2013 High Glucosinolate Mustard and Potato Trial

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2013 HIGH GLUCOSINOLATE MUSTARD AND POTATO TRIAL

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High glucosinolate mustard (HGM) can be planted as a cover crop to suppress weeds and disease. Studies have shown a reduction in soil-borne diseases, as well as advantages in mitigating weed pressure, after planting HGM cover crops. Mustards, and many other cruciferous plants, contain glucosinolates, which are allelopathic, meaning they produce biochemicals that affect the growth and survival of other organisms. High glucosinolate mustard varieties have high levels of glucosinolates and have been shown to suppress the growth of weed seedlings, as well as helping to reduce soil-borne disease. The glucosinolates in HGM plants hydrolyze into molecules called volatile isothiocyanates, which are partially responsible for allelopathy. Little research has been done in the Northeast to quantify the effects of HGM cover crops in reducing skin disease in potatoes (*Solanum tuberosum*). Potato demand hinges on appearance, as consumers often refuse individual potatoes with skin defects such as common scab or rhizoctonia, and potatoes for seed are rejected if they have significant damage to skin quality. Rhizoctonia, a soil fungus, is particularly common in cool, wet growing regions like the Northeast. Reducing these skin diseases would increase the marketable yields of potato crops. High glucosinolate mustard cover crops would provide additional benefits to weed competition and soil health. Keeping the ground covered with a living cover crop for months after a regular-season cash crop is harvested helps to stabilize and build soil aggregates, as well as providing organic matter and scavenging nutrients in the soil. The integration of HGM cover crops into vegetable production could prove to be a beneficial introduction in multiple ways.

In 2012, UVM Extension's Northwest Crops & Soils Program, in collaboration with the University of Maine Extension, set out to determine whether HGM cover crops could be used to decrease weed populations and potato skin disease, while increasing yields and the overall percentage of marketable potatoes. For organic growers in particular, HGM cover crops could serve as tools in the reduction of pest pressures and help increase the viability of cash crops while enhancing soil health.

MATERIALS AND METHODS

A research trial was designed and implemented at the Heleba Potato Farm in Center Rutland, VT, where potatoes have long been in production. The plot design was a randomized complete block with a split plot arrangement and three replications (Table 1). The soil at the research site was a Paxton fine sandy loam, with 2-8% slopes. The previous crop was potatoes. Main plots consisted of three HGM treatments, including a 'Caliente' variety, a blend of 'Ida' and 'Pacific Gold' varieties (called 'Ida & Pacific Gold' here), and a control (no HGM cover crop). Subplots were the two potato varieties 'Yukon Gold' (yellow skin and flesh) and 'Modoc' (red skin, white flesh). Interactions between HGM cover crop treatment and potato variety were analyzed in addition to the effects of main treatments.

Table 1. HGM and potato trial specifics, Center Rutland, VT, 2013.

Location	Heleba Potato Farm – Center Rutland, VT
Soil type	Paxton fine sandy loam, 2-8% slope
Previous crop	Potatoes
HGM cover crop treatments	3 (Caliente; Ida & Pacific Gold; control)
Potato varieties	2 (Yukon gold; Modoc red)
Replications	3
Plot size (ft)	3 x 8.5
HGM planting date	16-Aug 2012
HGM planting equipment	Carter cone seeder
HGM seeding rate (lbs ac^{-1})	Ida & Pacific Gold - 6; Caliente - 9
HGM termination	5-Nov 2012; walk-behind DR trimmer
Fall tillage	6-Nov 2012; Kuhn EL42 74" rototiller
Potato planting date	6-Jun 2013
Row width (in.)	36
Weed control	Mechanical row cultivator
Harvest date	9-Sep 2013
Harvest equipment	Rear-mounted bed lifter

Main plots of HGM were planted in 8.5' wide north-south strips and subplots of potato varieties were planted the following spring in 3' east-west rows. HGM was seeded on 16-Aug 2012 (Figure 1) with a walk-behind Carter cone seeder. The Ida & Pacific Gold variety was seeded at 6 lbs per acre; Caliente was seeded at 9 lbs per acre. Biomass samples and soil samples were taken just before the termination of the mustard crop (5-Nov 2012). A 2.37 ft^2 area was harvested in each HGM plot; a subsample of approximately one pound was collected and dried. Dry matter yields were calculated and subsamples were shipped to Cumberland Valley Analytics in Hagerstown, MD for wet chemistry analysis of nitrogen concentrations. Soil samples were processed by UVM's Agricultural and Environmental Testing Laboratory for organic matter, cation exchange capacity, and macro- and micronutrients. On 5-Nov 2012, a walk-behind all-terrain DR trimmer was used to harvest mustard plots. On 6-Nov 2012, all plots were tilled with a Kuhn EL42 74" rototiller to incorporate mustard plants and prepare the soil for winter.

Figure 1. HGM seeded in main plots in Aug 2012, shown here on 28-Sep 2012.

Figure 2. Individual potatoes were laid out and assessed for marketability and skin disease.

Figure 3. Common potato scab.

Potatoes were planted in 36" rows, alternating varieties, on 6-Jun 2013. On 12-Jul 2013, each plot was sampled for soil nitrate levels. Weed and potato plants were counted at that time to calculate plant populations. The most predominant weeds identified were galinsoga (*Galinsoga parviflora*), common ragweed (*Ambrosia artemisiifolia*), redroot pigweed (*Amaranthus retroflexus*), yellow foxtail (*Setaria pumila*), and crabgrass (*Poaceae digitaria*). Most weeds were in the early cotyledon stage. At harvest on 9-Sep 2013, a rear-mounted bed lifter was used to loosen soil, and potatoes were dug and collected by hand. Yields were measured for each plot, and 20 potatoes from each plot were used to estimate the percentage of marketable potatoes and skin disease (Figure 2). The incidence levels of common scab and rhizoctonia were assessed for each individual plot with a visual assessment based on a protocol from the University of Maine. Common scab (*Streptomyces*) is a pathogen than can overwinter in residue or on field equipment, and usually becomes most noticeable late in the season, just prior to harvest (Figure 3). Rhizoctonia (*Rhizoctonia solani*) appears as black or brown three-dimensional, hard masses, and is quite common in cold, wet climates.

Data were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within trials were treated as random effects, and HGM and potato treatments were treated as fixed. Mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$). P-values are listed to convey level of significance. In the case of two variables (cation exchange capacity and nitrate levels), a t-test was used to determine significant differences between treatments ($p<0.10$). This means that each treatment for those variables was analyzed with a pairwise comparison.

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 hybrids 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 (LSDs) at the 0.10 level of significance are shown, except where analyzed by pairwise comparison (t-test). 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 that for 9 out of 10 times, there is a real difference between the two treatments. Treatments that were not significantly lower in performance than the top-performing treatment in a particular column are indicated with an asterisk. In the example below, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these hybrids did not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these hybrids were significantly different from one another. The asterisk indicates that hybrid B was not significantly lower than the top-yielding hybrid C, indicated in bold.

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

RESULTS

Temperature, precipitation, and accumulation of Growing Degree Days (GDDs) were consolidated for the 2012-2013 growing season (Table 2). Data are from cooperative weather observation stations in Rutland, VT, in close proximity to Center Rutland, VT. Average temperatures were not far from the 30-year (1981-2010) average, though the 2013 early spring months (March and April), were notably colder than average. Monthly precipitation ranged between 2.54 inches less and 1.93 inches greater than the historical average, with a particularly wet start to the 2013 planting season. GDDs are calculated at a base temperature of 32°F for HGM and 40°F for potatoes. Between the planting and harvest of HGM cover crops in 2012, there were 2571 accumulated GDDs for mustard, 55 fewer than the historical average. Between May 2013 and September 2013, there were 3488 GDDs accumulated for potatoes, 127 fewer than the historical average.

Table 2. Consolidated weather data and GDDs for mustard (32°F) and potatoes (40°F), Rutland, VT, 2012-2013.

	2012					**2013**								
Rutland, VT	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average temperature (°F)	67.9	58.5	50.4	35.0	29.4	20.2	23.1	30.6	42.5	56.1	63.8	71.4	65.3	57.2
Departure from normal	0.3	-1.1	2.2	-3.4	3.1	-0.6	-0.5	-1.9	-3.0	-0.3	-1.4	2.2	-2.3	-2.4
Precipitation (inches)	3.42	4.58	4.57	0.71	4.08	1.85	0.78	1.51	2.58	5.60	5.93	5.59	3.30	3.25
Departure from normal	-0.68	0.80	0.74	-2.54	1.12	-0.59	-1.37	-1.26	-0.30	1.89	1.93	0.82	-0.80	-0.53
Growing Degree Days (base 32°F)	1114	795	572	90	0	0	0	0	317	747	956	1220	1034	755
Departure from normal	11	-35	70	-101	0	0	0	-16	-89	-8	-39	65	-70	-75
Growing Degree Days (base 40°F)	866	555	324	0	0	0	0	0	76	499	716	972	786	515
Departure from normal	11	-35	70	0	0	0	0	0	-89	-8	-39	65	-70	-75

Based on National Weather Service data from cooperative observation stations in Rutland, VT.
Historical averages are for 30 years of NOAA data (1981-2010) from Rutland, VT.

HGM Cover Crop by Potato Interactions

There were no significant interactions between cover crop treatment and potato variety on soil characteristics, potato or weed populations, nitrates, yield, or disease incidence. This suggests that the effects of HGM cover crops were statistically similar across both potato varieties.

Impact of HGM Cover Crop

High glucosinolate mustard cover crops were mowed and incorporated at a height of 2 to 3 feet. There was no significant difference between HGM varieties in dry matter yield, which averaged 3417 lbs per acre (Table 3). The nitrogen concentration of the HGM cover crop averaged 2.13%, and was not significantly different by variety.

Table 3. HGM harvest data, 5-Nov 2012, Center Rutland, VT.

HGM cover crop	Dry matter yield	Nitrogen
	lbs ac^{-1}	% of DM
Caliente	**3470**	**2.14**
Ida & Pacific Gold	3364	2.11
LSD (0.10)	NS	NS
Trial mean	3417	2.13

NS – Treatments were not significantly different from one another (p=0.10).
Treatments shown in **bold** are top-performing in a particular column.

In November 2012, soil samples from each cover crop treatment were analyzed for pH, available nutrients, and organic matter (Table 4). Soil pH varied significantly by cover crop treatment, with the highest pH in ‘Ida & Pacific Gold’ (6.17). The Caliente HGM did not alter the pH of the soil significantly from the control (no cover crop). Available phosphorus (P) was significantly greater in both HGM treatments than in the control (Figure 4). There were no significant variations in potassium (K) or calcium (Ca) by cover crop treatment. Magnesium (Mg) was significantly greatest in Ida & Pacific Gold (61.7 ppm), while Aluminum (Al) was significantly greater in the control treatment (93.0 ppm) than in either HGM treatment. The cation exchange capacity (CEC) was significantly greatest in the Ida & Pacific Gold treatment (5.05 mEq per 100 g). Zinc (Zn) levels were highest in the control (1.20 ppm), but not significantly greater than in the Caliente treatment. Organic matter averaged 2.83% overall and was greatest in the Caliente treatment (2.93 %).

Table 4. Soil test results by HGM cover crop treatment, Nov 2012, Center Rutland, VT.

HGM cover crop	Soil pH	Available P	K	Mg	Al	Ca	CEC	Zn	Organic matter
		ppm	ppm	ppm	ppm	ppm	mEq 100 g^{-1}	ppm	%
Caliente	5.83	**9.53***	**57.3**	47.7	78.3	549	3.27	1.10*	**2.93***
Ida & Pacific Gold	**6.17***	9.43*	55.7	**61.7***	79.7	**704**	**5.05***	1.00	2.77
Control	5.73	9.03	54.0	44.3	**93.0***	602	4.70*	**1.20***	2.83
LSD (0.10)	0.28	0.37	NS	13.6	9.3	NS	●	0.13	0.08
P-value	0.0426	0.0786	0.8148	0.0939	0.0309	0.2238	0.0902	0.0609	0.0137
Trial mean	5.91	9.33	55.7	51.2	83.7	619	4.10	1.10	2.84

NS – Treatments were not significantly different from one another (p=0.10).
* Treatments with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
● This variable does not have an LSD value, as it was analyzed with a t-test (p=0.10).
Treatments shown in **bold** are top-performing in a particular column.

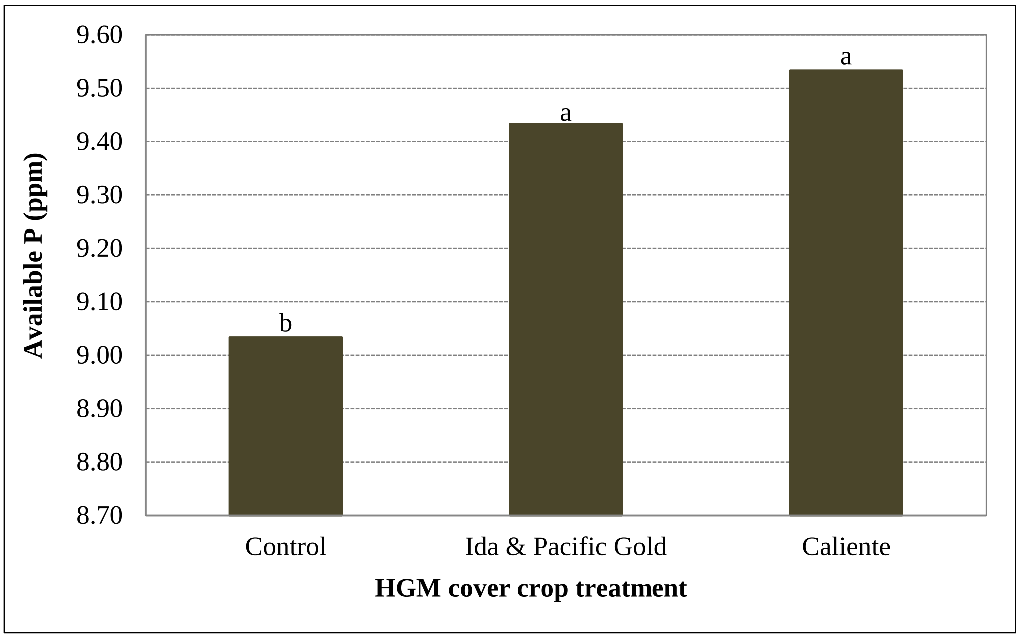

Figure 4. Available P by HGM cover crop treatment, Nov 2012, Center Rutland, VT.

Soil micronutrients showed little statistically significant difference by cover crop treatment (Table 5). Sulfur (S) was not impacted by cover crop treatment. Manganese (Mn) varied significantly by cover crop treatment, and was greatest in Ida & Pacific Gold (4.13 ppm). Boron (B), copper (Cu), and iron (Fe) were all statistically unaffected by cover crop treatment. Sodium (Na) was greatest in Ida & Pacific Gold (12.3 ppm), though this was not statistically higher than Caliente (10.7 ppm).

Table 5. Micronutrients by HGM cover crop treatment, Nov 2012, Center Rutland, VT.

HGM cover crop	S	Mn	B	Cu	Fe	Na
	ppm	ppm	ppm	ppm	ppm	ppm
Caliente	10.3	3.47	0.07	**0.45**	9.6	10.7*
Ida & Pacific Gold	10.7	**4.13***	**0.10**	0.43	10.7	**12.3***
Control	**13.0**	3.20	0.07	0.42	**10.9**	9.0
LSD (0.10)	NS	0.57	NS	NS	NS	2.1
P-value	0.2578	0.0383	0.1317	0.1317	0.3690	0.0520
Trial mean	11.3	3.60	0.08	0.43	10.4	10.7

NS – Treatments were not significantly different from one another (p=0.10).
* Treatments with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
Treatments shown in **bold** are top-performing in a particular column.

In July 2013, potato and weed populations were measured to assess crop establishment and weed pressure (Table 6). Though the greatest potato population was in the control treatment (3.8 plants per m^2), this was not statistically significant. There were no significant differences in weed population by cover crop treatment. The lowest populations of annual grasses were in Ida & Pacific Gold (51.47 plants per m^2), though this did not vary by treatment. Annual broadleaf populations were lowest in the Caliente cover crop treatment, but the difference was not statistically significant. There were few perennial weed species, and no perennial broadleaves, identified. Soil nitrate-N levels, tested on the same date, differed statistically by cover crop treatment. The Caliente cover crop treatment had the highest nitrate level (51.3 mg per kg of NO_3), though this was statistically similar to the nitrate level of Ida & Pacific Gold (31.2 mg per kg of NO_3).

Table 6. Potato and weed populations and nitrate levels by HGM cover crop treatment, Center Rutland, VT.

HGM cover crop	Population				Soil nitrate-N
	Potato	Annual grasses	Annual broadleaves	Perennial grasses	
	plants m^{-2}	plants m^{-2}	plants m^{-2}	plants m^{-2}	mg kg^{-1}
Caliente	3.71	58.28	**52.2**	**0.00**	**51.3***
Ida & Pacific Gold	3.29	**51.47**	55.3	0.76	31.2*
Control	**3.80**	55.26	56.0	**0.00**	23.7
LSD (0.10)	NS	NS	NS	NS	●
P-value	0.647	0.898	0.847	0.402	0.002
Trial mean	3.60	55.01	54.4	0.25	35.4

NS – Treatments were not significantly different from one another (p=0.10).
* Treatments with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
● This variable does not have an LSD value, as it was analyzed with a T-test (p=0.10).
Treatments shown in **bold** are top-performing in a particular column.

Yield and disease incidence was measured at harvest (Table 7). Yield was not statistically altered by cover crop treatment, though yields in the control treatment were slightly higher than in HGM cover crop treatments. Yields of both red and gold potatoes averaged 274 bushels (or 8.22 tons) per acre (Figure 5). The percentage of the yield that was marketable was not statistically impacted by cover crop treatment, though the average was low (29.2%), due in part to disease issues.

Table 7. Potato yields and disease incidence, Center Rutland, VT, 2013.

HGM cover crop	Yield		Marketable yield	Disease incidence	
				Scab	Rhizoctonia
	bu ac^{-1}	lbs plant^{-1}	%	%	%
Caliente	257	1.09	21.7	5.87	0.57
Ida & Pacific Gold	258	1.11	**35.0**	**4.57**	**0.42**
Control	**307**	**1.24**	30.8	4.91	1.53
LSD (0.10)	NS	NS	NS	NS	NS
P-value	0.484	0.585	0.583	0.606	0.119
Trial mean	274	1.15	29.2	5.12	0.84

NS – Treatments were not significantly different from one another (p=0.10).
Treatments shown in **bold** are top-performing in a particular column.

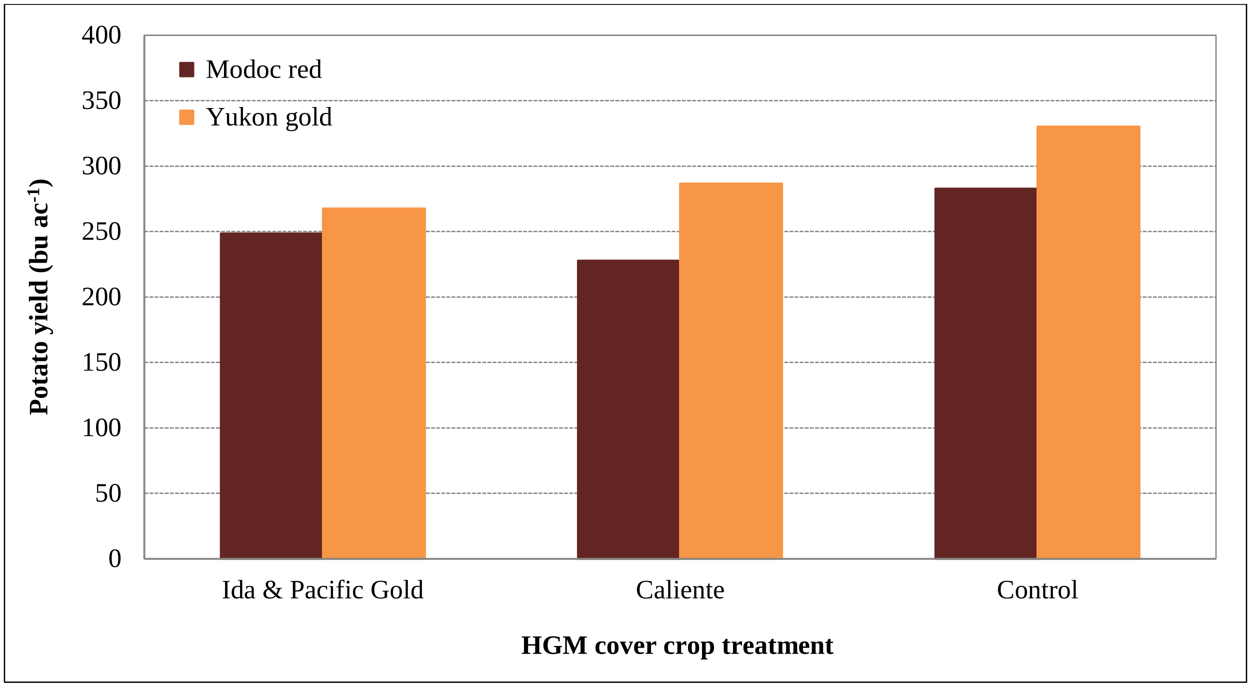

Figure 5. Potato yield as impacted by HGM cover crop treatment, Center Rutland, 2012-2013. There were no significant differences in potato yields by either cover crop treatment or potato variety (p=0.10).

Though there was no statistically significant difference in the incidence of the skin disease rhizoctonia among HGM cover crop treatments, there was a notable trend (p=0.1194) towards lower incidence in HGM treatments than in the control (Figure 6).

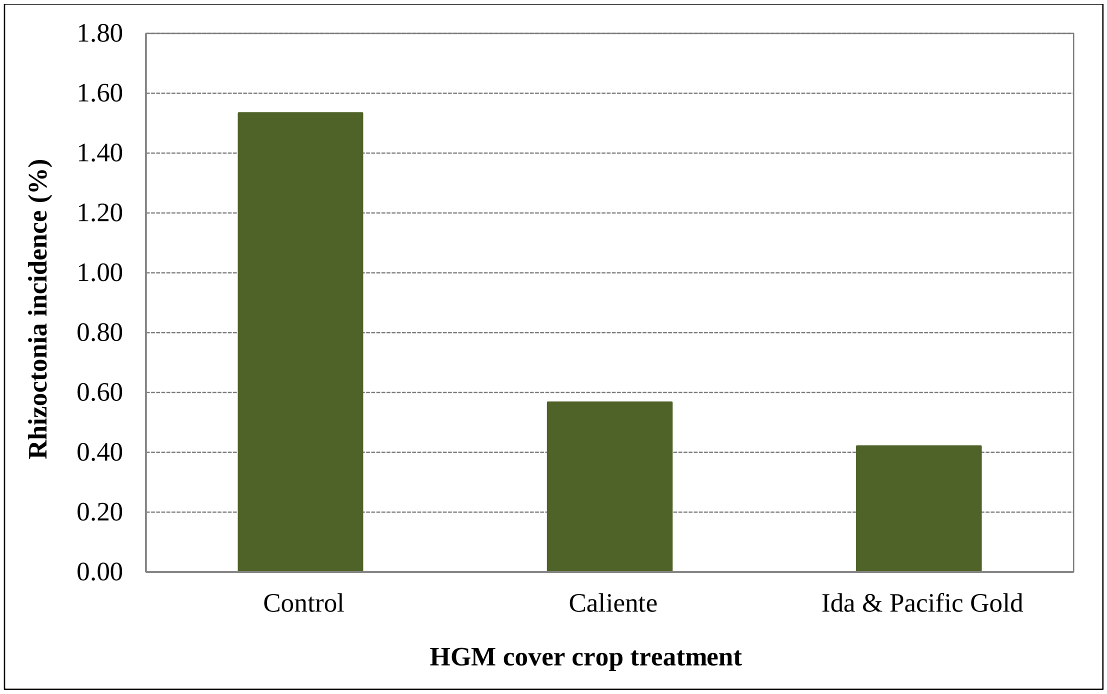

Figure 6. Incidence of potato rhizoctonia between HGM cover crop treatments. There was no significant difference in rhizoctonia (p=0.10).

Impact of Potato Variety

Potatoes were planted on 6-Jun 2013, and on 12-Jul 2013 potato and weed populations were measured. Potato populations varied significantly by variety; there were an average of 4.28 plants per m^2 in Yukon Gold plots and only 2.93 plants per m^2 in Modoc plots (Table 8). There was no significant difference in weed populations by potato variety, and few perennial weeds (no perennial broadleaves) identified. July soil samples showed no significant difference in nitrate levels by potato variety.

Table 8. Plant populations and nitrate levels by potato variety, 2013, Center Rutland, VT.

Potato variety	Population				Soil nitrate-N
	Potato	Annual grasses	Annual broadleaves	Perennial grasses	
	plants m^{-2}	plants m^{-2}	plants m^{-2}	plants m^{-2}	mg kg^{-1}
Yukon gold	**4.28***	60.1	**53.5**	0.50	36.1
Modoc red	2.93	**50.0**	55.5	**0.00**	36.1
LSD (0.10)	0.84	NS	NS	NS	NS
P-value	0.016	0.418	0.7271	0.341	1.00
Trial mean	3.60	55.0	54.4	0.25	36.1

NS – Treatments were not significantly different from one another (p=0.10).
* Treatments with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
Treatments shown in **bold** are top-performing in a particular column.

Yields did not vary significantly by potato variety (Table 9), though Yukon Gold yields were slightly higher (295 bushels, or 8.85 tons per acre). Yields in lbs per plant varied significantly by variety, with higher yields in Modoc red potatoes (1.27 lbs per plant). The marketable yield percentage was not statistically different by variety, and common scab incidence was statistically similar in both Yukon Gold and Modoc varieties. Rhizoctonia incidence was impacted by variety, with significantly less damage in Modoc red potatoes than Yukon Gold (Figure 7). The average rhizoctonia incidence in 2013 potatoes was significantly lower (0.84%) than the incidence of common scab (5.12%).

Table 9. Potato yields and disease incidence by variety, 2013, Center Rutland, VT.

Potato variety	Yield		Marketable yield	Disease incidence	
				Scab	Rhizoctonia
	bu ac^{-1}	lbs $plant^{-1}$	%	%	%
Yukon gold	**295**	1.02	27.4	**4.81**	1.33
Modoc red	253	**1.27***	**31.0**	5.43	**0.35**
LSD (0.10)	NS	0.22	NS	NS	0.78
P-value	0.284	0.069	0.742	0.577	0.047
Trial mean	274	1.15	29.2	5.12	0.84

NS – Treatments were not significantly different from one another (p=0.10).
* Treatments with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
Treatments shown in **bold** are top-performing in a particular column.

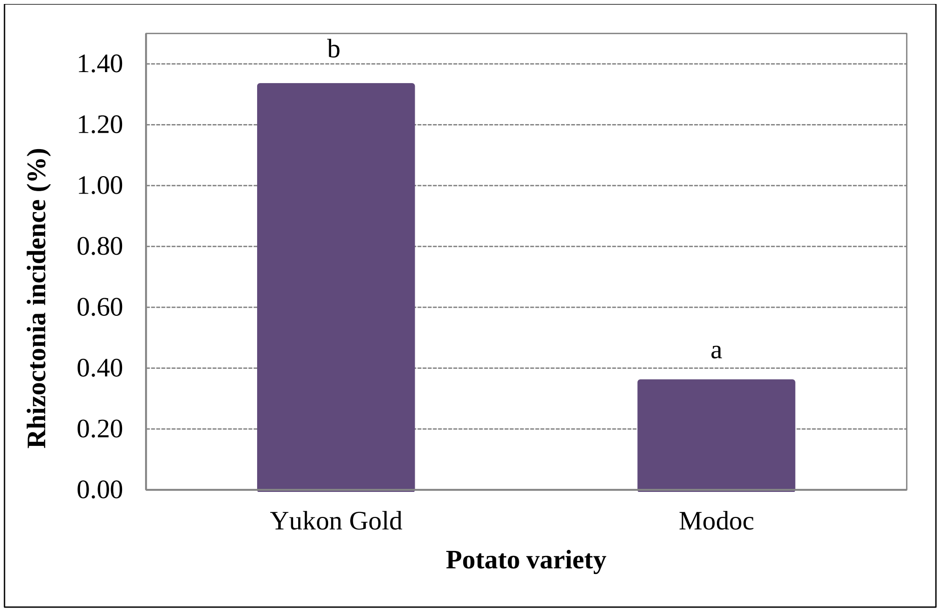

Figure 7. Rhizoctonia incidence by potato variety, 2013, Center Rutland, VT. Treatments that share a letter did not vary significantly from one another (p=0.10).

DISCUSSION

There were no significant interactions between cover crop treatments and potato varieties, meaning that the impacts of HGM cover crops were similar in both red and gold potato varieties trialed.

Approximately three months after being planted, the HGM was plowed under with about 3417 lbs (1.7 tons) per acre of green biomass. Interestingly, despite varying seeding rates for the two HGM varieties, there was no significant difference in the biomass accumulation between Caliente and Ida & Pacific Gold. This indicates that varying seeding rates for different HGM varieties may result in the same plant vigor; growers should follow given recommendations on seeding rate.

Soil characteristics were significantly impacted by the cultivation of HGM cover crops. Soil pH was highest in the Ida & Pacific Gold treatment. Available P was significantly greater in both HGM treatments than in the control, and there was no significant difference between Caliente and Ida & Pacific Gold treatments. Magnesium, Al, and Zn levels were all impacted by cover crop treatments. The cation exchange capacity (CEC), which is telling of the soil's capability of absorbing and utilizing nutrient inputs, was impacted by cover crop treatment. CEC was highest in Ida & Pacific Gold plots (5.05 mEq per 100 g). Organic matter was statistically greatest in the Caliente treatment (2.93%), 0.10% higher than the control treatment with no cover crop. High glucosinolate mustard cover crops also added significant nitrate levels to the soil. Though there was no significant difference in the nitrogen levels between the two HGM cover crops in November 2012, they were plowed in with an average of 2.13% nitrogen. This plant-based nitrogen led to elevated nitrate levels in soil samples taken the following July—both cover crop treatments had nitrate levels significantly greater than the control treatment with no HGM crop. Based on this study, the addition of HGM cover crops can have a highly significant impact on soil nutrient cycling and organic matter building.

There were no significant differences in potato or weed populations by cover crop treatment, showing that the HGM cover crop did not reduce weed pressure in any notable way, nor did the cover crop stifle plant population in potatoes. Yield was not statistically impacted by cover crop treatment, nor was the marketable portion of the yield. However, though statistically insignificant, it is notable that the greatest percentage of marketable potatoes was in the Ida & Pacific Gold treatment (35.0%). Disease incidence did not vary by cover crop treatment, though there was a notable trend towards lower rhizoctonia incidence in HGM treatments. This is logical, since rhizoctonia is a fungus that attacks the underground plant structure (tubers, stems, and stolons) of potatoes. Any allelopathic properties of HGM would be more noticeable in the incidence of soil-borne diseases like rhizoctonia than in common scab.

Potato plant populations varied significantly by variety, with denser populations in Yukon Gold. However, potato varieties had no statistical impact on weed populations, indicating that both varieties faced the same weed pressures. Nitrate levels were the same among potato varieties. Yield on a per acre basis was not statistically impacted by potato variety. However, Modoc red potatoes yielded significantly higher relative to plant population (1.27 lbs per plant). Overall yields paled in comparison to regional averages (this trial yielded 164 cwt per acre, while the 2012 USDA census indicated that the average yield for the nearby state of Maine was 275 cwt per acre). The average portion of marketable potatoes (29.2% of harvested individuals) was not statistically different by treatment and low overall, perhaps due to the cold, wet soil conditions of early spring in 2013. While there was no varietal difference in common scab incidence, the incidence of rhizoctonia was significantly lower in Modoc red potatoes than in Yukon Gold. Overall, scab was much more common in both potato varieties than rhizoctonia.

This study shows that HGM cover crops did have a significant impact on some soil characteristics, providing organic matter and nitrates to the soil, as well as altering soil chemistry and available nutrients. In this trial, there were few significant improvements in weed pressure or soil-borne disease because of HGM cover crops, though there was a trend towards reduction of rhizoctonia in HGM treatments. Yields were not significantly lowered by the introduction of a cover crop. The integration of HGM into a rotational system may have benefits to the soil health and could, under some conditions, reduce pest pressures and improve yields. It is important to note that these results, while significant, represent only one year of data at only one location. Consult additional research before making varietal selections or other agronomic decisions.

ACKNOWLEDGEMENTS

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Figure 8. Donald Heleba prepares to harvest potatoes, Sept 2013.

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

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