Trial Report – BMP1: Cover Cropping Before Potatoes

Trials Overview:

In BMP1, we examined different fall cover crops seeded the fall before planting potatoes, following tillage. In each field, we compared one or two cover crops against a check strip growing side by side in a commercial field. The purpose of this trial is to assess soil health from biological, physical and chemical standpoints, as well as the effect of these crops on marketable yield of potatoes.

There were six trials established in the fall of 2019, and planted to potatoes in 2020. The fall cover crops were seeded between late August and early October.

Of those six trials, there were three established in the Kensington North region; two in the East Prince region and one in the Souris area. In no particular order, the crops are outlined by trial as follows:

Trial #1- Mustard/Oats vs Bare Check Strip (Planted Aug. 28, 2019)

Trial #2- Spring Barley Seeded vs Bare Check Strip (Planted Sept. 19, 2019)

Trial #3- Radish vs Spring Barley vs Bare Check Strip (Planted Oct. 1-2, 2019)

Trial #4- Icarus Radish vs Mustard vs Bare Check Strip (Planted Sept. 23, 2019)

Trial #5- Mustard vs Bare Check Strip (Planted Sept. 22, 2019)

Trial #6- Oats vs Bare Check Strip (Planted Sept. 27, 2019)

Methods:

Soil sampling was done at each site in the fall of 2019 and spring of 2020 for chemical analysis, the soil health package, *Verticillium dahliae* (VD) and root lesion nematodes (RLN). Soil nitrate samples were collected to three depths (0-6", 6-12" and 18") in the fall of 2019, but most of the results came back low (<5.00ppm) with no clear trends evident. Soil chemical and health analysis samples were analyzed at the PEI Analytical Labs. Soil nematodes were analyzed at the Potato Quality Institute, also in PEI. The *Verticillium dahliae* samples were sent to Agricultural Certification Services (ACS) in Fredericton, NB. Percent green ground cover was measured at each site with the Canopeo smartphone app, taking a series of photos at different time points in the fall to compare the cover crop (s) to a bare check strip. A subset of the fields was tested for soil erosion with metal splash pans.

In the fall of 2020, four or five 10-foot harvest samples/treatment were collected to compare total yields, percent defects, percent smalls, percent of potatoes over 10 ounce size, specific gravity, marketable yields and crop value in $/acre. Statistical analysis was done for the potato yield attributes to a confidence interval of 90% (α=0.1). Variance was tested to confirm if each dataset was equally or unequally varied. Then the appropriate t-test was conducted. These samples were stored until grading in early November at Cavendish Farms Central Grading.

Results - Soil Health:

Within each trial, the soil chemical and health differences between treatment areas of the field in the fall were minimal, allowing us to average that data across areas and compare it to the results by treatment in the spring of 2020. From previous studies as well reports from literature, it was not expected to see

significant changes in chemical or soil health metrics from just one season of growing cover crops. However, it was felt that it was valuable to collect this information to identify any possible trends.

The average textural analysis showed a sandy loam class with roughly 60% sand, 30% silt and 10% clay. Working to build organic matter levels is important so that sandy soils can hold onto water and nutrients better. The organic matter levels varied by trial, with two fields being below 2.0%, one of them with organic matter in the 2.0-2.5% range, and the remaining three with levels in the 2.5-3.0% range. We did not observe any trends with regard to soil nutrient levels between treatments. Most differences between the treatments were very small or non-existent.

When looking at soil health metrics, the active carbon levels were also low in most of the trials. However, for five out of eight treatment/control comparisons, it appeared that the active carbon levels were slightly higher following a cover crop versus than the check in the spring of 2020. This may have been random variation, but it will be watched closely in future years of this project.

Table 1: Soil active carbon levels (µg/g) across trials over 2019-2020

	Active Carbon (µg/g)			
Trial: Treatment	**Fall 2019 (Composite)**	**Spring 2020 (Treatment)**	**Spring 2020 (Control)**	**Spring 2020 (Difference)**
Field 1: Mustard/Oats	542	492	451	+41
Field 2: Barley	395	382	351	+31
Field 3: Barley	336	242	310	-68
Field 3: Radish	336	337	310	+27
Field 4: Radish	413	388	344	+44
Field 4: Mustard	413	462	344	+118
Field 5: Mustard	280	285	290	-5
Field 6: Oats	385	329	342	-13
Average	**388**	**365**	**343**	**+22**

The soil aggregate stability was generally quite low at all the sites, below 30%. It is anticipated that a history of heavy tillage/soil disturbance compacting the soil structure paired with high sand-content contributed to these low scores in all the trials. There was not an observable trend of soil improvement in aggregate stability following cover crops in these fields.

Only one trial showed both lower *Verticillium dahliae* (VD) and root lesion nematode levels (RLN) between treatments and control, with an oats cover crop compared to the bare check. Three of the other trials showed lower levels of one of these pests, and higher levels of the other, in the cover crop as compared to the check. There were no consistent trends obvious from the results for these two variables across all six fields. This is not a surprise, given the site-specific nature of VD and RLN populations, as well as the fact that none of the cover crops planted are known to be preferred hosts for these pathogens. In addition, it may be challenging comparing *Verticillium* and nematode counts in the fall of one year with counts in the spring of the following year. In future years the research team will investigate options to perform testing at consistent times for each year in an attempt to control the seasonal effect on these variables.

Results- Canopeo % Ground Coverage:

Trials #1 and #2 had the best green ground coverage (roughly 80% and 25% respectively), as they were the earliest planted trials; however, the other four trials did not establish as well, with only 5-10% green cover. Most of the trails were seeded in late September, which is less favorable to get a good catch of the cover crops. The fall conditions in 2019 were not ideal; very dry in August (making tillage difficult), then followed by significant rainfall with Hurricane Dorian (and more rainfall immediately afterwards). It was consistently wet and cool through early and mid-September delaying seeding dates and reducing the window of growth for many of these cover crops. Fields established in the fall of 2020 through BMP1 were generally planted much earlier (August/or earlier in September), increasing the likelihood of obtaining good crop growth.

Results - Potato Grades/Yields:

A few trials had significant differences for a handful of potato crop quality attributes **(Table 2).**

Table 2: Potato yield and quality measurement differences between treatment and control from 2020 harvest samples

Trial/Treatment	Total Yield (cwt/ac)	% Smalls	% Over 10 oz	Specific Gravity	Marketable Yields (cwt/ac)	Crop Value ($/Acre)
Field 1:Mustard/Oats	**+27.2**	-0.7	-8.2	-0.001	+17.7	+231
Field 2: Barley	+2.6	-1.9	**+5.0**	+0.001	+8.9	+118
Field 3: Barley	**+59.5**	**-9.6**	-4.1	NA*	**+69.0**	**+1196**
Field 3: Radish	**+47.2**	**-12.7**	**-5.0**	NA*	**+62.6**	**+1084**
Field 4: Radish	-12.4	-0.3	**+6.8**	+0.004	-21.3	-221
Field 4: Mustard	+9.2	+0.5	+1.5	-0.001	-8.5	-197
Field 5: Mustard	+13.7	+1.1	-1.6	+0.003	+12.3	+274
Field 6: Oats	**+55.9**	-6.5	+1.6	NA*	**+53.0**	**+914**
Average	+25.4	-3.8	-0.5	0.001	+24.2	425

Note: NA= Not Applicable. In this case not measured. Statistically significant differences are bolded.

Across all treatment/check comparisons, the average increase in marketable yield after using a fall cover crop was 24.2 cwt/ac. This response is relatively consistent with potato yield increases following cover crops documented by the Agriculture and Horticulture Development Board (AHDB) researchers in the United Kingdom, as well as tomato yield increases following fall cover crops by the University of Guelph/Ridgetown researchers in Ontario.

Summary:

Based on the six trials discussed above, the differences in organic matter and most soil health attributes measured were minimal, but these fields would likely have to be followed over a longer time period to see trends over time. There could be a slight trend in active carbon levels, but it will continue to be assessed in future years. The soil root lesion nematode and *Verticillium dahliae* counts were inconsistent to date, needing additional data collection to determine if there are any longer-term trends.

Percent green ground cover was excellent in two of the trials, but low in the remaining four, indicating that more suitable fall weather conditions and earlier planting date would result in better establishment rates. Total potato yields were statistically significantly higher in at least half of the trials due to cover cropping compared to bare soil.

Despite being in the middle of a global CO-VID pandemic, it has not affected the data collection aspect of the work plans through the Potato Board to the same extent as some other collaborative Living Labs research partners. The main set-back to-date was a delay submitting soil samples to some laboratories in the spring of 2020 during the Public Health directive to restrict business services for a period of roughly 8 weeks. Once it was safe for the labs to re-open sample, submissions resumed smoothly. Additionally, one adaptation was made moving most meetings online (with a much smaller in-person component) to share results with larger audiences. However, it can be less interactive communicating over these technologies compared to in-person meetings.

When the soil sampling for the health package began in 2019, it was originally collected using the shovel method described in the Cornell Soil Health Manual (CSHA). However, after discussing it with a local nutrient management specialist, since an auger reaches a similar depth of 6 inches (15cm) and taking into account the additional time that would be required to collect many samples with a shovel, a decision was made to switch to an auger for the 2020 year. Soil sampling for chemical analysis in 2019 was originally done using a soil probe to reach a 30cm depth, but based on efficiency with other soil sampling protocols, it was justified to switch to using an auger for the 2020 sampling to the same depth.

In 2019, soil erosion testing was conducted comparing data from two pans/treatment, but moving into 2020, a decision was made to increase the testing by putting three pans/treatment. This increased testing capacity was possible after ordering additional equipment. Soil erosion pins (metal rebar) were also used to assess soil erosion in both years, but the results have been quite inconsistent, with no clear trends (some pin heights above the original and some below) so that method will likely be discontinued in future years of the project. The data from the splash pans was more reliable in both years.

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