation	**Pasture, intensive grazing**	100	25	140
Nutrients supplied	**SN treatment**	29.0	0	0
Nutrient balance	**SN treatment**	-71.0	-25	-140
Nutrients supplied	**PM treatment**	71.9	57.5	43.1
Nutrient balance	**PM treatment**	-28.1	+22.5	-96.9
Nutrients supplied	**SN + PM treatment**	100.9	57.5	43.1
Nutrient balance	**SN + PM treatment**	+0.9	+22.5	-96.9

With pelletized PM priced at \$0.25 lb^{-1} and SN priced at \$0.53 lb^{-1}, the price to fertilize per acre is listed in Table 16. The cost per pound of applied N is \$3.31 for SN, \$5.00 for PM, and \$4.51 for SN+PM. Some of these fertilizer treatments may be feasible for pasture-based dairy farmers, however, one also needs to consider the amount of time taken to apply the fertilizer and one would want to verify the potential benefit sources in organic systems may outweigh the benefit realized from the application. In this study, a small