Evaluating NS Compost for the Agricultural Market

2018-2022 Final Report

FEBRUARY, 2023

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Introduction

In 2017, DivertNS and Nova Scotia Environment funded the project, “Creating an Agriculture Market for Compost in Nova Scotia - Phase 1” to bring the agriculture and compost industries together to discuss challenges and opportunities to using compost. The project indicated there was an opportunity and enthusiasm for both industries to work together. The demand for compost from the agricultural industry has been low, due to a lack of awareness of the value of compost for improved soil health.

A five-year (2018-2022) project “Creating an Agricultural Market for Nova Scotia Compost – Phase 2” was funded by DivertNS, NS Environment and Municipal Group to conduct compost research and demonstration projects on agricultural land.

The goals of Phase 2 were:

- Set up demonstration fields across NS to evaluate and demonstrate the agronomic benefits of using compost. This included economic value, improved soil condition, microbial activity and crop yields.

- Develop a focused communication plan, with marketing strategies better designed for the agriculture industry (factsheets, farm tour workshops, etc.)

- Investigate potential new product classification through testing and field projects. Phase 1 indicated that Ag expressed interest in more immature compost to capture a greater nitrogen value that is not found in fully matured compost traditionally sold to soil blenders and home garden.

- Produce a clean compost, free of plastics and consistent in moisture and nutrients and identify potential product or logistical issues.

Summary

The project compared four treatments on the same fields for five years. Treatments included control (no compost, farmers traditional fertilizer program), immature compost applied yearly at 10 tonnes/acre, mature compost applied yearly at 10 tonnes/acre and mature compost applied only in the first year at 30 tonnes/acre.

Test parameters included soil analysis, soil condition, tissue analysis, microbial analysis and crop yield and quality.

Three long-term project fields (field crops) were established in 2018:

- Stewiacke
- Brookfield
- Scotsburn

The 2018 fields were owned by dairy farmers who have been the most progressive in utilizing waste-to-resource amendments. Dairy is the largest agricultural sector in the compost facility locations. The project fields grew corn, soybeans, barley, and wheat.

In 2019, a fourth long-term project field was established in:

- Thomson Station – lowbush blueberries.

Two additional investigative projects for developing blueberry fields were added to the project in 2021:

1. Application on newly cleared land. The purpose of this project was to evaluate if the decomposition of the wood waste from land clearing was quicker and if the blueberry plants grew and spread faster.

2. Filling in field bare spots to encourage crop spread. The purpose of this project was to compare compost and sawdust for improvement in blueberry spread. Blueberries do not spread as quickly into bare spots.

Samples of the mature and immature compost from the two participating compost facilities were sent for amendment analysis. The nutrient content of the compost varied between facilities and years, however, variation in the product is acceptable within the industry.

The immature compost (IC) contained more ammonium-N, which is immediately available to the crop. The mature compost had higher levels of phosphorus (P_2O_5), potassium (K_2O) and magnesium (Mg), which increased the fertility value.

The fertility value of the compost was calculated using world market fertilizer prices. Although organic matter is a significant component, it is difficult to calculate a dollar value. As the agricultural model is developed for premium carbon credit prices on the voluntary market, there will be considerable value for organic matter. When the price of fertilizer increases, the value of compost increases, resulting in a higher return on investment. As fertilizer costs increase, it can increase the demand for alternative sources of fertilizers.

Soil samples were collected pre- and post-applications annually and analyzed for organic matter, nutrients, pH and cation exchange capacity (CEC). The results were compared between the crop fields (barley, corn, soybeans and wheat) which have the same soil nutrient requirements, and lowbush blueberries which have unique soil and nutrient requirements.

All compost treatments increased soil nutrient levels over the control in all fields. IC10 and MC10 had the largest increase, for P_2O_5, K_2O, calcium (Ca) and cation exchange capacity (CEC). Increasing CEC increases the soils ability to hold onto nutrients.

It is very difficult to increase soil organic matter. MC30 and MC10 had the largest increase in organic matter.

The soil condition parameters that were tested included soil moisture, soil compaction, bulk density, water holding capacity and soil biology.

The soil moisture and soil compaction testing results were not consistent between years and fields. Other testing methods were better indicators for soil health.

Soil bulk density is related to soil function for improved root growth through structure, water movement and aeration. The annual application of compost improved bulk density. The soil bulk density was optimum in all treatments in three of the four fields. In the fourth field, IC10 was the only treatment to have ideal bulk density. IC10 and MC10 had the most improved bulk density in two of the four fields.

Water holding capacity is the amount of water the soil can hold. An increase in water holding capacity improves soil resiliency against climate change and drought. The treatments that improved water holding capacity was IC10 and control. Despite the varying results, the addition of compost has shown improvement in soil water holding capacity through increasing organic matter.

Soil microbial communities are important for nutrient cycling, organic matter decomposition, soil structure, disease control and plant growth. The compost treatments all had higher levels of mineralizable nitrogen, microbial soil activity, active carbon and total gram-negative microbes over the control.

The soil health index is a numbering index developed to categorize overall fertility and soil health. MC10 had the highest soil health index followed by MC30. All compost treatments scored higher than the control. The addition of compost had a significant positive impact on soil biology and overall soil health.

Crop yields and quality were measured. The field crop yields had higher yields in the compost treatments in all but one field with the highest yield achieved by MC30 (88%). Crop quality was improved with the addition of compost in soybeans, barley and wheat. The return on investment (ROI) is higher using compost to achieve equal/higher yields, resulting in higher farm profit.

The addition of compost to the new cleared blueberry field shortened time of decomposition of wood material. The blueberry plants were larger and spread further than the field that did not receive compost. The addition of compost significantly increased the soil nutrient levels, providing necessary fertility for plant growth and improved soil health.

Applying compost to bare spots in an established lowbush blueberry field increased both vegetation and crop spread when compared to sawdust. Compost should be used as an alternative to sawdust to improve plant spread into bare patches in fields.

Compost presentations and farm field tour workshop were successful in educating the agriculture industry on the significant potential of using compost in agricultural systems.

Nova Scotia Environment needs to review their Class A and B metal standards for land application of amendments and composts. Inorganic fossil fuel fertilizers shipped from other countries such as Russia and China only have to meet Class B metal standards, yet local sustainable amendments must meet Class A metal standards. This is a significant barrier to using local amendments that sequester carbon, have a lower carbon and greenhouse gas emission footprint than inorganic fertilizers.

The project supports the use of immature compost for agricultural production. This can save significant municipal expenditures of ensuring all their compost meets maturity while allowing a cost-effective product to be used by agriculture. Compost Council of Canada is concerned about governments allowing the use of immature compost because of their long history of educating the public on quality compost. This concern can be addressed if governments only regulate the use of immature compost for agricultural land application. It would require a new product classification without the name compost. It would still have to meet metal, pathogen and foreign material standards.

Farmers are interested in using compost, however plastic content remains a significant issue. It will be essential that facilities commit to reducing plastic and foreign material before shipping compost to the agriculture industry. If compost facilities send out poor quality compost, the agricultural industry will not use compost and the market potential will be lost.

Project Design and Locations

Project Design

The project evaluated different rates of mature and immature compost and their impact on soil health and fertility. Standard inorganic fertilizer was compared to the compost treatments.

Immature compost (IC) was compared to mature compost (MC) as the agricultural community would prefer a more active compost with higher nitrogen levels. This could provide significant savings to compost facilities, by shortening the composting period, allowing compost facilities to handle more feedstock in a year and produce a product for the agricultural industry. This could provide significant savings to farmers by reducing the reliance on expensive chemical fertilizers and improve soil health.

Fields were divided into four treatments. The application rate of 10 t/acre was used as it is a traditional application rate for solid manure. The treatment application rate of 30 t/acre was used to determine if one heavy application will have the same effect as lesser applications over multiple years and if there were crop phytotoxic effects. The treatments were:

1) **IC10** = immature compost is applied at 10 t/ac each year.
2) **MC10** = mature compost is applied at 10 t/ac each year.
3) **MC30** = mature compost is applied once in the first year of the project only.
4) **Control** = farmer follows their traditional fertility program using only chemical fertilizer. No products containing organic matter are applied.



Project Fields (2018-2022)

Project fields (field crops) were set up in the spring of 2018 in Stewiacke, Brookfield and Scotsburn.




Dairy is the largest agricultural sector in those areas. The project fields were owned by progressive dairy farmers who have been utilizing waste-to-resource amendments. Crops grown in the fields included corn silage, grain, forage and soybeans.

The fields received the fourth and last annual application of compost in 2021. The compost was applied to the Scotsburn and Stewiacke fields in the spring prior to planting. The Stewiacke field had compost applied after winter wheat was harvested in the fall.

The project was expanded to the lowbush blueberry industry in 2019. Lowbush blueberries are grown on shallow soils with low organic matter and high carbon content. Fields that have been newly cleared have tree branches, roots and bark which tie-up nitrogen in the decomposition process, robbing it from the blueberry plants. Decreasing the years between clearing a field to harvesting berries increases the return on investment significantly.

In 2021, Canadian lowbush blueberry production encompassed over 50% of the total fruit acreage in Canada at 170,500 acres. Quebec grew the largest acreage at 79,091 acres. NB is second at 36,127 acres, followed by NS at 35,814 acres. PEI grew 16,068 acres while NFLD only grew about 3400 acres. Blueberry acreage continues to expand every year.

Project field set up in Thomson Station. The first compost application was in late fall of 2019. Compost was applied after crop dormancy on slightly frozen ground to avoid damaging the shallow roots and rhizomes.

The blueberry fields received the final application of compost in the early spring of 2022.


Pre-application


10 t/ac


30 t/ac

Two additional projects were established at the same lowbush blueberry farm to address industry challenges: increasing rate of carbon decomposition in new cleared land and fill in bare spots in fields to encourage crop spread.

1) application on newly cleared land and

2) filling in the bare spots to encourage spread.

Compost Nutrient Analysis & "Value"

Immature and mature compost samples from each facility were sent for soil amendment analysis.

The compost was analyzed as a soil amendment and not as a soil media (traditional testing). Soil media is the material in which plants are grown. A soil amendment provides fertilizer and other components that will be added to the soil media to grow plants. Compost has been used in whole or in part, as a soil media in the nursery and horticultural sectors. Using compost as a soil amendment requires different testing methodology and reporting to reflect this end-use. The test results will differ depending on which analysis and reporting protocol is used.

Two compost facilities participated in the project, supplying immature and mature compost. The nutrient content of the compost varied between facilities, and years, in fertility content, moisture and the C:N ratio.

Farmers are most interested in the fertility content of the compost. Facility 1, the largest variation was in the potassium content, by 2.3 kg/t (0.2%). This variation equates to 23 kg/ac with the application of 10 t/ac and 69 kg/ac with the application of 30 t/ac. Facility 2, the largest variation was in the phosphorus content, by 4.6 kg/t. This variation equates to 46 kg/ac with the application of 10 t/ac and 138 kg/ac with the application of 30 t/ac.

When recommending residual amendment products to farmers, current tests should be used, as variations are expected. This variation is acceptable within the industry.

Table 1: Facility 1 Compost Results for Immature (IC) and Mature (MC) Compost

As Applied in Kg/T	IC 2019	IC 2020	IC 2021	MC 2019	MC 2020	MC 2021
Dry Matter %	56.6	54.4	60.4	50.9	46.5	55.67
Total Nitrogen	11.8	10.5	11.6	12.6	11.4	11.0
Ammonium-N	ND	2.5	2.4	ND	1.5	0.8
Carbon:Nitrogen Ratio	15.1	9.0	9.1	9.1	8.0	14.7
P_2O_5	5.6	6.7	4.9	8.2	6.6	6.6
K_2O	4.5	2.2	2.2	4.3	4.8	2.7
Calcium	35.0	38.7	28.2	32.9	28.2	32.7
Magnesium	4.4	5.3	1.8	4.9	5.5	3.5

Table 2: Facility 2 Compost Results for Immature (IC) and Mature (MC) Compost

As Applied in Kg/T	IC 2019	IC 2020	IC 2021	MC 2019	MC 2020	MC 2021
Dry Matter %	56.7	57.5	58.3	45.3	72.5	74.1
Total Nitrogen	13.2	15.1	15.0	12.8	13.0	16.3
Ammonium-N	2.6	3.6	3.8	2.1	1.8	1.4
Carbon:Nitrogen Ratio	ND	11.8	9.4	ND	7.9	7.4
P_2O_5	7.0	6.9	7.0	9.0	9.2	13.6
K_2O	3.3	3.1	2.7	2.4	3.7	4.0
Calcium	19.5	26.7	41.0	22.7	54.7	40.3
Magnesium	2.5	1.7	3.8	3.1	5.7	5.0

The immature compost contained more ammonium-N, which is immediately available to the crop. The mature compost contained more phosphorus (P_2O_5), potassium (K_2O) and magnesium (Mg) which increased the value.

Compost fertilizer value is calculated using the world fertilizer market prices. The value is not the selling value, rather the value to the farmer and their return on investment. Using compost requires increased trucking and spreading costs. As chemical fertilizer prices increase, the value of the compost increases.

Table 3: Compost Fertilizer Value Changes base on Year

Based on 2019 Analysis	2019	2020	2021	2022
Facility 1 IC	$115	$117	$120	$126
Facility 1 MC	$120	$123	$127	$133
Facility 2 IC	$84	$86	$91	$97
Facility 2 MC	$85	$87	$101	$107

**based on approximate 2019 world market prices for N, P, K, Ca and Mg*

Parameter Analysis

The testing parameters in each treatment included:

- Soil Analysis
- Soil condition
- Tissue Analysis
- Crop Yield and Quality

Soil sampling

Soil samples were collected pre- and post-applications annually and analyzed for organic matter, nutrients, pH and cation exchange capacity (CEC).

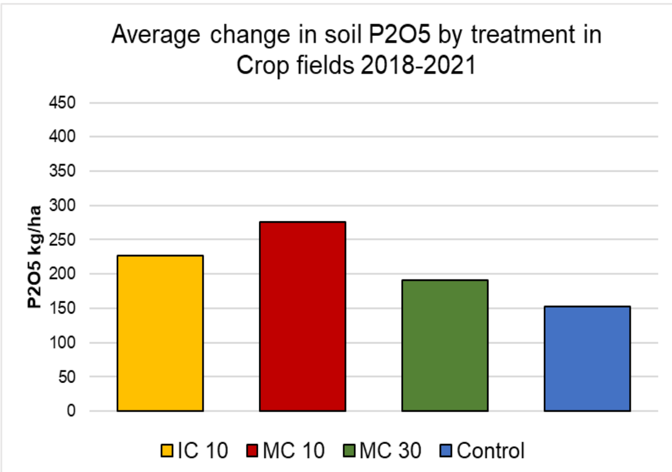
The results were compared between the crop fields (barley, corn, soybeans and wheat) which have the same soil nutrient requirements, and lowbush blueberries which have unique soil and nutrient requirements.

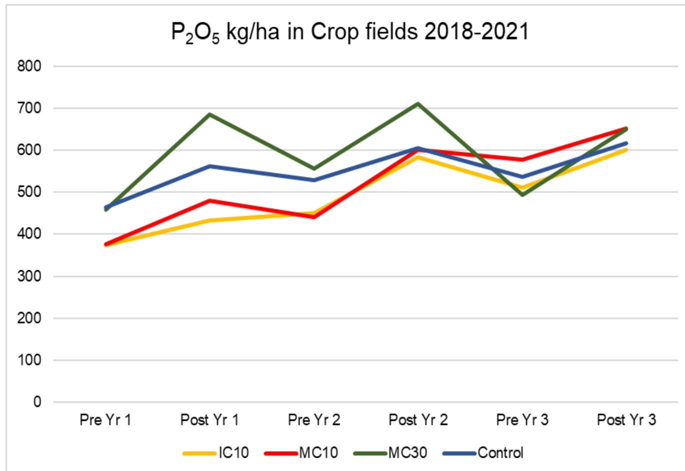
- **Phosphorus (P_2O_5)**

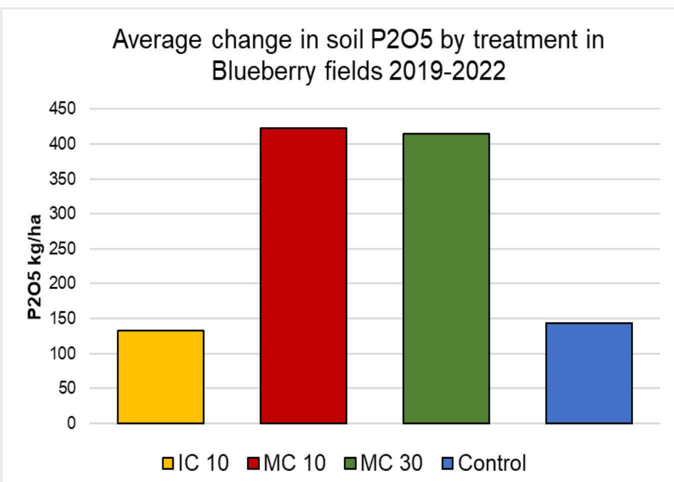
The P_2O_5 soil levels increased in all treatments.

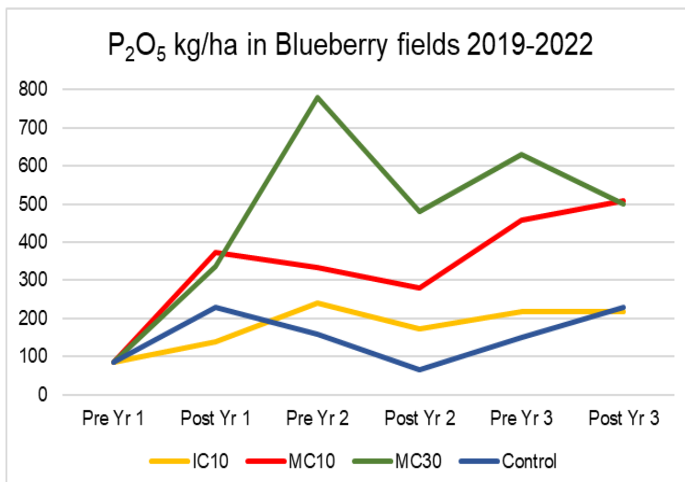
In the crop fields, MC10 had the greatest increase, followed by IC10. All the compost treatments increased more than the control.

In the blueberry field, MC10 had the greatest increase followed by the control. MC10 and MC30 increased the most, while IC10 and control increased the same.









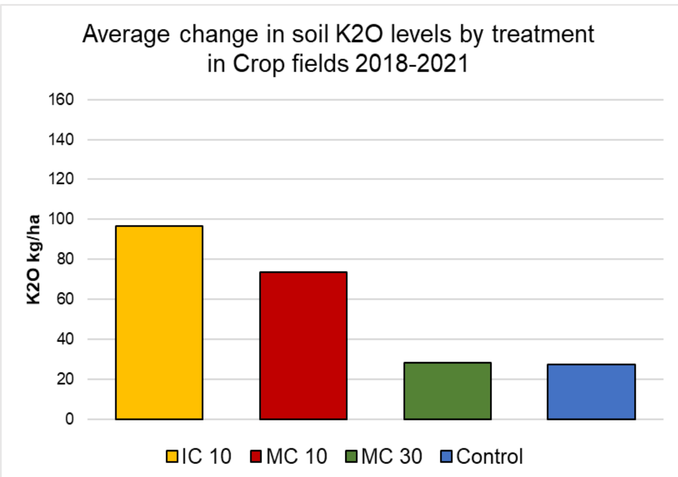
- **Potassium (K_20)**

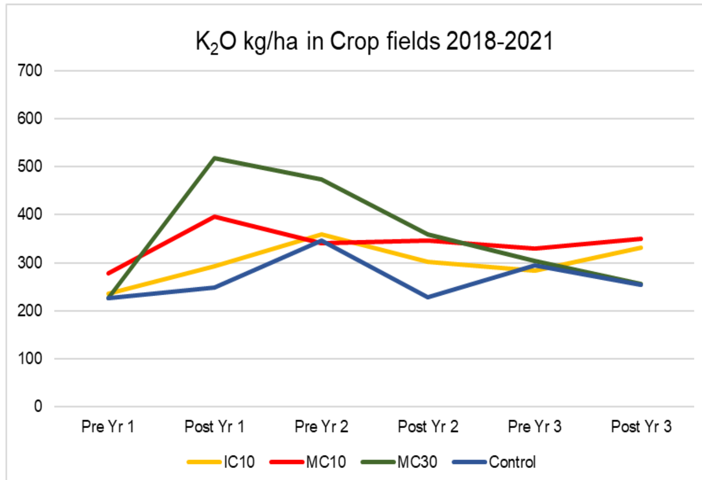
The K_20 levels increased in all treatments in the crop fields.

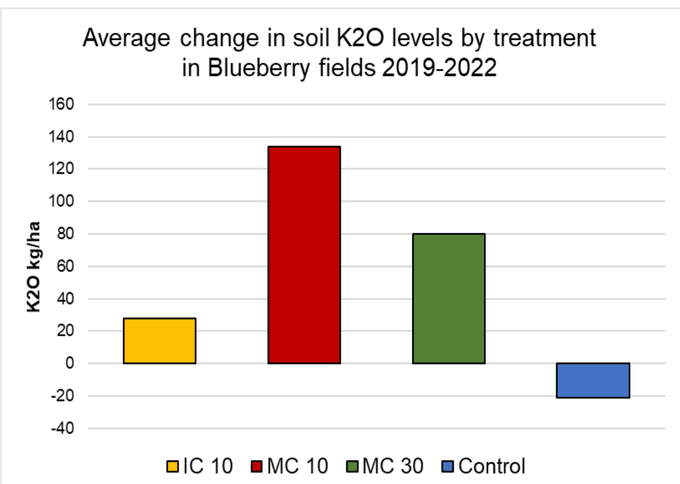
In the crop fields IC10 had the greatest increase followed by MC10. In the blueberry field, MC10 had the greatest increase followed by MC30.

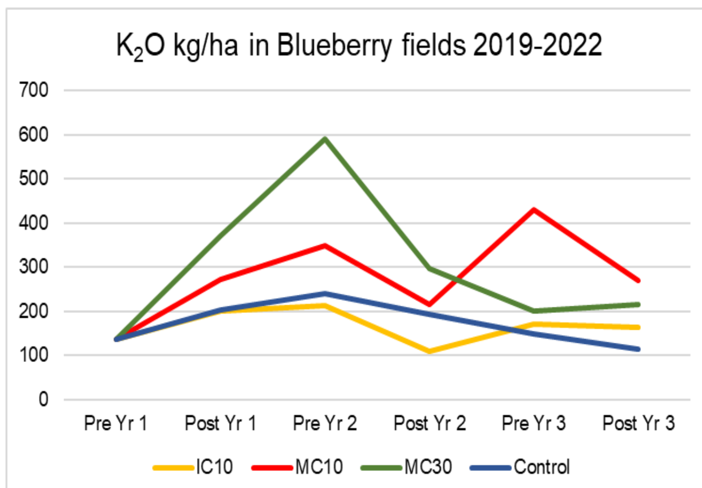
The control had a negative change (decreased). All compost treatments increased while the control decreased.

K_20 is removed by the crop at the highest rate of all soil nutrients. The compost supplies enough K_20 to meet crop removal rates.







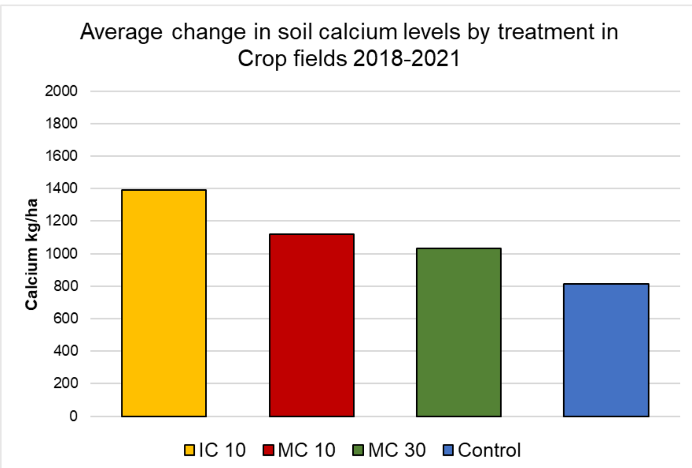


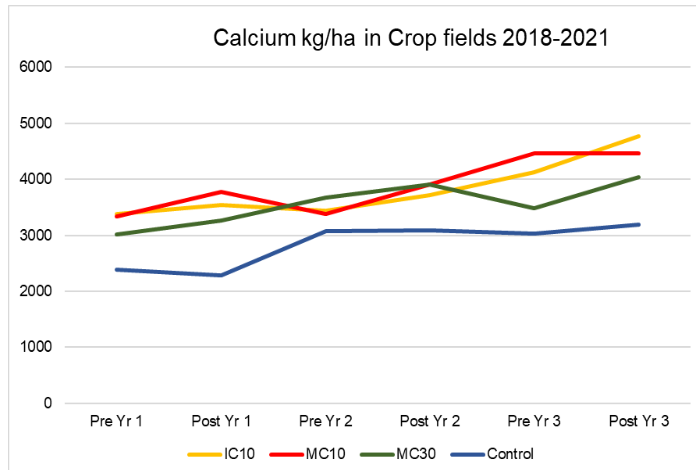
- **Calcium (Ca)**

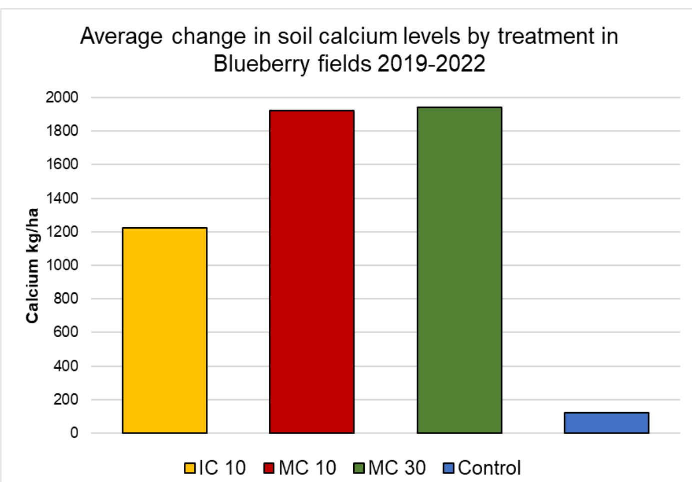
The calcium levels increased in all treatments.

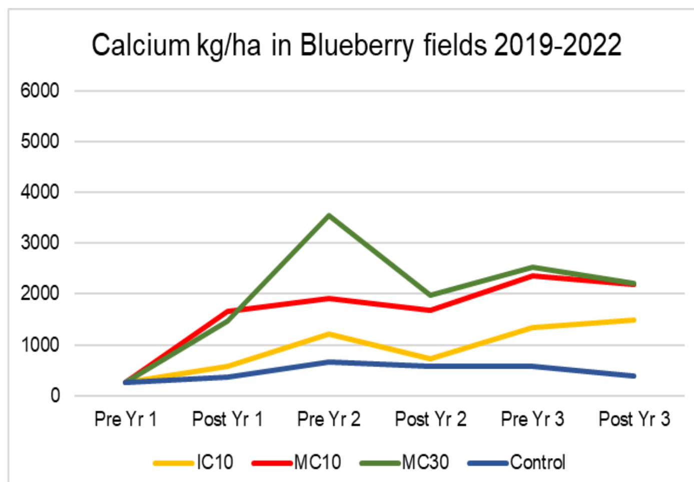
In the crop fields, IC10 had the greatest increase followed by MC10. The compost treatments increased more than the control.

In the blueberry field, MC30 had the greatest increase followed by MC10. All compost treatments increased more than the control.









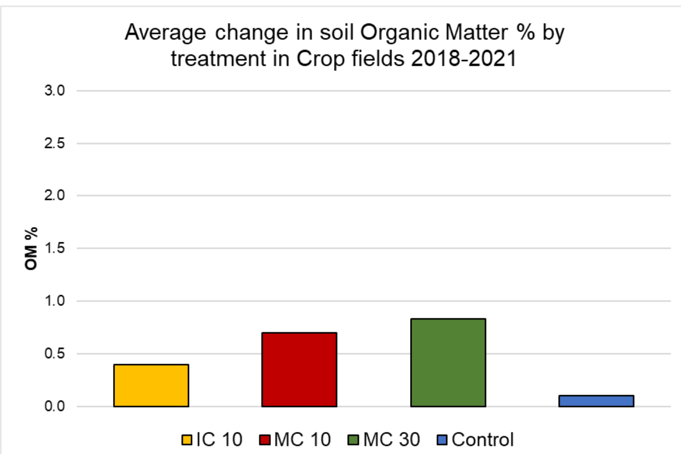
- **Organic Matter (OM)**

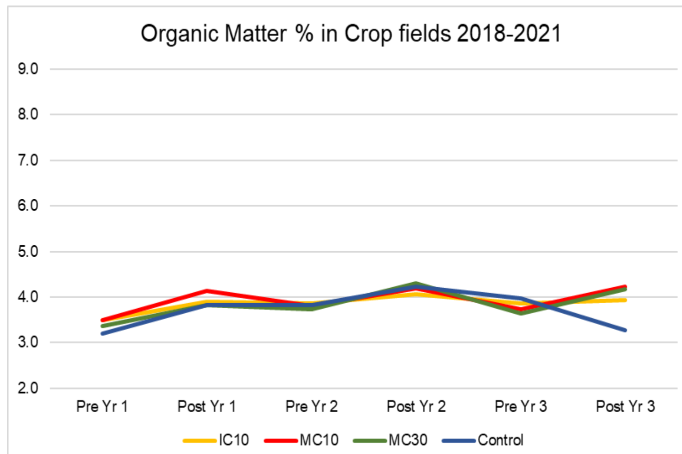
Organic matter increased in all treatments.

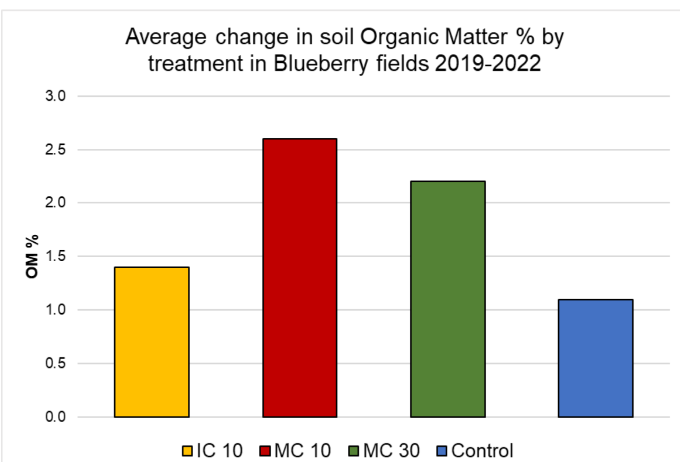
In the crop fields, MC30 had the greatest increase followed by MC10. All compost treatments increased more than the control.

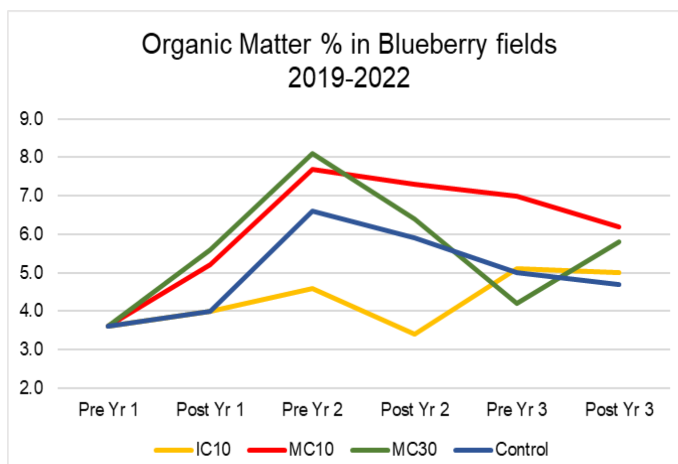
In the blueberry field, MC10 had the greatest increase followed by MC30. All compost treatments increased more than the control.

It is very difficult to increase soil organic matter. The crop fields had annual tillage, which reduces organic matter. The blueberry field did not have any tillage. Although there is no agreed upon dollar value for organic matter, the ability to increase it is valuable to agriculture for combatting climate change.









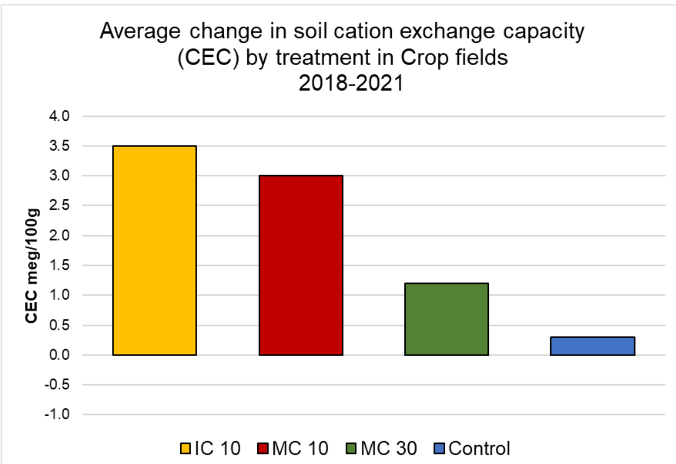
- **Cation Exchange Capacity (CEC)**

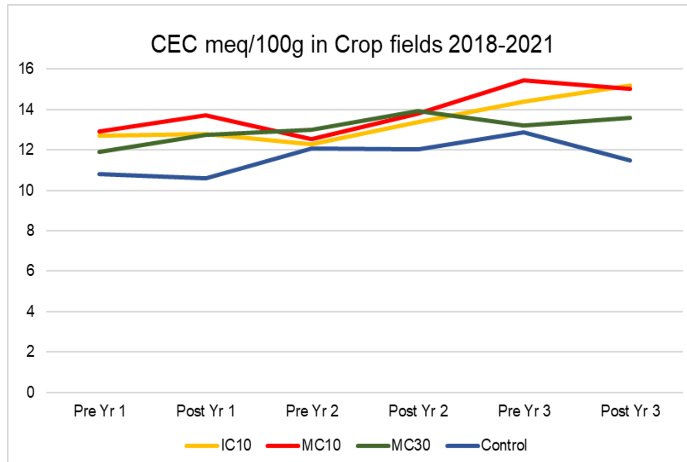
The cation exchange capacity (CEC) increased in all treatments, except the blueberry control.

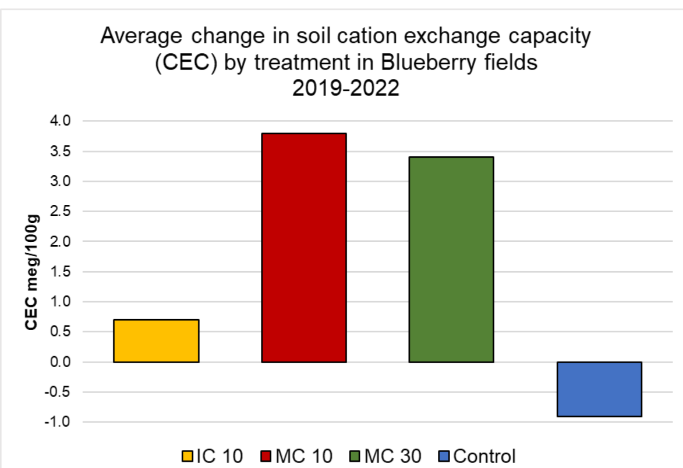
In the crop fields, IC10 had the greatest increase followed by MC10. All compost treatments increased more than the control.

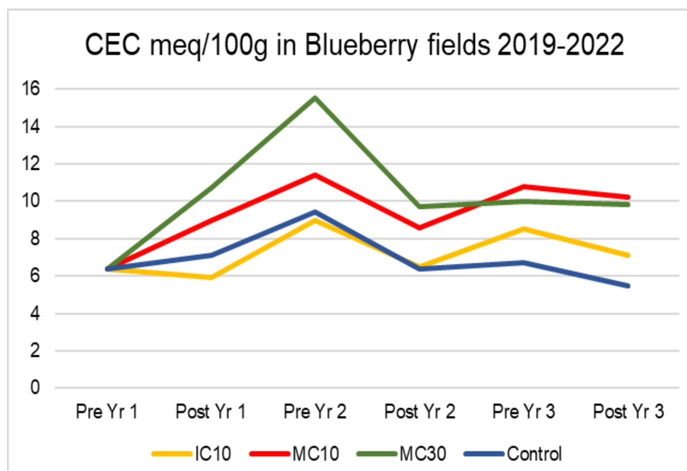
In the blueberry field, MC10 had the greatest increase followed by MC30. The control treatment had a negative change (decreased). All compost treatments increased more than the control.

This indicates that the compost treatments have improved the nutrient holding capacity of the soil.









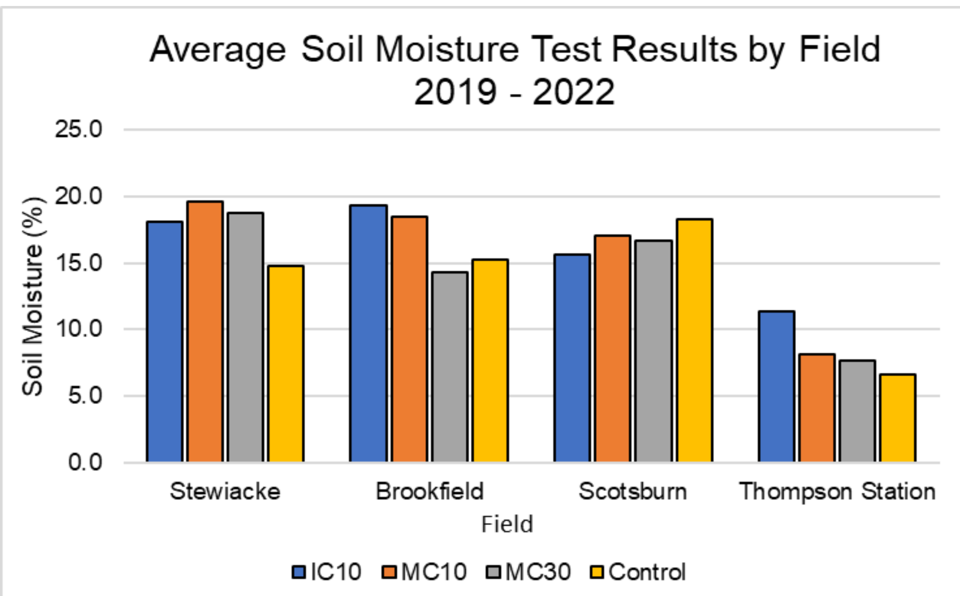
Soil Condition

Soil moisture meter and penetrometer readings were recorded in 10 random locations within each treatment annually. Bulk density, water holding capacity and samples for soil biology testing were collected from each treatment in each field at the end of the project.

- **Soil Moisture**

Soil moisture results were not consistent in each field. The addition of compost over time did not result in consistent improved water holding capacity data.

The topography of the fields may be influencing the results. The Stewiacke and Brookfield fields are flat, while the Scotsburn and Thomson Station fields have rolling hills with variable drainage.



- **Soil Compaction**

A penetrometer was used to measure soil compaction to determine if there was an improvement in soil structure from the addition of compost.

The results were not consistent between fields and there was very little difference between treatments. Other testing methods were better indicators for soil health.

- **Soil Bulk Density (SBD)**

Soil bulk density is related to soil function to improve root growth through structure, water movement and aeration. It is used to express the soil's physical, chemical and biological measurements on a volume basis.

Ideal bulk density for root growth depends on soil texture. The project fields had three different soil types. The Scotsburn field was gravelly clay loam, the Thomson Station field was sandy loam, and the Brookfield and Stewiacke fields were silt loam.

Table 4: Relationship of SBD to Root Growth		
Soil Texture	Ideal Bulk Density for Plant Growth	Bulk Density that Restricts Root Growth
Sandy	<1600 kg/m^3	>1800 kg/m^3
Silty	<1400 kg/m^3	>1650 kg/m^3
Clayey	<1100 kg/m^3	>1470 kg/m^3
Source: Soil Quality Physical Indicator Information Sheet Series; https://cafnr.missouri.edu/wp-content/uploads/2016/09/bulk-density.pdf		

Lower bulk density levels are better for root growth.

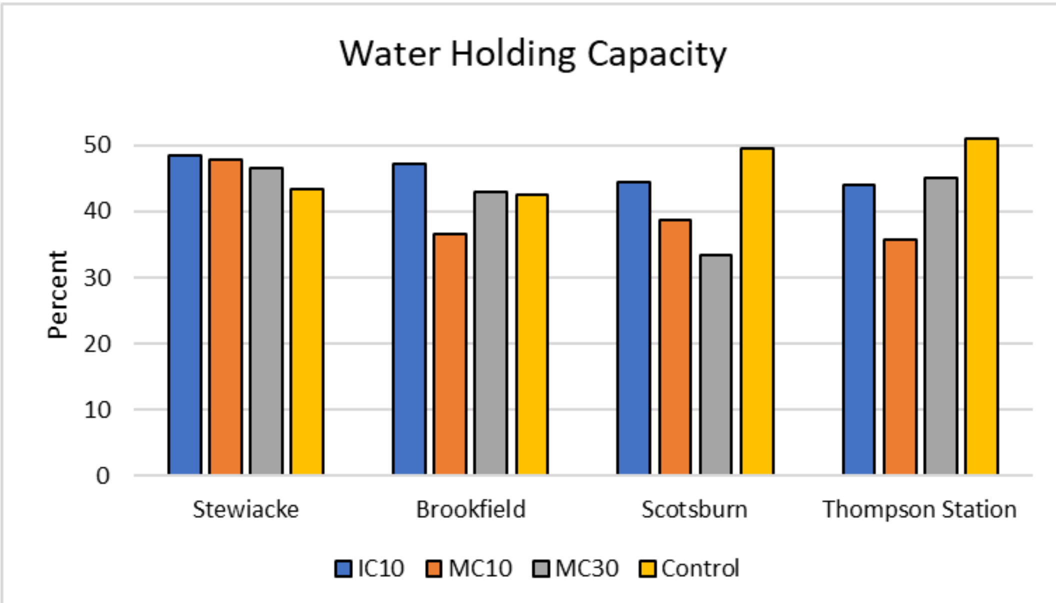
The results of the bulk density tests indicate that the Stewiacke and Brookfield fields (silty) had ideal bulk density. In the Scotsburn field (clayey), none of the treatments had ideal levels, but IC10 and MC10 were the only treatments below levels restricting root growth. In the Thomson Station field (sandy), all treatments had ideal bulk density.

The bulk density was the best in IC10 and MC10, in two of the four fields. The annual addition of compost improves the bulk density.

Table 5: SBD Results				
Bulk Density (kg/m3)	Stewiacke	Brookfield	Scotsburn	Thomson Station
IC10	1173	**1226**	**1368**	1468
MC10	**1081**	1292	1420	**1291**
MC30	1309	1324	1705	1488
Control	1350	1291	1472	1475

- **Water Holding Capacity**

Water holding capacity is the amount of water soil can hold. An increase in water holding capacity improves resiliency against climate change and drought. Low water holding capacity results in drought stress and erosion. The soil will have a narrow threshold between too much water and not enough.



IC10 and control had the best water holding capacity in two of the four fields each.

Despite the varying data, overall results indicate compost improves water holding capacity through increasing organic matter. The compost increased organic matter in the project.

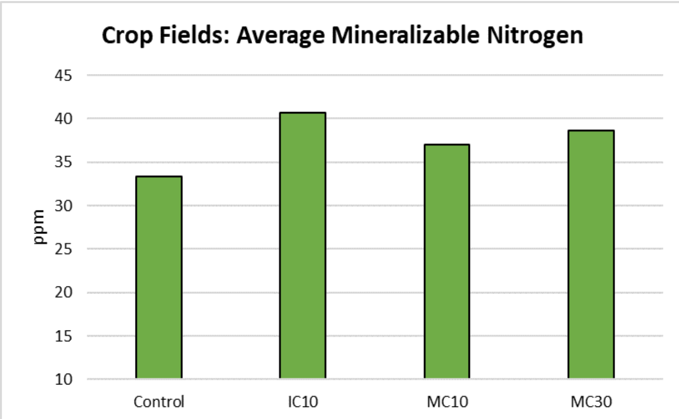
Soil Biology

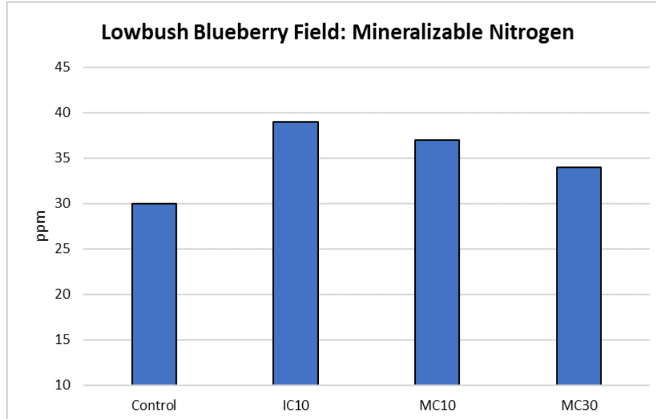
Soil samples were analyzed for biological soil health tests. The tests measure the biological composition of the soils. The presence or absence of certain types of microbes is an indicator of soil health.

Soil biology is important for nutrient cycling, organic matter decomposition and soil structure. It is fundamental for plant growth.

- **Mineralizable Nitrogen**

Mineralizable nitrogen is the amount of stable nitrogen in the soil that is converted to plant available nitrogen by soil bacteria.



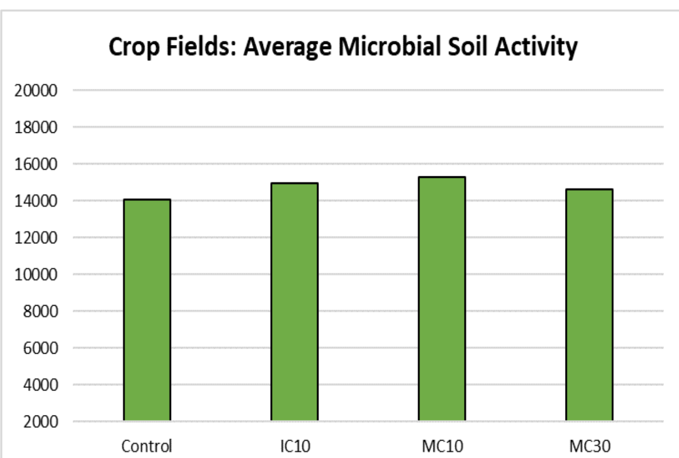


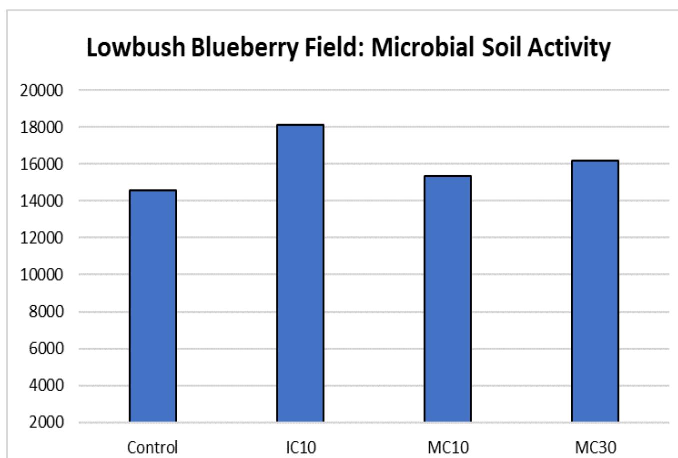
IC10 had the highest level of mineralizable nitrogen in the crop and blueberry fields, followed by MC30 in the crop fields and MC10 in the blueberry field.

All the compost treatments had higher mineralizable nitrogen levels than the control.

- **Microbial Soil Activity**

Microbial soil activity is the biological activity in the soil. Soil levels above 10,000 are required for healthy soils.





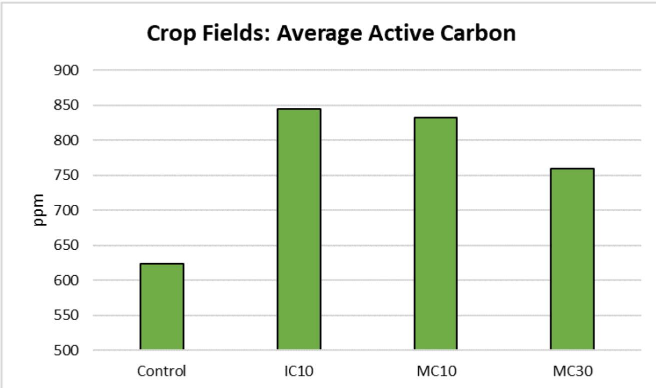
In the crop fields, MC10 had the highest activity followed by IC10.

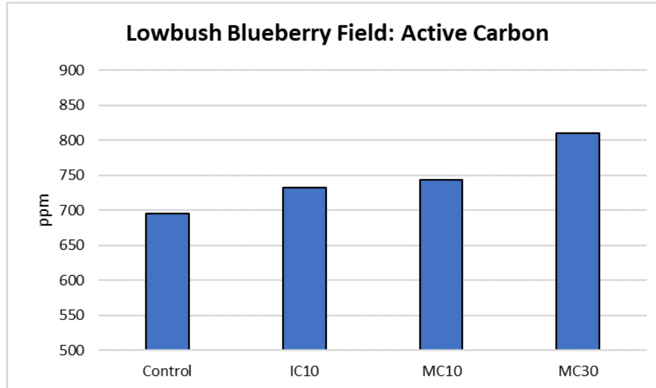
In the blueberry field, IC10 had the highest activity followed by MC30.

All compost treatments had higher activity than the control. All treatments had healthy levels.

- **Active Carbon**

Active carbon is the available carbon for soil microbes to flourish. Levels above 600 ppm are required for healthy soils.





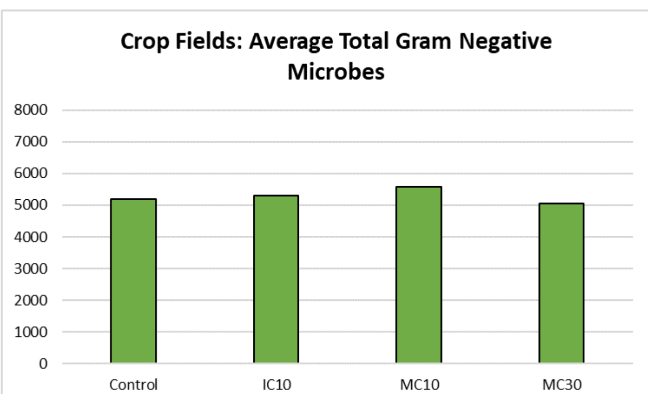
In the crop fields, IC10 had the highest levels followed by MC10.

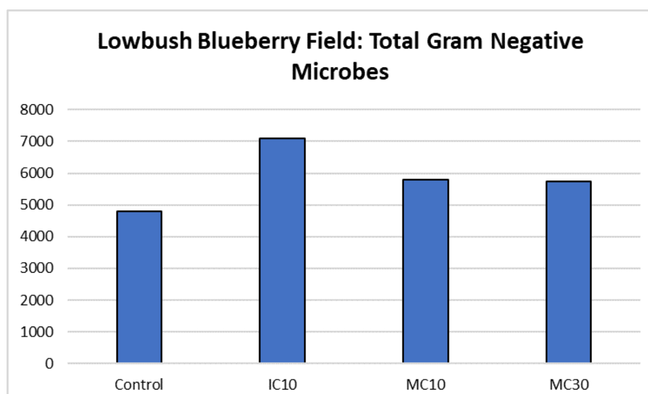
In the blueberry field, MC30 had the highest levels followed by MC10.

All compost treatments had higher levels than the control. All treatments had healthy levels.

- **Total Gram-Negative Microbes**

Total gram-negative microbe counts are plant derived carbon sources. They are very susceptible to loss through agronomic practices such as tillage and are very difficult to repopulate. Levels above 7000 are considered healthy.





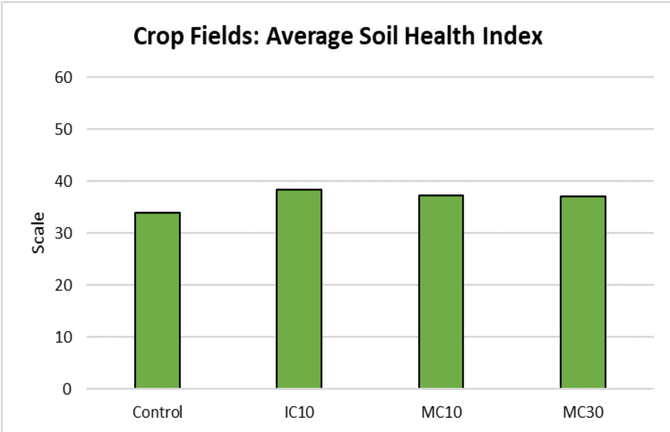
In the crop fields, MC10 had the highest levels followed by IC10.

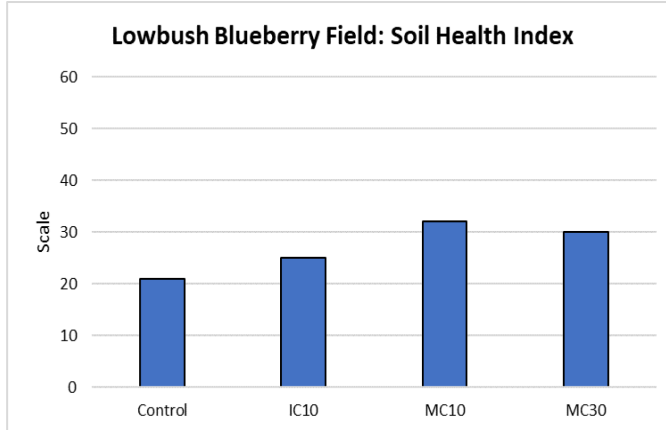
In the blueberry field, IC10 had the highest levels, followed by MC10.

IC10 in the blueberry field is the only treatment with healthy levels. The crop fields had annual tillage, while the blueberry had no tillage.

- **Soil Health Index**

Soil health index is a numbering index to categorize overall fertility and soil health.





In the crop fields, IC10 had the highest index, followed by MC10.

In the blueberry field, MC10 has the highest index, followed by MC30.

All compost treatments scored higher than the control. The addition of compost had a positive impact on soil biology and overall soil health.

Underwear Test

White cotton underwear were buried each year in each treatment as a visual comparison of microbial activity. The results mirrored the biological soil health tests.

The annual application of compost resulted in more biological activity, visible in the destruction of the underwear.

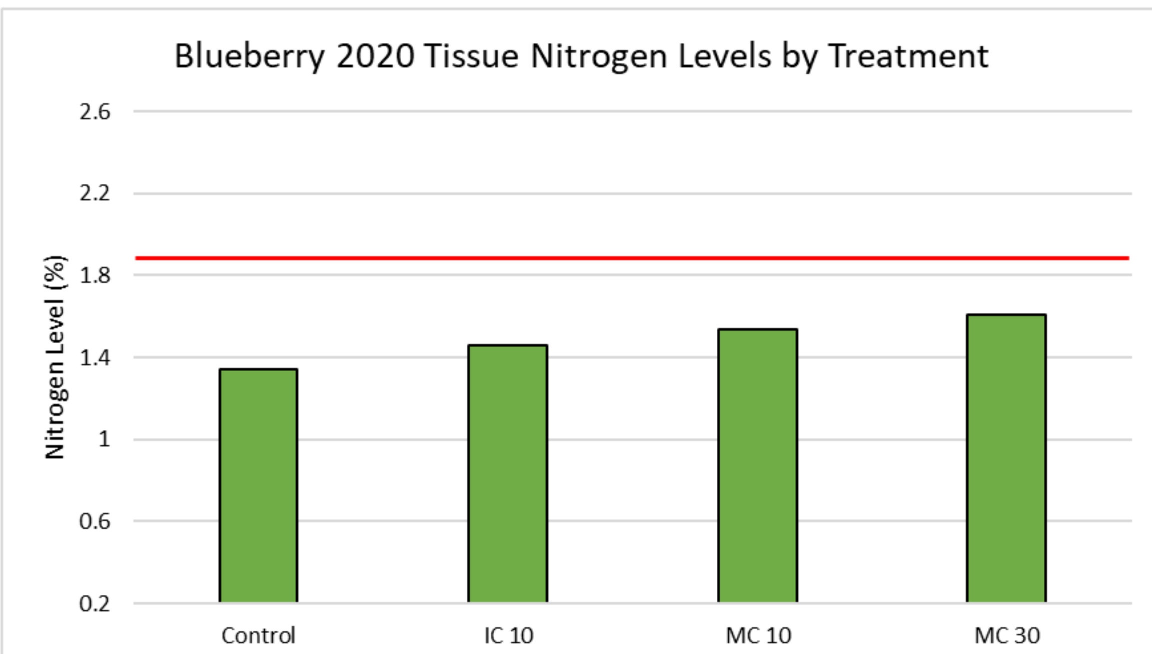
Lowbush Blueberry Tissue Sampling

Tissue analysis is a plant health indicator, measuring nutrient levels in the plant tissue. During the sprout year (2020), post application leaf samples were collected at the tip-dieback growth stage and sent for analysis.

Unfortunately, in 2021, a spring chemical herbicide application in killed blueberry plants and left the remaining plants severely stunted. Because of severe crop stress, samples were not collected.

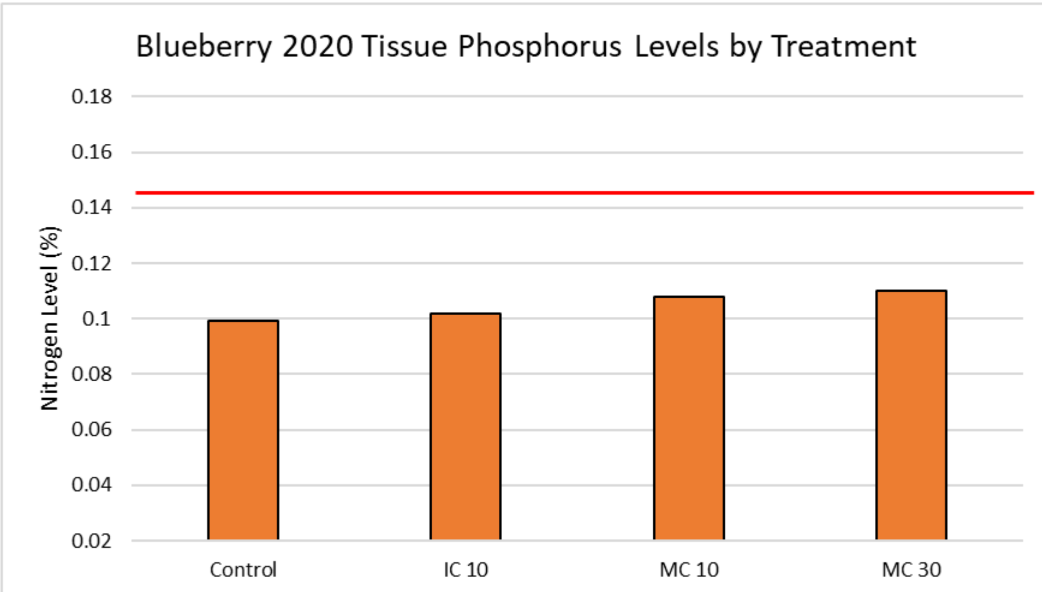
- **Nitrogen**

Nitrogen levels increased with higher application rates of compost. MC30 had the highest level followed by MC10. The control had the lowest level. All treatments were below optimum levels.



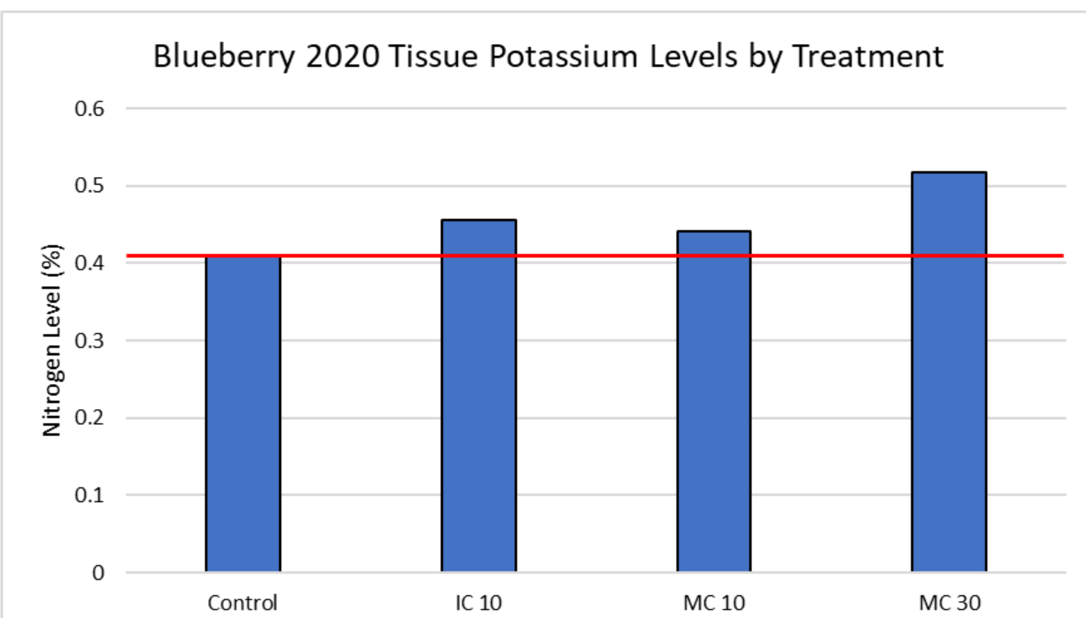
- **Phosphorus**

Phosphorus levels were highest in MC30, followed by MC10. Control had the lowest levels. All treatments were below optimum levels.



- **Potassium**

Potassium levels were highest in MC30, followed by IC10. Control had the lowest levels. All treatments were within optimum range.



Crop Yield and Quality

Crop yields were measured by harvesting a section in each treatment. The harvested area was measured and the yield was calculated (metric tonnes per acre). The field crops were corrected for moisture for accurate comparison.

Crop samples were analyzed for crop quality. Soybean and small grains quality were measured by test weight and crude protein, while corn silage was analyzed for feed quality and measured by crude protein and digestibility parameters. The data was expressed as relative feed value. Blueberry quality was measured by brix (sugars) as a measure of sweetness.

Crop quality and yield are what farmers will use to determine if they should incorporate amendments in their crop production program. If the amendment does not increase yield or quality, it is more difficult to calculate a positive return on investment.

- **Yield Results**

The average yields of the field crops, in all but one field, indicated that the compost treatments resulted in higher yields over the control.

The addition of compost improved yields over fertilizer alone. The return on investment is higher using compost to achieve equal or higher yields, resulting in higher farm profit.

Table 6: 2018-2021 Crop Yields

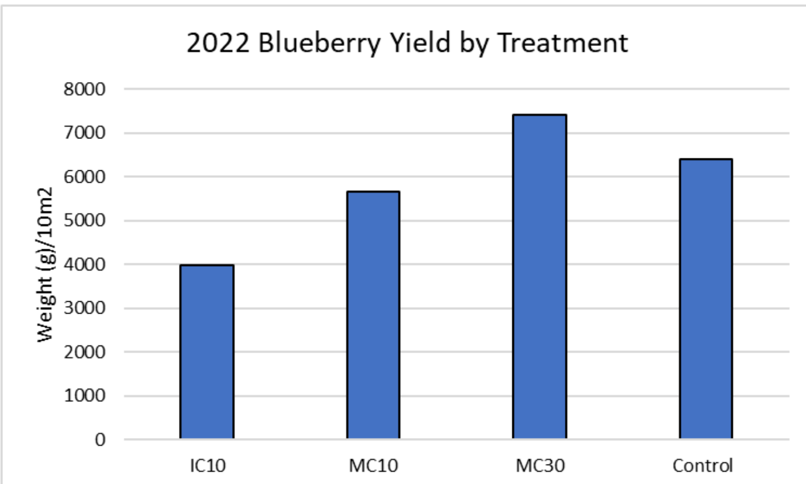
Crop Yield (tonnes/acre) *Corrected moisture- soybeans, barley and wheat 15%M, corn silage 65%M*									
	2018		2019		2020			2021	
Treatment	Soybeans (2)	Corn Silage (1)	Barley (1)	Corn Silage (2)	Soybeans (1)	Barley (1)	Corn Silage (1)	Wheat (1)	Corn Silage (2)
IC 10	1.5	9.1	1.6	7.7	1.38	0.65	11.09	2.4	15.7
MC 10	1.4	10.2	1.8	8.7	1.37	0.71	8.84	2.9	16.6
MC 30	1.4	9.0	2.1	9.1	1.37	0.59	13.13	3.3	15.1
Control	1.4	11.0	1.6	9.0	1.34	0.48	12.95	3.0	14.6

Between 2018 and 2021, nine crops were grown. Of those nine crops:

- MC30 had the highest yield four times (45% of the time)
- IC10 and MC10 had the highest yield 2 times each (22% of the time each)
- Control had the highest yield once (11% of the time)

The blueberry crop was harvested for the first time in 2022. Lowbush blueberries are only harvested every other year. As a newly developed field, this was the first harvest.

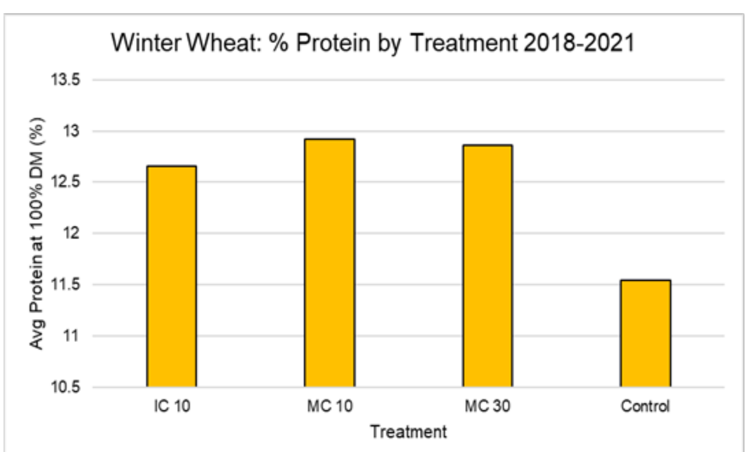
Treatment MC30 had the highest yield, followed by the control. Its difficult to accurately measure yield on first year harvest.

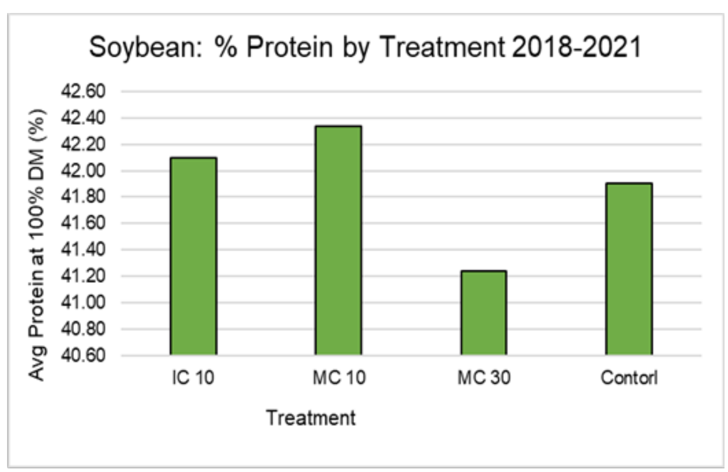


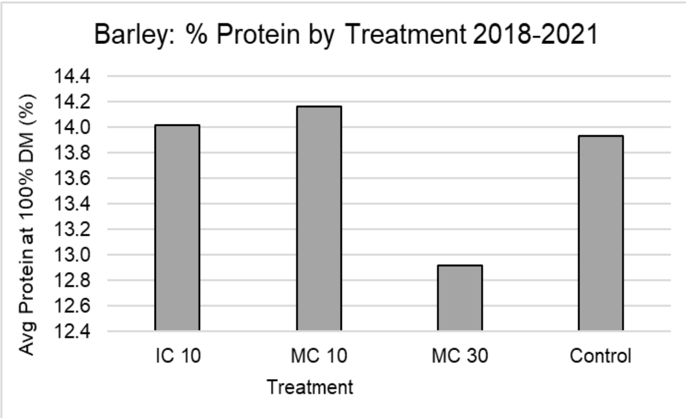
- **Crop Quality**

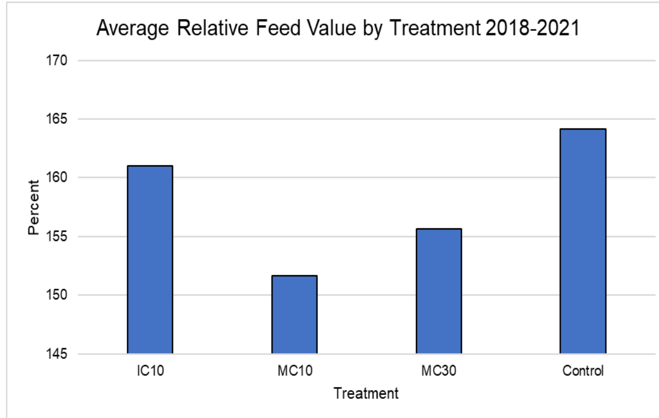
In the crop fields, the treatment with the most increased quality depended on the crop.

In winter wheat, barley and soybeans, MC10 had the best quality, followed by IC10 in soybeans and wheat, and MC30 in barley. For corn silage, the treatment with the best quality was control, followed by IC10.

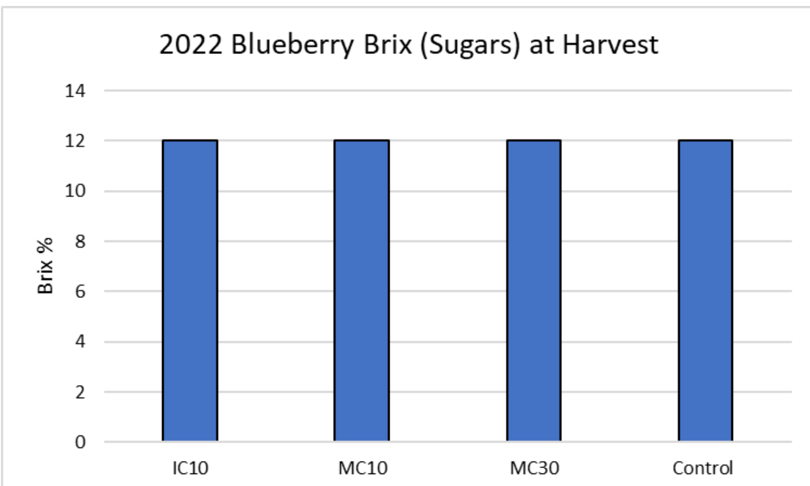








The lowbush blueberry treatments all had equal quality. There was no difference between treatments.



Percent coverage is a measurement used in lowbush blueberries for the percent of the field that has blueberry plants. Increasing plant coverage can have a significant impact on field crop yield.

Since the project field was a developing field, it did not have 100% coverage. There was more plant spread observed in IC10 compared to other treatments. Topography plays a large role in plant coverage and spread.

Project Expansion

The project was expanded with the addition of two lowbush blueberry field projects.

New cleared blueberry fields contain a large amount of carbon and wood fibre, which requires nitrogen to decompose. Decreasing the time required to develop a field provides a faster return on investment. Products that encourage plant spread would be valuable to the industry. It was hypothesized that the compost would encourage plant spread, improving overall yield.

1) New Cleared Field

Compost was applied to a newly cleared field at an application rate of 30 t/ac. The field had significant carbon material from the land clearing process such as large branches and wood material.

Observations showed improvement in decomposition of roots, large branches and wood material with the addition of compost compared to the section with no compost applied.

The blueberry plants in the field that received compost had more branching and had larger leaves compared to the section that did not receive compost.

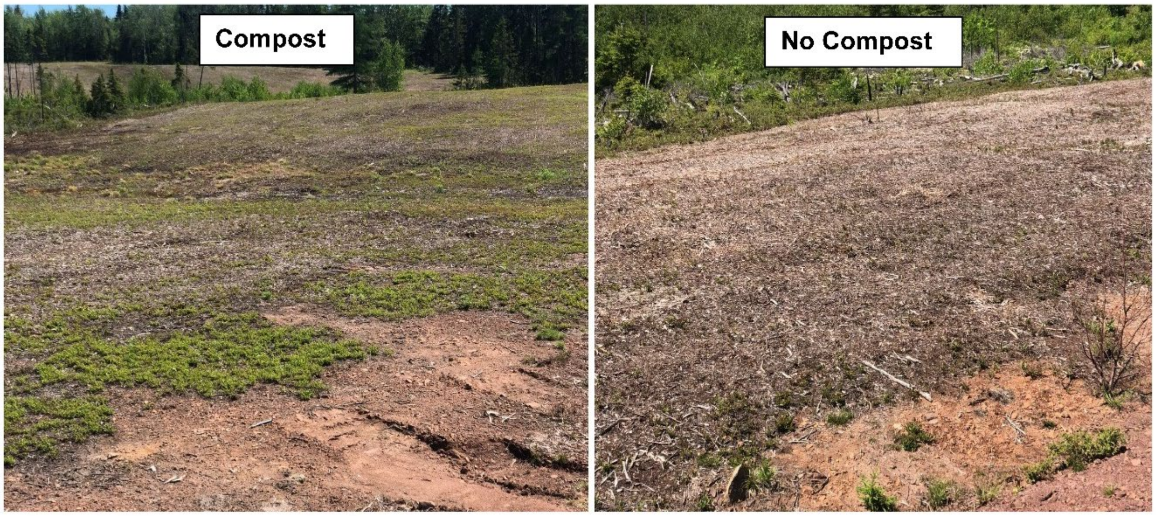
Soil samples were collected from the new cleared field pre- and post-application at the end of the project.

The post-application soil test showed a significant increase in soil nutrient levels, CEC and organic matter in the compost field.

Table 7: New Cleared Field Soil Sample Results Post Application

New Cleared	OM (%)	P2O5 (kg/ha)	K2O (kg/ha)	Ca (kg/ha)	Mg (kg/ha)	CEC
Compost	5.4	433	339	2183	194	10.1
Control	3.9	25	50	447	18	5.2

Early July 2022 - Faster spring growth in compost field



The compost provided nutrients for plant growth, increased blueberry spread and reduced carbon decomposition.

2) Bare Spots

In 2021, compost and sawdust was applied on bare spots in an established field where there was little to no topsoil (either parent soil material was showing or bedrock). The compost was spread by hand to a thickness of 6-8 inches. Soil samples were collected from each area prior to applying compost and sawdust and in 2022. The project included:

- 15 bare sections had compost applied. Four sections also had sawdust applied for comparison to the compost.
- Sawdust was used for comparison as it is traditionally what farmers use to encourage spread into bare areas. It was expected that compost will provide a higher success rate.
- The sections were flagged, outlined with string, and measured to be able to identify if blueberry plants move into each section.

Two months after the compost was applied a large amount of vegetation was observed in the compost areas, but little vegetation had grown into the sawdust. Blueberries plants do not like to spread into open areas.

The soil samples prior to the application of compost and sawdust were very similar. The post application soil sample in the sawdust showed no increase in soil nutrient levels compared to the control, however the compost sections had significant increases in soil nutrient levels.

The compost moved into the soil profile, while the sawdust remained on the surface with little change. The compost had some fungal fruiting bodies which are beneficial and a vital part of improving soil health. They were not found in the sawdust areas.

Challenges

Foreign material

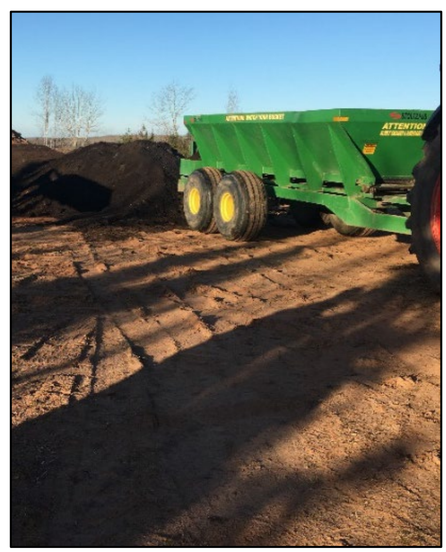
Foreign material was found in the compost and in the fields. The foreign material is more visual in the field in the spring of the following year. Farmers do not want contaminates in the field.

In 2019, the blueberry field received all compost from facility 1 because of highly visible plastic contamination in the facility 2.



In 2020, facility 2 cleaned the plastics out of the coverall storage area, which reduced the plastic in the compost ,making it suitable for field application.





In 2021, the compost had less foreign material than previous years, however there was still visible plastic in the product. The immature compost had more plastic and was less consistent in particle size than the mature compost.



In 2022, the compost sourced in the early spring from facility 1 had more plastic than any previous compost from this facility. The load for the farm tour workshop in July was very clean.



Compost Storage

The 2019 compost from facility 1 was wet, sticky and difficult to apply due to being stored outside. This is not acceptable compost quality.



The 2020 compost was drier and much easier to apply in the spring. In the fall of 2020, the Thomson Station blueberry field received mature compost from facility 2 and the immature compost from facility 1. The immature compost wasn't sent from facility 2 based on concerns it was stored outside and may be too wet.

Since discovering that storage conditions affect the application of the product, screened compost is stored indoors.

In 2021, compost was shipped from facility 1 for the Scotsburn field and facility 2 for the Stewiacke, Brookfield and Thomson Station fields. There was no issue with the storage or application of the product.

In 2022, the compost was shipped from facility 1 for Thomson Station field for early spring application and later in July for the farm tour workshop. There were no issues with the compost.

Fruit and Vegetable Sector Participation

Annapolis Valley and Colchester County has the highest acreage in fruit and vegetable production where the soil has low organic matter and poor water and nutrient holding capacity. Compost would be an excellent soil amendment for improving soil health and yields and thereby meeting the demands of climate change.

Producers in this sector have declined to participate in the project because of pre-conceived ideas on product quality and available nutrients.

Some of the perceived obstacles have been application rates, spreaders, timing of application, nutrient loading, nitrogen release, damage to crops, meeting CanadaGAP regulations and plastics and other foreign material in the product. LP Consulting had meetings with CanadaGAP and received permission for compost application in this sector.

New ways to encourage the sector to utilize compost will need to be explored.

Presentations and Farm tour workshops

Farm tour workshops were not conducted in 2021 due to the Covid-19 pandemic, however there were several opportunities for presentations on the project.

- February 2021 – presented *Update on Agriculture Compost Project* at the Solid Waste Associate of North America (SWANA)

- March 2021 – presented *Revolutionary Lowbush Blueberry Fertility Research* at a workshop for 75 blueberry producers.

- November 2021 – presented at Soil Conservation Council of Canada's soil summit about the importance of soil amendments for the health of our soils.

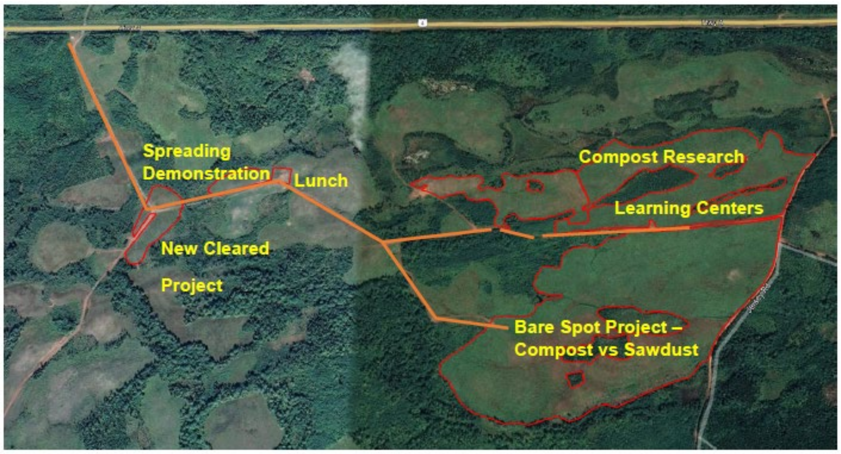
- November 2021 – presented *What's New and Exciting in the World of Waste to Resource Programs* for Waste Resource Association of Nova Scotia (WRANS)

- December 2021 – presented *Nova Scotia Agriculture Compost Research Project Update – Barriers to Opportunities Between Farms & Industry* for Nova Scotia Department of Environment.

Tours of the facilities did not take place as plastics continue to be problematic. The visible plastics may give a false, negative impression to farmers. As an alternative, the compost was delivered to the farm tour workshop.

2022 Farm tour workshop

A farm tour workshop at the Thomson Station blueberry field was hosted on July 14, 2022. Blueberry weed specialists, fertilizer and pesticide retailers and LP Consulting senior agrologists spoke at the various education stations.



The farm tour workshop attracted blueberry and producers, government specialists and industry stakeholders.

The event was a huge success with approximately 70 attendees, and producers continue to speak highly of the workshop and the knowledge they gained.

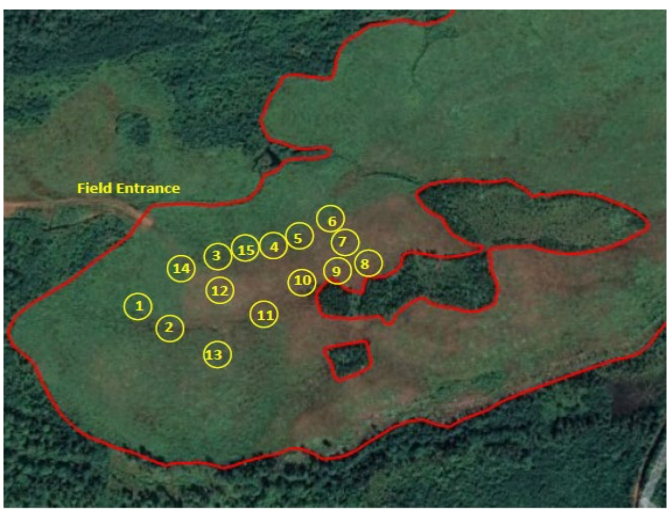
Attendees were divided into groups and led through four learning stations:

- Weed Control
- Foliar Fertilizers
- New Technology Fertilizers
- Compost Project

After the learning stations, a BBQ lunch was provided near the compost, wood ash and gypsum piles so the attendees could view them up close.

There was a spreading demonstration so attendees could witness how the amendments are applied.

The final hour of the farm tour workshop was to tour the new cleared field with and without compost application as well as the bare spot project. This generated a lot of positive discussion as there was a remarkable visible difference between sections.



Conclusions and Recommendations

The results of the project demonstrated that compost is beneficial in different cropping systems. It can economically displace a portion of the inorganic fossil fuel fertilizers, improve soil health and will improve climate change resiliency.

The value to the farmer for fertility and organic matter is substantial even with the annual variations in the compost analysis. The high price of inorganic fertilizers will continue to increase demand for amendment products.

Climate change is impacting agriculture and the focus has been to change management practices, increasing soil health and organic matter. They are learning that investing in soil health is necessary for producing crops in unpredictable weather.

The immature compost performed very well on farm. This can save significant municipal expenditures of ensuring all their compost meets maturity while allowing a cost effective product to be used by agriculture. Compost Council of Canada is concerned about governments allowing the use of immature compost because of their long history of educating the public on quality compost.

The project data and education programs have generated interest in using compost in agricultural cropping systems. Farmers have reached out to facilities to purchase compost.

The issue has been compost quality and the amount of plastics found in the product. Farmers have refused compost loads because of this issue and are not interested in using compost. LP has not been recommending most of the compost facility products at this time.

Plastics will continue to be a challenge for facilities. With a larger market for compost, facilities should be able to invest in improved screening to remove plastics.

Before facilities can ship compost to the agriculture industry, they need to commit to management practices which minimize plastics and foreign materials. We have seen the negative impact of facilities shipping poor product to agriculture.

Recommendations

1. Nova Scotia Environment should regulate the use of immature compost for agricultural land application. It would require a new product classification without the name compost. It would still have to meet metal, pathogen and foreign material standards.

2. Nova Scotia Environment should review their Class A and B metal standards for land application of amendments and composts. Inorganic fossil fuel fertilizers shipped from other countries such as Russia and China only have to meet Class B metal standards, yet local sustainable amendments must meet Class A metal standards. This is a significant barrier to using local amendments that sequester carbon, have a lower carbon and greenhouse gas emission footprint than inorganic fertilizers and provide economic incentives to municipalities and agriculture.

3. Compost facilities need to ensure quality control of their product for selling into the agricultural industry. They must commit to reducing plastic and foreign material. If compost facilities send out poor quality compost, the agricultural industry will not use compost and the market potential will be lost.

4. An alternative residual funding program should be implemented to encourage farmers to utilize local green amendments. New Brunswick Department of Agriculture is in the process of developing a funding program that helps to pay for transportation, product costs and application to encourage the use of compost and other alternative amendments. This benefits agriculture, industry and society.