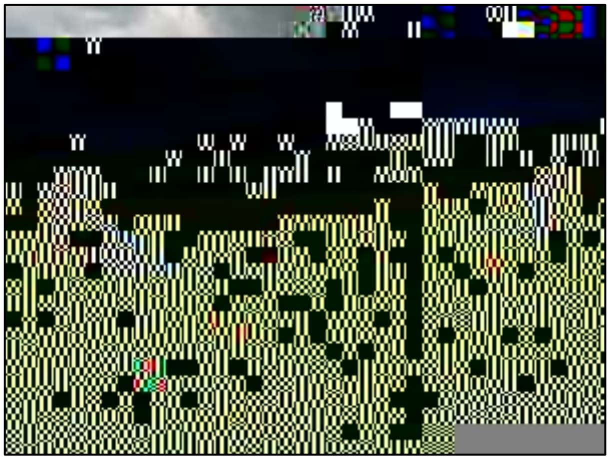
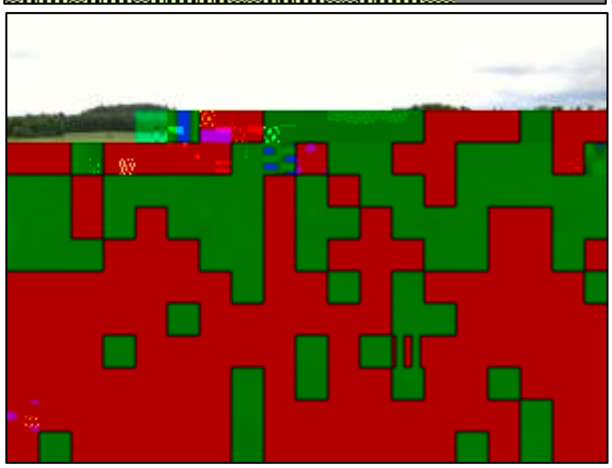
Enhancing Forages with Nutrient Dense Sprays Final Report





Dr. Heather Darby, UVM Extension Agronomist
Susan Monahan, UVM Extension Crops and Soils Technician

Visit us on the web: http://www.uvm.edu/extension/cropsoil

ENHANCING FORAGES WITH NUTRIENT DENSE SPRAYS-FINAL REPORT

Dr. Heather Darby, University of Vermont Extension
Heather.Darby[at]uvm.edu

The purpose of the Nutrient Dense Spray (NDS) trial was to evaluate the impact of nutrient dense foliar sprays on perennial forage yield, quality, and fatty acid concentrations. The nutrient spray program was developed by Advancing Eco-

TAG/mL acetone), 2 mL of toluene, and 2 mL of 2% methanolic H_2SO_4 acid were added to 500 mg of ground feed composites samples. The solution was heated at 50°C overnight. After cooling the samples to room temperature, 5 mL of 6% $KHCO_3$ solution and 1 mL of hexane were added. The samples were mixed and centrifuged at 500 x *g* for 5 min. The resulting hexane layer was dried and cleaned over a mixture of Na_2SO_4 and charcoal. An aliquot of the solution, containing the fatty acid methyl esters (FAME), was taken for GLC analysis. The analysis of FAME extracts was performed on a GC-2010 gas chromatograph (Shimadzu, Kyoto, Japan) equipped with a split injector, a flame ionization detector, an autosampler (model AOC-20s; Shimadzu), and a 100 m CP-Sil 88 fused-silica capillary column (100 m × 0.25 mm i.d

maintained at 250°C. Hydrogen was used as carrier gas at a linear velocity of 30 cm/sec. The sample injection volume

ram used was: initial temperature of 45°C held for 4 min, programmed at 13°C/min to 175°C held for 27 min, then programmed at 4°C/min to 215°C held for 35 min. Integration and quantification was based on the FID response and achieved with GC solution software (version 2.30.00, Shimadzu,

RESULTS AND DISCUSSION

Seasonal precipitation and temperature recorded at weather stations in close proximity to Westfield and Shelburne, VT from 2012 to 2014 are reported in Tables 4-6. In 2012, the temperature and precipitation in Westfield was close to the 30-year average. There were a total of 5530 GDD (growing degree days), 134 GDD above average. May, August and October were warmer than average in Westfield, with less rain in July and August. In Shelburne, monthly temperatures were above the 30-year average every month of the growing season. There were a total of 6488 GDD, 639 GDD above average. Warmer temperatures in Shelburne resulted in earlier harvests of 2nd and 3rd cut hay.

Table 4. Seasonal weather data collected near Westfield and Shelburne, VT, 2012.

Westfield*	Apr	May	Jun	Jul	Aug

Shelburne*	Apr	May	Jun	Jul	Aug	Sep	Oct
Average Temperature (F)	44.8	60.7	66.5	73.8	69.4	60.2	51.7
Departure from Normal	0.0	4.3	0.7	3.2	0.6	-0.4	3.5
Precipitation (inches)	2.05	8.74	9.86	4.49	3.07	4.74	2.59
Departure from Normal	-0.77	5.29	6.17	0.34	-0.84	1.10	-1.01
Growing Degree Days (base 32)	383	890	1034	1253	1161	846	609
Departure from Normal	-1	133	20	54	22	-12	107

*Data compiled from Northeast Regional Climate Center data from weather stations in Newport, VT and Burlington, VT. Historical averages for 30 years of NOAA data (1981-2010).

In 2014, the temperature in Westfield was below the 30-year average for the growing season, while precipitation was above average. There were a total of 4694 GDDs, which is 222 GDDs below the average. In Shelburne, monthly temperatures were above the 30-year average for every month of the growing season except April. There were a total of 5567 GDDs, 226 GDDs above average. Warmer temperatures in Shelburne contributed to the earlier harvests of hay. There was over 3 inches of precipitation above the 30-year normal for April through July. However, August and September were dry, almost 4 inches below than the 30-year normal.

Table 6. Seasonal weather data collected near Westfield and Shelburne, VT, 2014.

Table 7. Yield and quality of forages treated with Nutrient Dense Sprays, averaged across 3 years and 2 locations.

We analyzed over 542 forage samples to determine the fatty acid profile and concentration for this study. Overall, there were no interactions of the treatments by cut, and only two interactions of the treatments by environment (for concentration of mono-unsaturated fatty acids (MUFA) (Figure 1) and saturated fatty acids (Figure 2). Interestingly the forage FA concentrations parameters showed little response NDS treatments with the exception of BF 2012 where the All, Potassium, Rejuvenate, and PhotoMag treatments increased MUFA and SFA concentrations significantly. It is unclear why the NDS treatments resulted in a positive response in this year only and why the levels were so much higher compared to other site-years. In 2012, below average precipitation and above average temperatures may have been a contributor to this response. Since only two interactions were observed in the analysis, the data was analyzed across site-years.

There were no significant differences in forage fatty acids (FA) based on the NDS treatments (Table 10). Only the concentration of saturated fatty acids (SFA) and MUFAs were significantly different by treatment; however these dependent variables also had a treatment by environment effect. The level of Omega-3 FAs did not differ among treatments. Overall, we were surprised to not see an effect from the NDS treatments. Potentially, the reasons could be that the sites chosen for this study were already sufficiently high in nutrients and therefore additional applications did not make a difference, or perhaps, the NDS

Because the NDS regime did not have a significant effect on yield or quality in the first years of the study, we sent samples to Cumberland Valley Analytical Services for wet chemistry analysis of minerals. Wet chemistry is considered more accurate for detecting small differences in samples. There were no significant differences of the micronutrient levels of the 2012 forages at Butterworks Farm (Table 13). At Shelburne Farms, there were some differences detected. Interestingly, t phorus concentrations than the Control (Table 14). More in line with If funds were available it would have been good to evaluate mineral content during all years of the project. It is likely that minerals would have increased over time due to repeat applications of the NDS treatments.

Table 13. Micronutrient content of forages at Butterworks Farm, VT.

Treatment	Ash	Calcium	Phosphorus	Magnesium	Potassium	Sodium	Iron	Manganese	Zinc	Copper
	%	%	%	%						

Table 15. Hay yield and quality of large strip plots, Westfield, VT, 2014.

Treatment	DM yield	CP	Starch	ADF	NDF	NFC	NDFD
	lbs. acre^{-1}	%	[redacted]	%	%	%	%

Profile O-6	19.4	19.2	19.3	NS
Conc O-6	5.6	5.5	5.5	NS
Conc Total FA	26.1	26.6	26.4	NS
Ratio O-6:O-3	0.4	0.4	0.4	NS

NS Not Significant, none of the variables were significantly different from one another.

Interestingly, while there was no significant difference in the All vs. Control big strip plots at Butterworks Farm, there were many differences at Shelburne Farms (Table 18). The All treatment of the NDS resulted in higher profiles of C16 FA and SFAs. Otherwise, the Control had higher levels of C18:2 FA, MUFAs, PUFAs, Omega-6 FAs and Total FAs. Again a further look at NDS applications on larger research areas would be important to understand the ability of these sprays to increase fat content of forages.

Table 18. Fatty Acid Profile (%) and Concentration (mg/g) of All and Control Treatments at Shelburne Farms, 2014.

	All	Control	Trial mean	LSD ($p<0.10$)
Profile C16	**22.4***	21.3	21.8	0.6

CONCLUSION

Farmers are interested in strategies that will help them improve the yield and quality of their perennial forages. In particular, farmers would like to see forages packed with nutrients to help improve cattle health, nutrition, and ultimately reduce the purchase of off-farm concentrates. Applying foliar fertility has been identified as a means to improve nutrient density of crops. Many farms in the region have been interested in learning more about the benefits of these types of amendments. Although this experiment was conducted over 3 years, it was difficult to identify the benefits to using foliar fertility on perennial forages. The weather, baseline soil fertility, and size of plots appeared to heavily influence project results. The inability to also use wet chemistry techniques to look at mineral content of the forages may have also limited our ability to pick-up statistical differences among the treatments. Lastly, it is unclear if and what timing might be best for application of these types of amendments. As an example, in some cases first harvest responded more favorably to NDS treatments. More research should be conducted to understand the potential benefits of these types of foliar amendments.

ACKNOWLEDGEMENTS

The UVM Extension Northwest Crops and Soils team would like to thank Butterworks Farm and Shelburne Farms for hosting these trials, and Conner Burke, Lily Calderwood, Julija Cubins, Erica Cummings, Abha Gupta, Hannah Harwood, Ben Leduc, Lauran Madden, Julian Post, and Dana Vesty for their assistance with data collection and entry. Special thanks to the Lattner Foundation for funding this research.

UVM Extension helps individuals and communities put research-based knowledge to work.