Enhancing Forages with Nutrient Dense Sprays 2013 Trials

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ENHANCING FORAGES WITH NUTRIENT DENSE SPRAYS, 2013 TRIALS

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The nutrient dense study was continued at two locations in Vermont during the 2013 growing season to evaluate the efficacy of amending forages with foliar sprays. The nutrient spray program was developed by Advancing Eco-Agriculture and consisted of five foliar sprays for the farms in this study. The recommended spray program included applications of Rejuvenate in the early spring and late fall, and a combination of PhotoMag, Phosphorus, Potassium and MicroPak applied in the spring and after each cut of hay or graze (Table 1). This study was conducted based on farmer interest in enhancing nutrient density of forages through foliar sprays and was funded by the Lattner Foundation. Any reference to commercial products, trade names or brand names is for information only, and no endorsement or approval is intended.

Table 1. Information on Advancing Eco-Agriculture nutrient dense sprays.[1]

Spray	What is it?	What does it do?
Rejuvenate	humic substance, carbohydrates, sea minerals	stimulates soil microbial life
PhotoMag	magnesium, sulfur, boron, cobalt, sea minerals	promotes chlorophyll and sugar production
Phosphorus	mined phosphate ore	improves photosynthesis and plant root vigor
Potassium	mined potassium sulfate	improves storability
MicroPak	boron, zinc, manganese, copper, cobalt, molybdenum, sulfur	enhances sugar translocation, root strength, and plant immunity

[1]Information gathered from the Advancing Eco-Agriculture website: growbetterfood.com.

MATERIALS AND METHODS

In 2013, forages were amended with nutrient dense sprays at two locations: Shelburne Farms in Shelburne, VT and Butterworks Farm in Westfield, VT. Both hayfields had been in native grass/legume mixture for numerous years. The nutrient recommendations from Advancing Eco-Agriculture are listed in Table 2. In order to understand what may cause a response, if any, we compared the recommended spray regime ('All') to individual components, as well as a control of water. The experimental design was a randomized complete block with four replications.

Table 2. Timing and amount of Nutrient Dense Sprays used.

Timing	Recommendations (per acre)
Early Spring	3 tons compost, 20 lb. Borate (10%), and 5 lbs. Zinc sulfate, 2 gallons Rejuvenate
After Each Cut	1 gallon PhotoMag, 1 gallon Phosphorus, 1 quart Potassium, 2 quarts MicroPak
Fall, post harvest	6 quarts Rejuvenate, 2-3 tons compost

Six by ten foot plots were established in existing hay fields in 2012. The same plots were used for the 2013 study. Harvest and spray dates for each location are listed in Table 3. Plots were harvested with a BCS sickle bar mower (Portland, OR), raked by hand, gathered and weighed on a platform scale. A subsample was dried at 40^{o} C and weighed to determine dry matter. Oven dry samples were coarsely ground with a Wiley mill (Thomas Scientific, Swedesboro, NJ), finely ground with a UDY cyclone mill with a 1 mm screen (Seedburo, Des Plaines, IL) and analyzed with an NIRS (Near Infrared Reflectance Spectroscopy) DS2500 Feed and Forage analyzer (Foss, Eden Prairie, MN) at the University of Vermont Cereal Testing Lab (Burlington, VT). Results were analyzed with an analysis of variance in SAS (Cary, NC).

Table 3. Harvest and spray dates at each location.

Treatment	Butterworks Farm	Shelburne Farms
Spray Rejuvenate	1-May	30-Apr
Spray All Treatments	1-May	30-Apr
1st Cut	4-Jun	22-May
Spray All Treatments	12-Jun	30-May
2nd Cut	3-July	18-Jun
Spray All Treatments	16-Jul	2-Jul
3rd Cut	9-Aug	6-Aug
Spray All Treatments	20-Aug	19-Aug
Spray Rejuvenate	3-Oct	1-Oct

Forage samples were dried, ground and analyzed for quality characteristics including crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF) and various other nutrients. The Nonstructural Carbohydrates (NSC) were calculated from forage analysis data. Mixtures of true proteins, composed of amino acids and non-protein nitrogen make up the crude protein (CP) content of forages. The bulky characteristics of forage come from fiber. Forage feeding values are negatively associated with fiber since the less digestible portions of the plant 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). Chemically, this fraction includes cellulose, hemicellulose and lignin. Recently, forage testing laboratories have begun to evaluate forages for NDF digestibility. Evaluation of forages and other feedstuffs for NDF digestibility is being conducted to aid prediction of feed energy content and animal performance. Research has demonstrated that lactating dairy cows will eat more dry matter and produce more milk when fed forages with optimum NDF digestibility. Forages with increased NDF digestibility (NDFD) will result in higher energy values, and perhaps more importantly, increased forage intakes. Forage NDF digestibility can range from 20 – 80%. The NSC or non-fiber carbohydrates (NFC) include starch, sugars and pectins.

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 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 example below, A is significantly different from C but not from B. The difference between A and B is equal to 1.5 which is less than the LSD value of 2.0. This means that these varieties did not differ in yield. The difference between A and C is equal to 3.0 which is greater than 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 recorded at weather stations in close proximity to Westfield and Shelburne, VT are reported in Table 4. The temperature and precipitation in Westfield was close to the 30-year average. There were a total of 5243 GDDs (growing degree days), 112 GDDs below average. May, July, and October were warmer than average in Westfield, with substantially more rain in May, June, July and September. In Shelburne, monthly temperatures were above the 30-year average every month of the growing season except September. There were a total of 6176 GDDs, 323 GDDs above average. Warmer temperatures in Shelburne contribute to the earlier harvests of hay. In May and June, it rained about 6 inches more than normal in Westfield and 11.5 inches more than normal in Shelburne.

Table 4. Seasonal weather data collected near Westfield and Shelburne, VT, 2013.

Westfield*	April	May	June	July	August	Sept	Oct
Average Temperature (F)	39.4	55.7	62.2	69.3	64.6	56.5	47.4
Departure from Normal	-3.2	0.9	-1.6	1.3	-1.5	-1.8	1.0
Precipitation (inches)	2.78	6.53	7.08	7.29	2.78	6.79	2.46
Departure from Normal	-0.03	2.86	3.12	2.96	-1.83	3.41	-1.64
Growing Degree Days (base 32)	221	736	906	1156	1012	735	477
Departure from Normal	-102	26	-48	84	-45	-56	29

Shelburne*	April	May	June	July	August	Sept	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).

At Butterworks Farm in Westfield, VT, there was no statistical difference in yield among the nutrient dense sprays for first, second or third cut hay (Tables 5-7). First cut yields were similar to 2012 yields, however 2nd and 3rd cut yields were much lower than the previous year's yields, averaging about 1000 lbs DM acre^{-1} each (Figure 1), where 2012 yields averaged 2200 and 1400 lbs acre^{-1}, respectively (see 2012 Nutrient Dense Spray Report). Crude protein generally increased with each cut (Figure 2) averaging 17.7% for 1st cut, 21.0% for 2nd cut, and 22.8% for 3rd cut. The first cut Phosphorus treatment had the lowest NDF, however it was only significantly different than one treatment (Table 5). Overall, there were no differences in yield or quality of the hay harvests at Butterworks Farm from the nutrient dense sprays.

Table 5. First cut hay yield and quality, Westfield, VT, 4-Jun 2013.

Treatment	DM Yield lbs. acre^{-1}	CP %	Starch %	ADF %	NDF %	NFC %	NDFD %
All	2161	18.1	2.0	27.8	53.5*	27.8	36.7
Control	2256	17.6	1.8	29.2	55.8*	26.3	35.5
MicroPak	2105	17.6	2.0	28.4	54.4*	27.6	35.7
Phosphorus	2086	18.1	2.0	27.6	**53.5***	28.3	36.9
PhotoMag	2114	17.7	2.0	28.0	53.6*	28.0	36.0
Potassium	2124	18.2	1.9	28.7	55.0*	26.6	35.8
Rejuvenate	2303	16.8	1.7	29.2	57.8	26.2	36.2
Trial Mean	2164	17.7	1.9	28.4	54.8	27.2	36.1
LSD (p<0.10)	NS	NS	NS	NS	2.64	NS	NS

*Varieties with an asterisk indicate that it was not significantly different than the top performer in column (in **bold**).
NS - None of the varieties were significantly different from one another.

Table 6. Second cut hay yield and quality, Westfield, VT, 3-Jul 2013.

Treatment	DM Yield lbs. acre^{-1}	DM %	CP %	Starch %	ADF %	NDF %	NFC %	NDFD %
All	1087	13.0	20.7	1.9	26.2	52.9	26.2	40.7
Control	1023	13.7	21.2	1.6	26.0	53.3	25.9	39.7
MicroPak	1081	13.8	21.4	2.0	25.6	51.6	27.1	38.9
Phosphorus	1070	12.3	21.1	2.1	26.5	52.2	26.9	38.4
PhotoMag	1070	13.5	21.1	2.1	25.2	50.9	27.7	37.9
Potassium	1051	13.0	20.4	2.0	25.5	52.3	27.1	39.7
Rejuvenate	1060	13.9	21.0	1.8	25.9	52.7	26.6	38.1
Trial Mean	1063	13.3	21.0	1.9	25.8	52.3	26.8	39.1
LSD (p<0.10)	NS	NS	NS	NS	NS	NS	NS	NS

NS - None of the varieties were significantly different from one another.

Table 7. Third cut hay yield and quality, Westfield, VT, 9-Aug 2013.

Treatment	DM Yield lbs. acre^{-1}	DM %	CP %	Starch %	ADF %	NDF %	NFC %	NDFD %
All	998	13.1	23.0	1.4	25.9	49.8	26.8	36.9
Control	1070	14.2	23.3	1.7	25.9	51.8	26.7	35.2
MicroPak	1059	14.6	21.9	1.4	26.5	51.5	27.0	38.9
Phosphorus	886	12.8	22.9	2.0	25.4	49.7	28.0	33.8
PhotoMag	945	13.3	22.3	1.5	25.7	51.0	27.5	37.3
Potassium	1090	14.0	22.8	1.6	25.6	50.3	27.3	36.4
Rejuvenate	1007	13.2	23.3	1.4	25.9	50.0	26.6	36.3
Trial Mean	1008	13.6	22.8	1.6	25.8	50.6	27.1	36.4
LSD (p<0.10)	NS	NS	NS	NS	NS	NS	NS	NS

NS - None of the varieties were significantly different from one another.

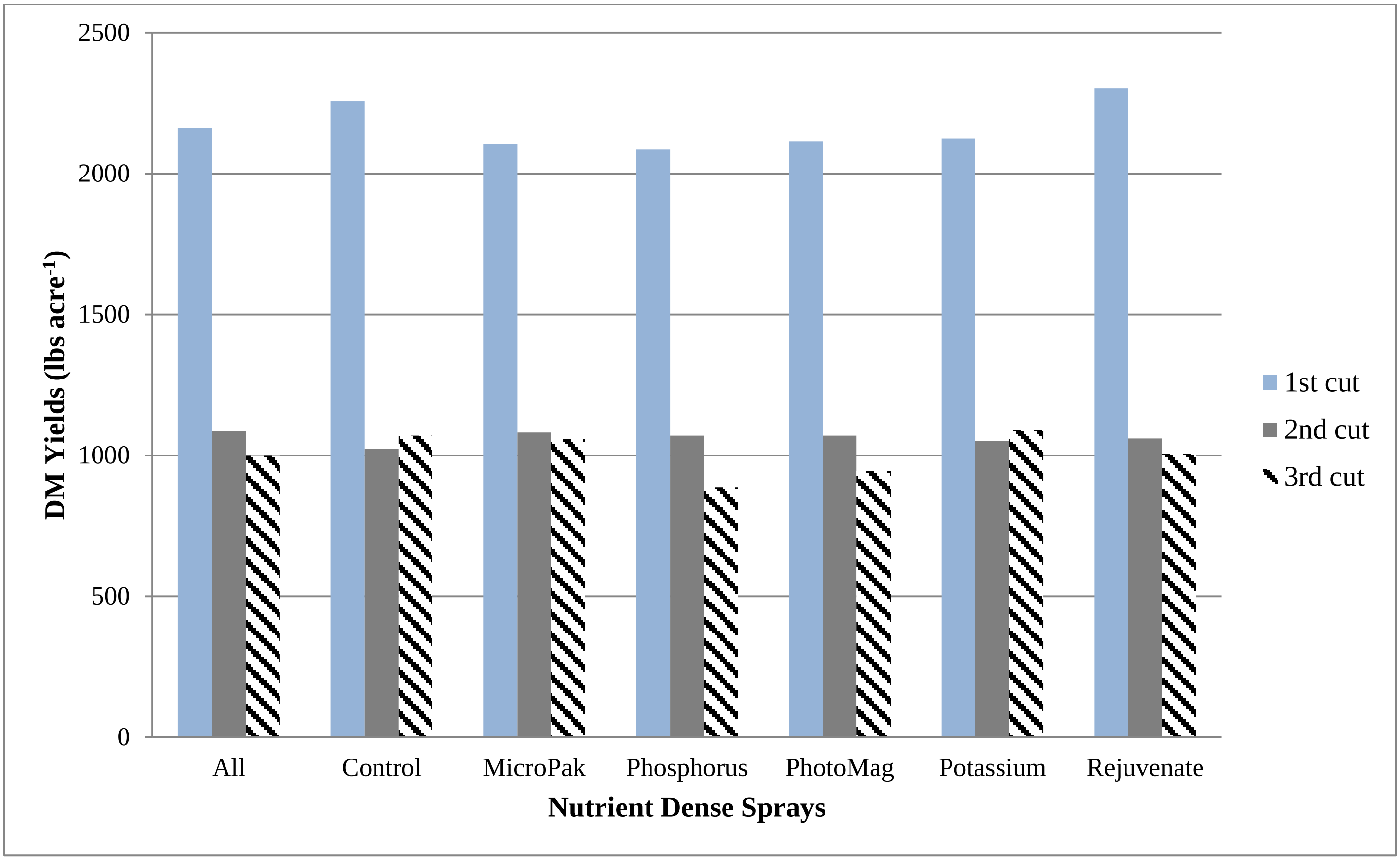

Figure 1. First, second and third cut dry matter yields, Westfield, VT, 2013.

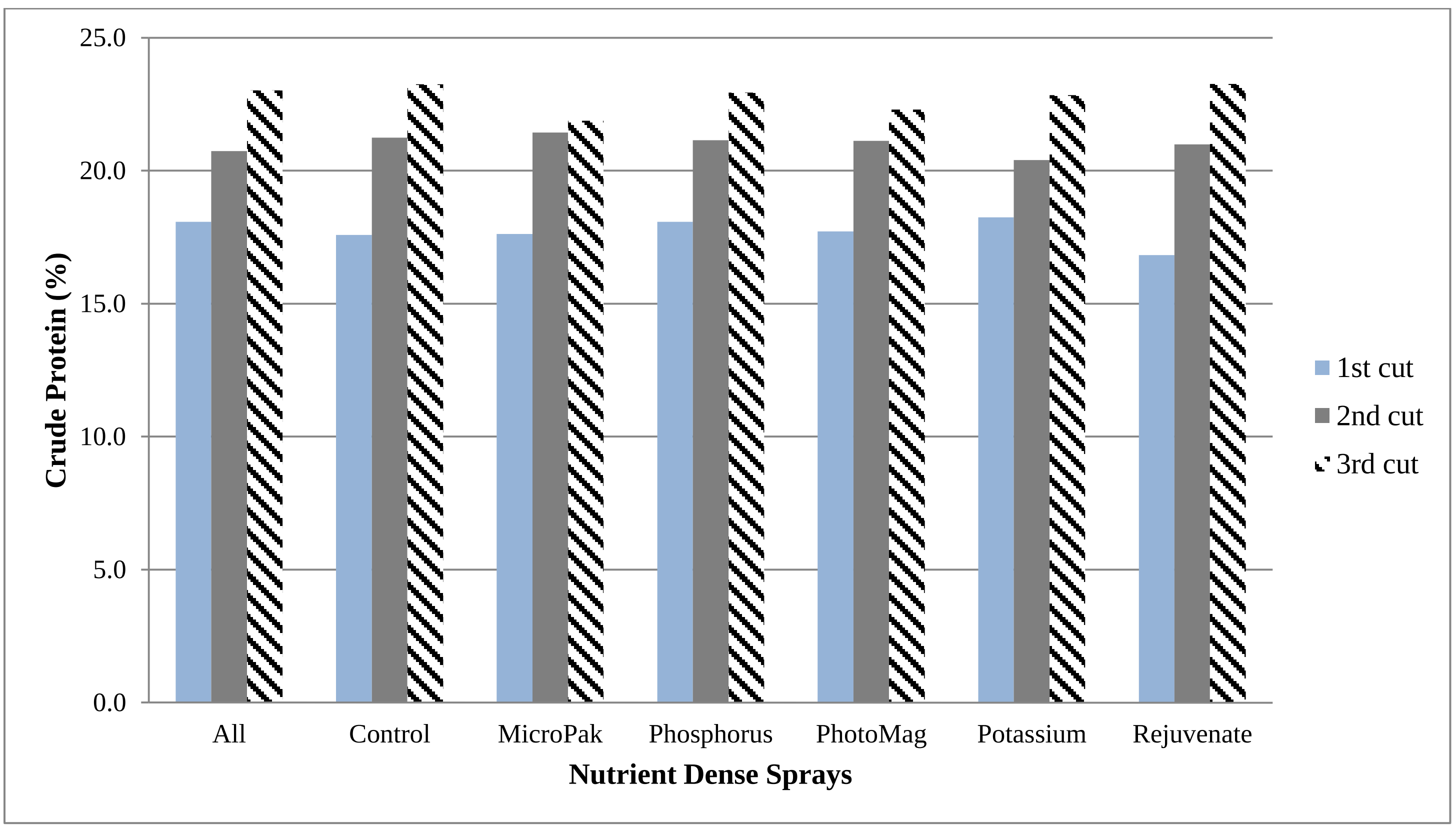

Figure 2. First, second and third cut crude protein, Westfield, VT, 2013.

At Shelburne Farms, there were no significant differences for yield or quality for first, second or third cut hay among the nutrient dense spray treatments (Tables 8-10). The only exception to this was third cut digestible NDF; Rejuvenate, Potassium, MicroPak, and the Control had higher digestible NDF levels than other treatments (Table 10). Dry matter yields were highest for first cut, averaging 2635 lbs acre^{-1}(Figure 3). For most treatments, 3rd cut yields—averaging 2096 lbs acre^{-1} were higher than 2nd cut—averaging 1862 lbs acre^{-1} (Figure 3). Crude protein levels were generally highest for third cut, averaging 15.3% (Figure 4).

Table 8. First cut hay yield and quality, Shelburne, VT, 22-May 2013.

Treatment	DM Yield lbs. acre^{-1}	DM %	CP %	Starch %	ADF %	NDF %	NFC %	NDFD %
All	2825	20.2	14.3	0.2	32.3	69.7	19.1	43.6
Control	2758	19.9	14.4	0.6	31.5	67.9	20.4	43.4
MicroPak	2868	19.8	14.4	0.4	32.3	69.4	18.7	41.0
Phosphorus	2528	19.7	14.2	0.5	32.0	69.0	19.6	43.5
PhotoMag	2347	18.8	14.5	0.3	32.3	69.5	19.6	45.6
Potassium	2413	18.9	14.6	0.3	31.7	68.6	19.6	43.5
Rejuvenate	2702	18.6	15.4	0.3	31.3	67.0	20.1	45.1
Trial Mean	2635	19.4	14.5	0.4	31.9	68.7	19.6	43.7
LSD ($p<0.10$)	NS	NS	NS	NS	NS	NS	NS	NS

NS - None of the varieties were significantly different from one another.

Table 9. Second cut hay yield and quality, Shelburne, VT, 18-Jun 2013.

Treatment	DM Yield lbs. acre^{-1}	DM %	CP %	Starch %	ADF %	NDF %	NFC %	NDFD %
All	1699	23.0	13.9	0.8	31.7	66.1	20.1	39.4
Control	2018	23.1	14.2	0.9	30.9	64.5	21.1	40.1
MicroPak	1898	22.6	13.4	0.7	32.1	67.0	19.5	40.5
Phosphorus	1664	23.0	14.1	0.6	31.3	65.5	20.5	40.0
PhotoMag	2079	24.2	14.3	0.7	31.5	65.4	20.2	40.8
Potassium	1925	22.9	13.6	0.9	31.7	65.8	20.7	40.4
Rejuvenate	1751	21.8	14.5	1.0	30.8	64.1	21.6	40.0
Trial Mean	1862	23.0	14.0	0.8	31.4	65.5	20.5	40.2
LSD ($p<0.10$)	NS	NS	NS	NS	NS	NS	NS	NS

NS - None of the varieties were significantly different from one another.

Table 10. Third cut hay yield and quality, Shelburne, VT, 6-Aug 2013.

Treatment	DM Yield lbs. acre^{-1}	DM %	CP %	Starch %	ADF %	NDF %	NFC %	NDFD %
All	1467	23.3	15.1	1.0	30.2	61.0	22.5	35.5
Control	2116	22.4	15.7	0.8	29.6	59.9	22.5	37.9*
MicroPak	2295	23.2	15.0	0.9	29.8	61.2	22.0	38.0*
Phosphorus	2407	22.4	15.7	0.8	29.5	59.9	22.8	37.8
PhotoMag	2430	22.5	15.7	1.1	28.9	58.6	23.9	37.3
Potassium	1844	22.1	15.6	0.7	29.8	61.2	22.4	39.2*
Rejuvenate	2114	23.1	14.4	0.8	30.9	62.3	22.6	**40.3***
Trial Mean	2096	22.7	15.3	0.9	29.8	60.6	22.7	38.0
LSD ($p<0.10$)	NS	NS	NS	NS	NS	NS	NS	2.4593

*Varieties with an asterisk indicate that it was not significantly different than the top performer in column (in **bold**).
NS - None of the varieties were significantly different from one another.

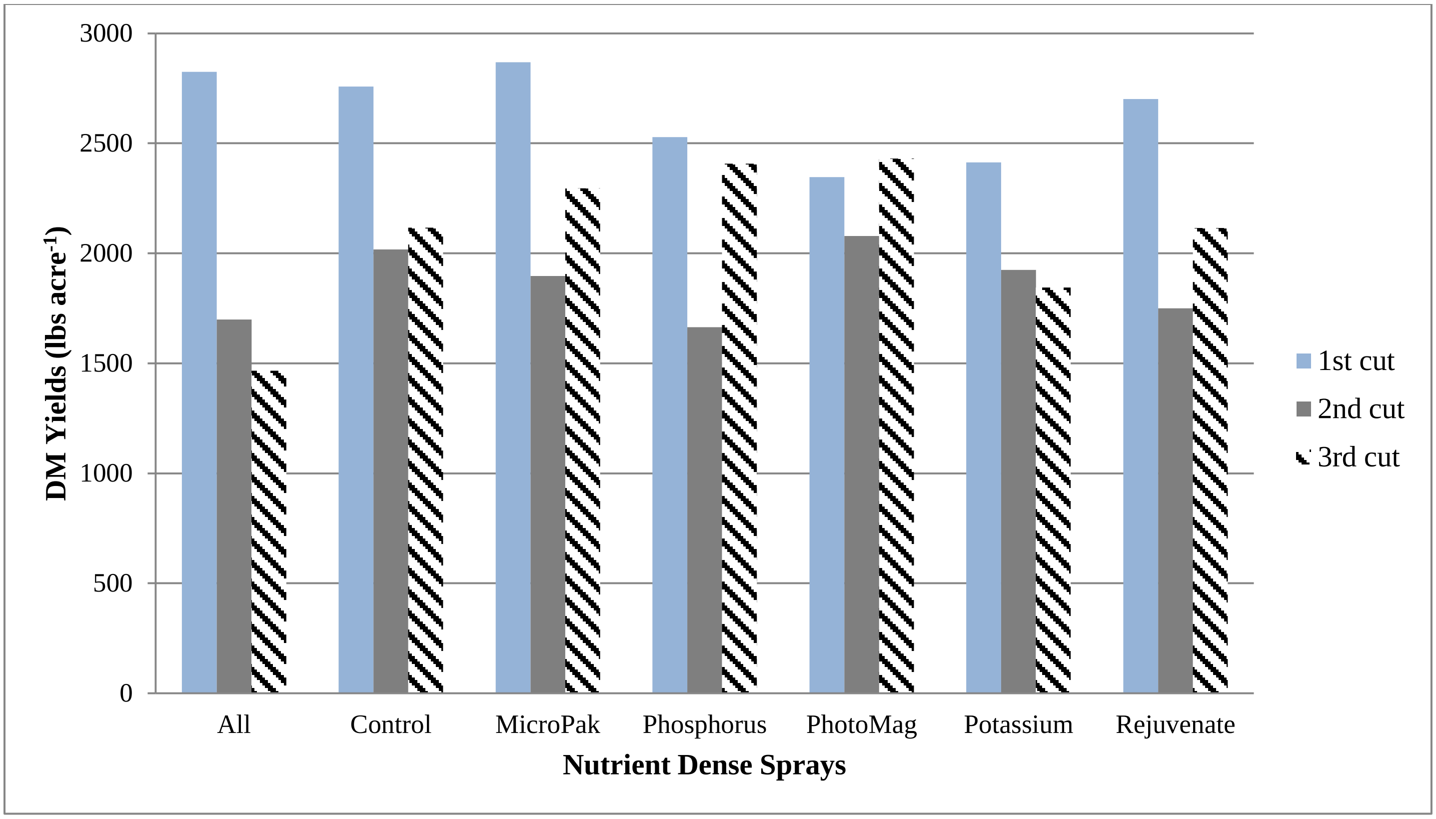

Figure 3. First, second and third cut dry matter yields, Shelburne, VT, 2013.

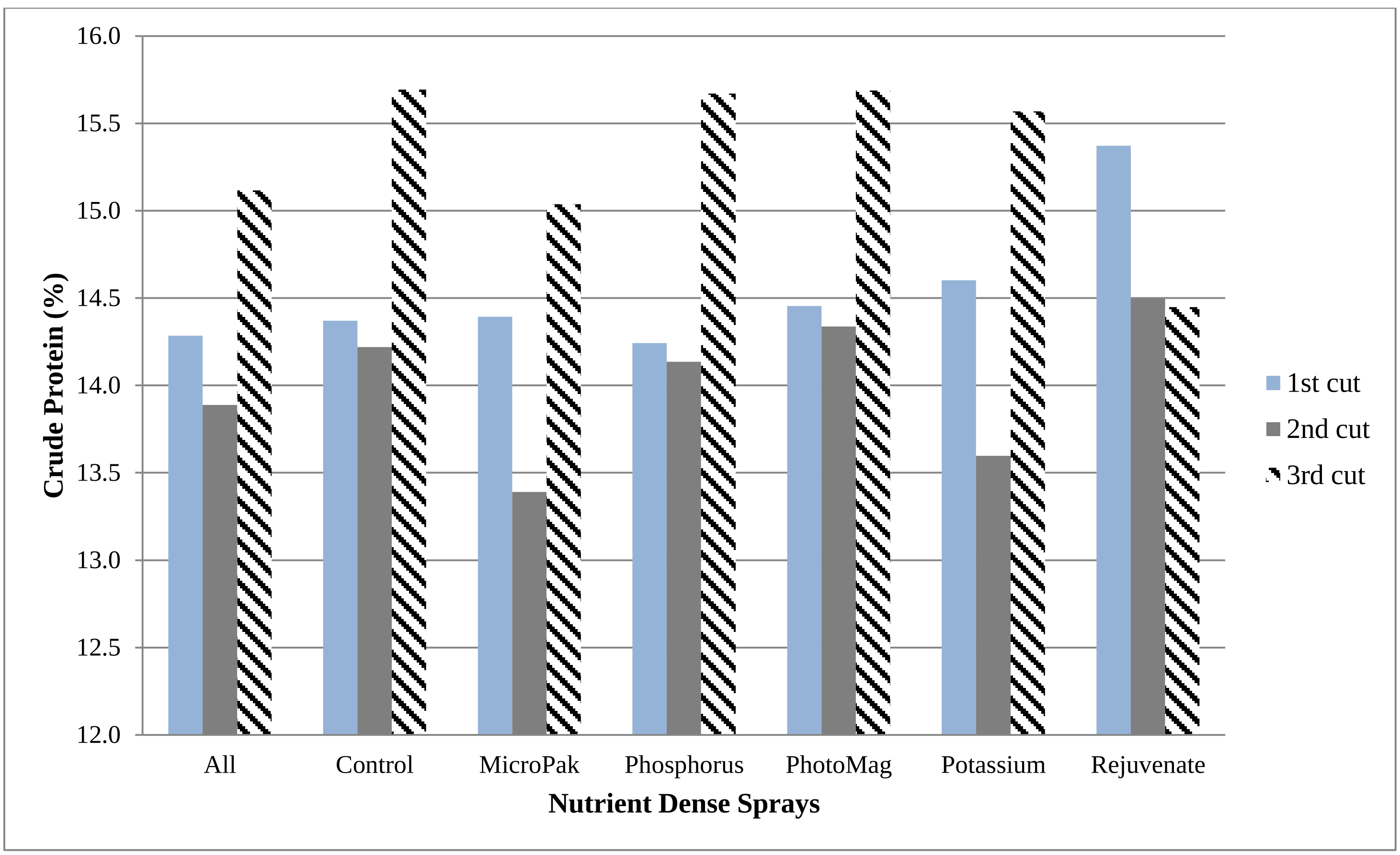

Figure 4. First, second and third cut crude protein, Shelburne, VT, 2013.

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