New Brunswick Soil & Crop Improvement Association Inc.

2-150 Woodside Lane Fredericton, NB E3C 2R9

Tel: 506-454-1736 Fax: 506-453-1985 www.nbscia.ca

CANADIAN AGRICULTURAL PARTNERSHIP

NEW BRUNSWICK SOIL AND CROP IMPROVEMENT ASSOCIATION INC.

ANNUAL REPORT 2019

Enhancing soil and crop sustainability

TABLE OF CONTENTS

President's Report – John Best

Thank you all for coming to the 41st Annual General Meeting and Technical Workshop of the New Brunswick Soil and Crop Improvement Association. It is indeed a pleasure to welcome you to my Region. I would also like to recognize the many members for their support of our association year after year. Together, we are making strides toward environmentally sustainable agriculture. Another Thank- You is extended to the government of New Brunswick Department of Agriculture Staff who have supported NBSCIA activities over the years and the Canadian Agricultural Partnership project and event funding. I would also like to thank our many sponsors without whose support, this event would not be possible and encourage you to support them with whenever possible.

The 2019 season was certainly a first of kind in living memory. It is this type of challenge along with rapidly changing trading rules that requires businesses to work smarter and more efficiently in order to remain viable and competitive. With changes in our climate, new opportunities are arising that are allowing us to grow crops that were not possible to be grown be here before and achieve higher yields on existing crops and creating opportunities for expansion allowing us to realize new export opportunities. All of this makes it essential to build our skill set through events such as this in order to stay profitable.

Although challenging the future looks promising and New Brunswick Soil and Crop has the skills and resources to assist you in achieving your goals. May you all have a successful 2020 growing season and we look forward to serving you in the future.

General Manager Report – Leigha Sandwith

NBSCIA started the year with our Annual General Meeting and technical workshop, held in Sussex and hosted by the Kings Soil & Crop.

The five candidates for the 2018 Farm of the Year were: Gerry & Tammi Boonstoppel, Longscreek Dairy Farm. Pirmin Kummer, Timber Eco Spuds. Byron McGarth & Scott Paul, B McGarth & Sons. Paul & Rhonda Langelaan, Langelaan Holsteins. Dwayne & Becky Perry, Perry Hill Farm.

The 2018 New Brunswick Soil and Crop Improvement Association Farm of the Year was Pirmin Kummer, Timber Eco Farms. Congratulations to the Kummer's and to all the participants. Pioneer graciously sponsored the award.

As of April 1, 2019 New Brunswick Soil & Crop assumed responsibility for the two northern clubs (North East/ Acadian Peninsula, North West) from the Agriculture Alliance of NB, leaving NBSCIA with 8 local clubs supported by six coordinator positions

NBSCIA was involved in a number of projects in 2019 funded by the Canadian Agricultural Partnership Enabling Agriculture Research and Innovation program.

C1819-0242-Y2 Cereal & Oilseed Cultivar Development, which Peter Scott was the project lead, C1819-0246-Y2 NB Forage Variety Evaluation & Management, Ron Smtih was the project leader for C1819-0271-Y2 Production of Elite Cultivars of Rhodiola rosea for Biomass Production in New Brunswick and C1819-0274-Y2 2019 Industrial Hemp Variety Evaluation Trial led by JP Prive. NBSCIA managed projects included C1920-0035 NB Crop Production Optimization, C1920-0036 Soil Health Benchmarking Reference, C1920-0201 Demonstrate Biofumigants as a Control of Root Lesion Nematode, C1920-0977 Y2 NB Weather Network, C1819-0977-Y2 NB Weather Mapping for Intensive Crop Management and C1920-0246 Y2 NB Forage Variety Evaluation & Management Trials.

Numerous training and speaker sessions were hosted throughout the year under the Developing Management Skills program across the province.

NBSCIA also completed third party research projects for Phytogene Resources Inc and Atlantic Grains Council.

Company Description

New Brunswick Soil and Crop Improvement Association Inc. (NBSCIA) is comprised of a diverse group of producers from across the province who are committed to pioneering advanced soil and crop practices in New Brunswick. New innovative approaches are developed through research for economic and environmental sustainability.

The Association is an organization dedicated to providing leadership in the development, management, and sustainability of soils and crops in New Brunswick. Our objectives can be summarized by the following five goals:

1. To develop, demonstrate and promote environmentally and economically sound agricultural practices as they relate to soils and crops in New Brunswick.
2. To provide New Brunswick farmers with services and resources necessary for the sound development and management of soils and crops in New Brunswick.
3. To encourage greater public awareness of the importance of a viable agricultural industry, and the vital role which effective soil and crop management play in achieving that objective.
4. To be a respected and positive influence on the government with respect to matters relevant to the NBSCIA and its members.
5. To develop and manage operating funds necessary to meet the goals of NBSCIA.

Historical Background

NBSCIA was founded 41 years ago in the Sussex area under the guidance of the department of agriculture staff in the late 1970's. The first local was established in the Sussex area and the provincial organization was constituted in 1978. The NBSCIA initially focused on education and the demonstration of new technology – this continues to be an important part of what the organization undertakes. It stressed soil and crop management practices, conducted tours to various locations in Canada and New England, and brought in experts to speak on new technologies, etc. These activities were primarily undertaken at the local level.

The NBSCIA has two objectives identified in its constitution:

1. To encourage the development and expansion of the activities of local associations in New Brunswick in the field of soil and crop improvement; and

2. To encourage the improvement of soil and crop management in the Province of New Brunswick.

Association Strengths

- A network of agrologists throughout the province to provide professional agronomy service to individual farm members and local organizations.
- NBSCIA has a long history of involvement in soil and crop research, information, education and policy support.
- Its membership represents farmers in almost all commodity sectors and regions in the province.
- NBSCIA is regarded as an objective, independent collaborator for research, testing and reporting results.
- The Association is uniquely qualified to represent the interests of farmers and other rural residents when contending with non-farm soil and water management issues.
- NBSCIA has demonstrated ability to be a credible partner with like-minded private sector firms.

Board, Committees and Employees

2019 Board Executive

President – John Best; Vice President – Andrew Lovell; Secretary/Treasurer – David Waddy

2019 Directors

John Riordon; Ellen Gammon; Charlie McIntosh; Dean Acton; Ryan van de Brand; Brian Walker;

Sheldon Moore; Tyler Coburn; Fred Anderson

Research Committee – Charlie McIntosh, Dean Acton and Walter Brown

Employees

Leigha Beckwith – General Manager

Coordinators:

- Jean- Mars Jean- Francois – North West
- Ray Carmichael – Carleton County
- Leigha Sandwith – Central
- Joseph Graham – Kings County
- Zoshia Fraser – Moncton/Chignecto
- Nadler Simon – North East/ Acadian Peninsula

Local Reports

Kings County Soil & Crop – Joseph Graham, Agro-environmental Coordinator

The year began for me in the spring, as I had just started with NBSCIA. The meetings and learning began immediately. Getting familiar with my board members and contacting my KCSCIA members was priority. Once the membership became familiar with me the work began to roll in. Mostly soil sampling and some GPS work. We also had some important projects that were on the go.

The weather mapping project was a success getting 5 new stations in place across the region. KCSCIA also tried to find suitors for the soil optics and yield monitoring project, however some members were quite busy with winterkill and many didn't get custom corn harvesting done, others lacked the important yield monitoring equipment. However, many members were able to take part In the Soil Health Project.

Collaboration with SCCC is an ongoing success. I was able to attend and help plant underwear. The Soil Your Undies event was even added into the CTV Atlantic broadcast. Early in the summer NBSCIA attended the Atlantic forage day In Nappan. It was my first real taste of forage crops and field days.

Over 90 people attended the Kings Soil and Crop field day event in Knightville at Jopp's farm in late summer. The meal was sponsored by the Sussex Co-Op and was prepared by Dawn Perry and her family. The Field day had equipment on display from many local tractor dealerships; Hall Bros, Green Diamond, Arbing Equipment, Millstream Agriculture, Tom's Lime Spreading were all in attendance. There was over 20 pieces of equipment on display, and one item that drew a lot of interest was the no till- grass and grain seeder. After the dealerships discussed their equipment Walter Brown lead a discussion on the current growing season and winterkill.

Shortly after the field day the NBSCIA coordinators attended the P.E.I conference on building resiliency in soils and the changing climate. It was a fabulous event in terms of speakers and topics. Every guest speaker was very engaging and we are happy that some are able to attend our provincial AGM. The topics and conversations were extremely relevant with the work we were doing here at home with NBSCIA.

The following weeks saw Central host the NB Angus pasture tour. The tour wet very well with some engaging topics and conversations. There were a few members from the Kings local attending the trip to farms in Fredericton and near Hartland. Later I was able to attend Chignecto's cover crop tour the local Forage crop specialist Jason Wells presented some great information on crop varieties and we toured an inter-seeded sorghum stand. The annual forage competition was once again on display at the NB exhibition, it was great to see some competitors from all across NB. Kings County was represent by Clearland Holsteins, who did well in several categories. With all the local field days and events during the summer the time went by very quickly and fall soil sampling got started right away.

Farm of the Year was presented to Eric and Daryl Walker of Lonsview Farm for the Kings area. A farm of the year diner was held at the All Seasons restaurant to honor their achievement. The event had over 40 people in attendance. The FOTY sign was sponsored by Cavendish and presented after the meal to Eric Walker and family. We are hoping they take home the big prize at the AGM banquet. Now that soil sampling and many of the summer events are over we are excited to be planning the local and provincial AGM's. Here in Kings the board and I are getting all the information ready to present to our members. NBSCIA is excited to have two strong guest speakers on the agenda for the event.

Moncton-Chignecto Soil and Crop – Zoshia Fraser – Agro-Environmental Coordinator

Twenty nineteen in the Moncton-Chignecto region started with each clubs AGM. Moncton's Annual General Meeting was held January 25th and featured a presentation from Cavendish Agri Services, on their new custom sprayer. We also saw a presentation from Paul Langelaan of Langelaan Holsteins, the Moncton Soil and Crop farm of the year. Chignecto's annual banquet was held on January 27th and featured a locally produced meal and a presentation from Timber River Eco Farms, the Chignecto Soil and Crop farm of the year. Timber River also went on to win the provincial title in February. Congratulations go out to Primin and the rest of the Kummer family!

I joined the NBSCIA team in February 2019 as the coordinator of both the Moncton and Chignecto clubs. This is the first time in two years that the clubs have had some consistency in the agrologist position. As a result uptake of the NBSCIA services has increased. Particularly in the Chignecto region, where we have a five year high in service users. The most popular services are soil sampling and balanced nutrient recommendations. There were over 160 soil samples collected, representing over 1400 acres of land and 16 farms were given nutrient recommendations. Other popular services included: environmental farm planning, mapping and forage recommendations.

In 2019, several members in the Moncton-Chignecto region participated in NBSCIA led research projects. The On-farm Forage Quality project (EARI15-042) wrapped up in the spring of 2019. With the delivery of individual farm results to the four participating farmers. There was also the launch of 3 new projects in the region. The first one, NB Agricultural Weather Network (C1819-0977), saw the installation of 4 new weather stations throughout the region, allowing the south-east to be included in the monitoring of Corn Heat Units, Growing Degree days and rainfall. We also had one member participate in NB Crop Production Optimization (C1920-0035), this farm was able to obtain 3D yield maps to demonstrate the areas of high and low production in their forage crop. Twelve farms were also selected as sample sites for Soil Health Benchmarking (C1920-0036).

We hosted 2 field days in the region in September 2019. The first was the Chignecto Emergency Forage Field Day, hosted by Willie Leblanc and Sons Ltd. in Memramcook, NB. It featured Guy and Patrick LeBlanc's first-hand experience using sorghum as an emergency forage crop and a presentation from Jason Wells, NBDAAF livestock feed specialist, on other emergency forage options. The day wrapped up with a BBQ featuring meat from Boudreau Meat Market Inc. The event was a huge success with over 30 participants. Later in the month, Moncton's Corn Field day was held at Wesselius Holstein Ltd, in Wheaton Settlement, NB. The day included an overview from Jacob Wesselius of their first season using their new Vaderstadtempo high speed Corn planter. A presentation on corn weed management from Gavin Graham, NBDAAF weed specialist and a presentation on European Corn borer from Jason Wells before wrapping up with snacks and networking. This field day was also well attended with over 20 participants. We hope to make this an annual tradition with each club hosting one field day a year!

Central Soil and Crop – Leigha Beckwith – Agro-Environmental Coordinator

The year started out with a successful Annual General Meeting at the Ramada. Robert Berthiaume from Quebec gave an in depth forage school and a report on NBSCIA projects by Ray Carmichael.

February was busy with NBSCIA AGM planning and organizing. The NBSCIA AGM went off without a hitch and the participants really enjoyed themselves at the meeting. March, was used to prep for the upcoming season with producers and projects.

June started with the planting of an emergency forage trial as well as grass and legume strips at Richmond Corner. Individual producer calls were low in June but I did soil sample and rented the no- till drill to a new member. July seemed to come and go every quickly. I began second cut sampling on alfalfa plots at Richmond Corner, did some GPS and Mapping work. A farm tour of 3 beef operations in collaboration with the NB Angus Association was a huge hit!

August started with a tour of the germplasm project in Hartland, tissue sampled orchards, and attending the PEI Institute of Agrologist Summer Meeting in Stanley Bridge. The annual Forage and Grain Competition had approximately 35 entries on display at the NBEX. Jason Wells, NBDAAF was the judge for the event. The fall was rounded out with farm visits, cereal plot harvest, soil sampling and nutrient recommendations.

Carleton County Soil and Crop – Ray Carmichael – Agro-Environmental Coordinator

Carleton membership for 2019 was thirty-four representing a range of commodities and 4 corporate sponsors. Carleton County Soils & Crops Annual General Meeting was held Jan.22, 2019 at Best Western, Woodstock following a very successful day of presentations and a large crowd in attendance.

During the course of the year seven EFPs, two NMPs, seven production recommendations, eleven farm map sets, one Canada GAP audit preparation and 150 soil samples were completed or collected for Club members.

Word version of the EFP Action Plan was completed and circulated to all coordinators. Assistance and orientation was provided to new coordinators for crop production recommendations and NMPs.

Eleven sets of month-end weather maps for Project C1819-0557-Y2 Climate Mapping for Intensive Crop Management were completed and additional stations were installed, bringing the total number of NBSCIA stations to 23. Combined with PAT stations this gives a network total of 53

In addition management and reporting was completed for the C1920-0035 NB Crop Production Optimization, C1920-0036 Soil Health Benchmarking Reference and C1920-0201 Demonstrate Biofumigant as Control of Root Lesion Nematode projects.

The Cereal and Oilseed Variety Evaluation Field Day was hosted Aug 1 and a Maizex corn and soybean plot tour Oct4.

In addition to the Cereal and Oilseed Variety Evaluation NBSCIA also managed an oat selection trial for Phytogene Resources Inc in Williamstown, Atlantic Grains Council barley and wheat management trials in Hartland and Forage Management trials in Richmond Corner.

A guide for early frosted corn was prepared and circulated to members.

North Shore-- Nadler Simon -- Agro-Environmental Coordinator

Farmers in the North Shore area continually express the need for consistent agronomic expertise leading to wise decisions for improvement of their fields. Conscious of its usefulness, especially for wild blueberry and forage producers, the agro-environmental club has this year (2019-2020) played an important role in the coordination of local agricultural activities. Our goals this year were to: i) recreate an atmosphere that inspires confidence among the local farmers after the structure revamp of the club, headed from now on by the NBSCIA; ii) provide basic agronomy services to members, notably in management of organic and chemical fertilizers, control of weeds, insect pests and diseases, achievement of environmental farm plans (EFP), preparing field maps, collaboration in R&D projects; iii) hold the local AGMs, make/renew the 2020-2021 membership registration, interpret soil and tissue analysis reports, document new developments in the agricultural industry and plan the upcoming agricultural season.

Our efforts during this 2019-2020 agricultural season have allowed significant success in all our activities. They enabled more than thirty (>30) members to be registered. We diagnosed major problems/priorities on each member field and formulated appropriate recommendations. In this context, we identified in the wild blueberry fields various weeds (sarsaparilla, bunchberry, witchgrass, Canada mayflower, lambkill, rhododendron, hardwood, hawkweeds, dogbane, etc.), insects (spanworm, thrips, etc.), diseases (Monilinia Blight, Botrytis Blight, Septoria leaf spot, leaf rust, etc.), over fertilization and late branching as the main source of concern for most blueberry producers, while in forage fields, soil compaction still remains a big challenge. In addition, five member's maps were prepared and delivered. Steps for four new EFPs were undertaken. Soil and tissue samplings were performed and analysis reports delivered from more than thirty (>30) fields, notably for forage crop. The North Shore area was involved in four R&D projects. For example, we worked, through field soil sampling, in the C1920-0036 Soil Health Bench Marking-Reference project led by NBSCIA in collaboration with DalAC, aiming at undertaking an initial survey of the range of soil health values/parameters across a range of soil types and/or management practices common to New Brunswick farm systems. One another interesting project this last summer was to evaluate the efficiency of a new high-tech chemical mixer (Handler IV H43P13V) considered as the king of batch induction systems with its larger liquid volume and incredible agitation capability. This instrument has been acquired by Les Bleuetières Ltd for the 2020 season to enhance its field operations by reducing sprayer fill time, as part of Enabling Agricultural Research and Innovation funding, supported by the Canadian Agricultural Partnership (CAP) program.

The activities of the 2019-2020 season demonstrate the North Shore NBSCIA is definitely operational and highlight at the same time its role in better serving agricultural producers in this area towards a profitable and sustainable agriculture.

Northwest --Jean-Mars Jean-François Agro-Environmental Coordinator

The first quarter was devoted to collecting data for fertilization plans for members. An environmental farm plan was completed for a new member and another revised. The Club continued to make Environmental Farm Plans as well as Action Plans. The Coordinator also participated in annual general meetings of the Agricultural Alliance of NB and NB Soils and Culture too. Likewise, the Club's annual general meeting was held in Grand Falls. Research was carried out on diseases control in Christmas tree production for a member and for two other farmers on the possibility of certification for maple syrup farm. The Club has designed and written two projects. The first submitted to EcoAction focused on best management practices to protect of the Iroquois-Blanchette watershed in Edmundston area. The second was to control the common scab in potato field. This proposal was submitted to the NB Department of Agriculture. It should be noted that no project was supported financially. The control of scab project was supported only by the three farmers themselves.

This second quarter corresponded to a big change in the Club; since its administrative management is now ensured by NBSCIA. The Club attended a meeting with the other Coordinator in Fredericton. It should be noted that, since the Iroquois-Blanchette Basin protection project had no funding, the Coordinator has initiated discussions with the City of Edmundston around financial support for the farms. This initiative paid because the Municipality gave twelve thousand dollars directly to three farmers to protect the water intake. This envelope was used for the purchase of a solar watering system to take the cattle out of the brooks and to install fences along the brooks. Another part of this money was used to install 300 feet of gutters on the roofs of the two manure pits. On the other hand, the experimental plots to control the common scab on potato with activated charcoal were set up a little later than expected due to the poor weather. Note that these plots are located in Drummond (two) and Saint-Quentin (one). Alfalfa leaf, soil, water and manure samples were collected and sent to the lab in PEI. Periodic visits were made to the farms to discuss with farmers about the evolution of the crops.

During the third quarter, petiole tests were collected for potato growers. No test was taken on the experimental plots, lack of fund. We also continued with the visits and followed in the field. The calibration of sprayer was carried out as well as an Environmental Farm Plan and an Action Plan. Some soil samples were collected from three farms. A good part of the time was devoted to trials on planting Christmas trees in Saint-Quentin and control of common scab in Drummond and Saint-Quentin. We negotiated estimation cost with Navi Club in Levis (Quebec) so that the farmers benefited from the financial support of the City of Edmundston (Solar kit). Two new environmental farm plans have been completed. Farm monitoring continued (8 in total).

About the last quarter, soil samples were collected for 9 farms, as well as Envirem compost samples (3 samples). Farm monitoring continued. The Solar pump Kits were delivered to farmers and the installation of gutters was monitored. Meanwhile, potatoes were harvested in the three experimental sites and the growth of Christmas trees was measured on a farm in Saint-Quentin. The samples were weighed, analyzed and the data processed in Excel. In terms of result, activated charcoal helps to control common scab with significant differences between the treated and control plots. However, we are unable to determine the rate of charcoal to be applied per acre. This will be the subject of the future of this project. In November 2020, two projects were designed, written and submitted to the Environmental Trust Fund. These projects relate to the management of grazing on the Iroquois-Blanchette watershed and the certification of maple syrup farm in New Brunswick.

NBSCIA Research Project Reports

NBSCIA sponsored a number of research and demonstration projects in 2019 funded by the Canadian Agricultural Partnership program. Contract projects were completed for Phytogene Resources and the Atlantic Grains Council.

CANADIAN AGRICULTURAL PARTNERSHIP

C1819-042-Y2 NB Cereal & Oilseed Evaluation

Peter Scott, Crop Specialist – Cereal and Oilseeds

An Enabling Agriculture Research and Innovation (EARI) Program projects was submitted and approved on behalf of the New Brunswick Soil & Crop Improvement Association (NBSCIA) in 2019. This research work in evaluating cereal, and oilseed varieties is a continuation of the variety development partnership between NBSCIA and New Brunswick Department of Agriculture, Aquaculture and Fisheries (NBDAAF) since the mid 1990's. NBSCIA has been supportive and is financially supported by this variety testing work and partnership with NBDAAF. NBSCIA continues to assure that these variety development activities continue that support the field crop value chain from plant breeding through to livestock feed and farm sustainability. This activity is a conduit to producer access to new crop germplasm best suited to New Brunswick agronomic conditions.

All cereal and oilseed trials under this project are conducted as per the Atlantic Field Crops Registration Committee approved – Testing procedures for cultivar registration, evaluation and recommendation protocols. Corn testing protocols are determined by the Atlantic Corn and Forage Team. Following is the final cultivar numbers that were tested in 2019.

CEREALS

The spring cereal grain evaluations include 5 different specific trials replicated three times in a randomized complete block design. The project site was in the Hartland area, and followed potatoes in the rotation.

Trial Name	Treatment Number
Maritime Six-Row Barley Reg. & Rec. Test	16
Maritime Two-Row Barley Reg. & Rec. Test	28
Maritime Oat Reg. & Rec. Test	21
Maritime Spring Wheat Reg. & Rec. Test	29
Eastern US Spring Malt Barley Test	25
Milling Oat	19

Total **414 plots**

CORN

The corn evaluation included 2 specific hybrid trials (silage and grain) at two locations with three replicates in a randomized complete block design with 67 hybrids entered for 2019. The project sites were in the Woodstock and Sussex areas, and involved a potato rotation (Woodstock) and a livestock forage rotation (Sussex). Hybrids under this year's test are supplied by 12 different companies.

Trial Name	Treatment Number
Regional Grain Corn Hybrid Evaluation Trial	34
Regional Silage Corn Hybrid Evaluation Trial	27

Total **366 plots**

OILSEED

The oilseed evaluation only included soybean. Attempts are underway to source a few pusles to demonstrate their potential. Trials consisted of four replications in a randomized complete block design. The project site was be in the Hartland area in a potato rotation.

Trial Name	Treatment Number
Maritime Conventional Soybean Test	12
Maritime Herbicide Tolerant Soybean Test	62

Total **296 plots**

C1819-0271: Production of Elite Cultivars of *Rhodiola rosea* in New Brunswick

Ron Smith and Stewart Cameron

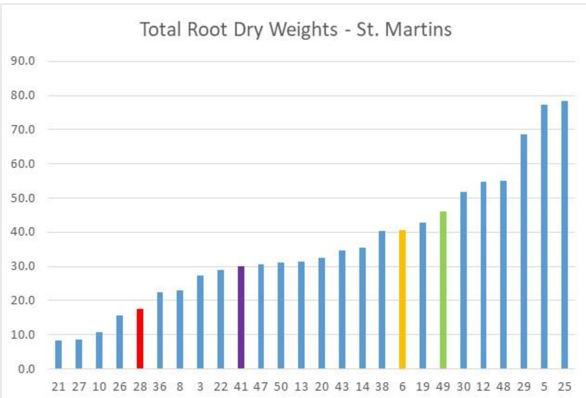
Summary

This short report highlights some of the key findings in 2019. The final harvest of plants from the St. Martins test site was conducted and the final harvest in Jacquet River is scheduled for 2020. The 2019 growing season was much better than in 2018 which was a severe drought year at both locations. There is lot of variation in both growth (root biomass) and levels of rosavins and salidroside (the bioactive chemicals of interest). This variability presents an opportunity to select for improved cultivars for future commercial cultivation of this plant.

Growth and Yield

The mean total root dry weight by seedlot, at each site, is given in Figure 1. Mean root dry weights at St. Martins and Jacquet River sites (all plants combined) was 36.2 and 30.7 g respectively. By comparison, the means in 2018 were 21.1 and 20.7g respectively. This represents an increase of 71 and 48 percent respectively for the two sites. The growing season in 2019 was much better than in 2018 which was a severe drought year at both locations. The increase in root dry weights (year over year) were close to double in 2018-2019 compared to 2017-2018. The mean total root dry weight for the top five families was 62.6g as compared to 39.1g in 2018.

To put these three-year results into perspective, commercial crops in Alberta and as reported in the literature, average around 100 grams dry weight per plant root at age 5. There were two individuals from St. Martins that had root dry weights of 92.7 and 107.3 g (these were from seedlots 5 and 29 respectively).



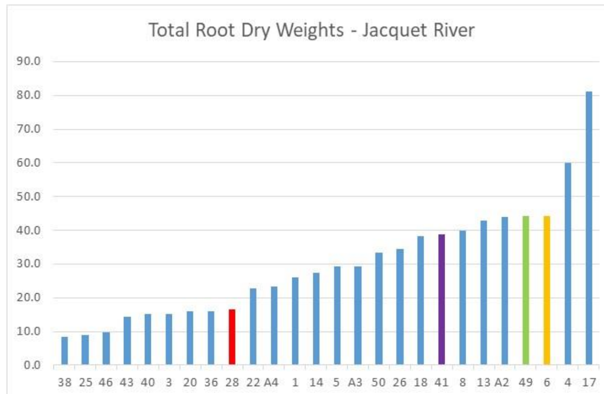
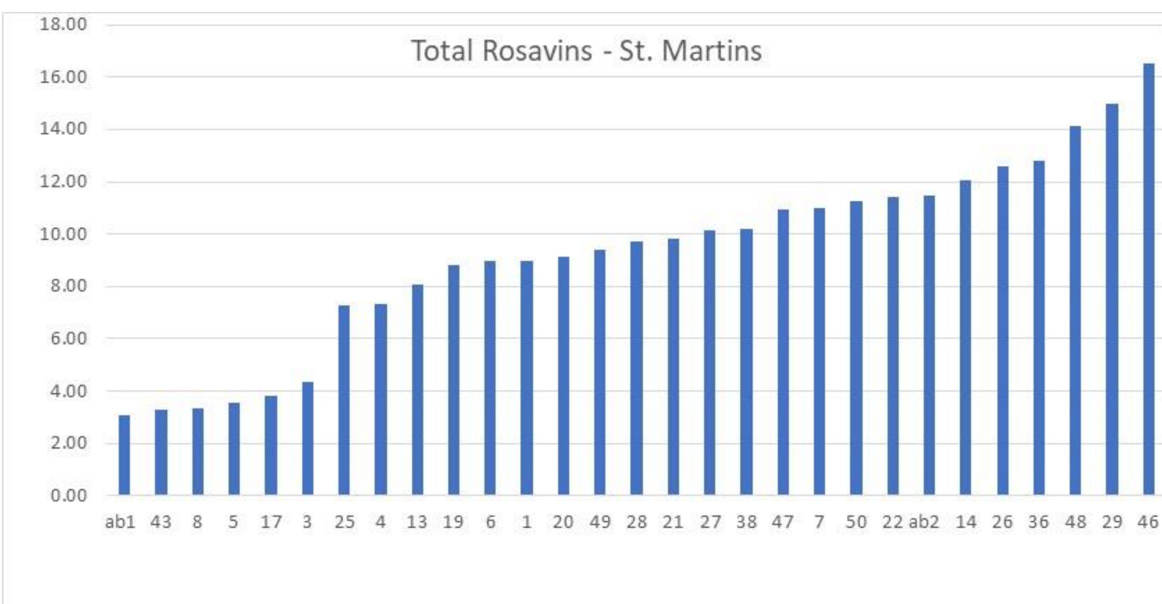


Figure 1. Total root dry weight (g) by seedlot, from the Jacquet River and St. Martins family tests.

Four coloured bars (red, purple, green and yellow) are highlighted in each graph. They show that while the relative ranking for these four seedlots on a site differs between the two sites, the actual amount of growth is quite similar at both locations.

Chemical content in the roots

The mean total rosavin content for all plants combined from the 2018 collections was 11.26 and 7.23 mg/g for St. Martins and Jacquet River respectively (Figure 1). These values compare very favorably with all commercial crops reported in the literature as well as by ARRGO (proprietary data which cannot be shared here).



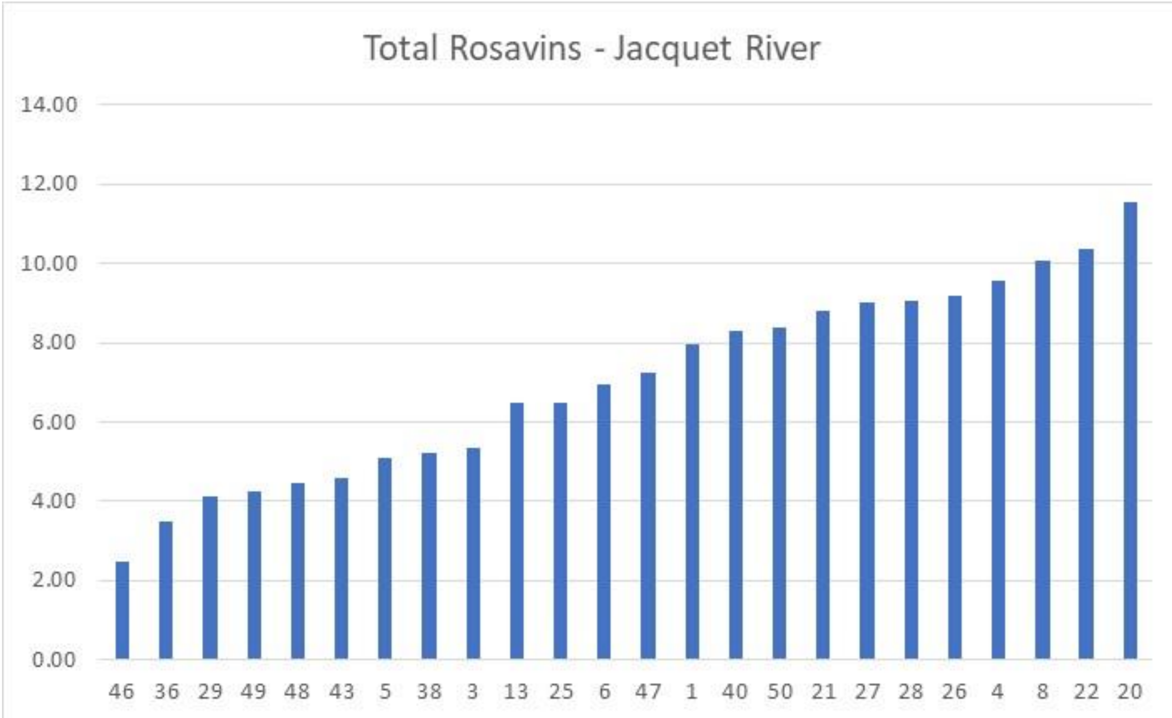


Figure 2. Graphs illustrating the mean total rosavin levels (rosin + rosavin + rosarin) in mg/g dry weight for A) St. Martins and B) Jacquet River test sites. Numbers across the bottom are seedlot numbers.

There was up to a five-fold difference between the best and poorest individuals within families for total rosavin content. For example, individuals from seedlot 29 varied from 1.50 to 10.31 mg/g. Once all of the remaining chemical analyses are completed, it should be possible to determine to what extent growth rate and rosavin levels correlate within seedlots.

The chemical analyses from the 2019 collections have yet to be completed, but results so far show similar levels of variation for all of the compounds assessed (salidroside, tyrosol, rosin, rosavin and rosarin).

Thus far, growth and chemical content among seedlots appear to vary somewhat independently. Therefore, it should be possible to find fast growing and high chemical producing individuals. For example, seedlots 29 and 5 (the seedlots with the two largest individuals in St. Martins), ranked third best and fifth from the bottom respectively with respect to total rosavins. While the rankings are preliminary, it does show that selection and potential improvement) can and should include both growth and chemical content. The level of variation in both of these parameters indicates that improvements (gains) in crop yield (biomass X chemical content) of at least 50% over the population mean should be achievable.

While some change in rankings would be expected, the key takehome message remains that some families are performing significantly better than average and there is significant genetic variation among families which presents an opportunity to select and breed for improvement within local (N.B. and N.S.) sources.

Seed collections

140 individual plant seed collections were made in 2019 from the two test sites and the clone bank. This is in addition to the 75 collections made in 2018. The seed has been extracted from the flowers and is in storage. NOTE: Seed is identified by plant and its location. This will enable seed to be selected from high producing

individuals (families) once the biomass and chemical analyses are completed.

When results from the analyses of the final harvests, seed from the superior plants will be sown to produce the first semi-commercial/commercial crop. The current plan is to have approximately 10,000 plants grown under contract and to be ready for spring planting in 2021or 2022 (see the Where are we going with this research? section below).

There is a strong interest by the Alberta Rhodiola Rosea Growers Organization (ARRGO) to enlist New Brunswick farmers to start growing Rhodiola rosea commercially. The current demand for sustainably grown Rhodiola far exceeds current supply globally. The results from this project are demonstrating that Rhodiola can be commercially grown in New Brunswick. The levels of genetic variation measured affords an opportunity to significantly improve plant quality (rosavins and salidroside content). The unit price is typically based on chemical content. Levels of bioactives increase with plant age (up to age 6 or 7). However, the plants in this study will be of sufficient age to make a strong case for the opportunity to harvest earlier and meet or exceed minimum levels after 4 years in the field. Total biomass per plant will be less than for 6 or 7 year old plants, but this can be weighed against the cost of carrying the costs of production for the additional three years.

NB Oat Evaluation- Phytogene Inc:

Leigha Beckwith, NBSCIA General Manager, Coordinator

In 2019 NBSCIA again established an evaluation site in the Lakeville area on the farm of Shawn Paget in cooperation with Art McElroy, an Oat Breeder in Ontario. The site contained some 517 plots containing in excess of 475 varieties, the majority in single plots. The rational for supplying the material early in a breeding program is to select lines that do well in the New Brunswick climate to hopefully produce lines that will perform well here and provide NB Seed Growers Co-operative Ltd. This project will continue in 2020.

C1920-0274-Y2 CHTA Industrial Hemp Variety Trial

Dr. Jean-Pierre Privé & MHI

The primary objective of the project in 2019 was to assemble, establish and evaluate 14 promising industrial hemp varieties for New Brunswick and the Maritimes as part of a larger national hemp variety trial. Quantitative and qualitative characteristics monitored included, plant growth and development, seed, fibre, and non-narcotic cannabinoids. All records were maintained according to license specifications and the production data was sent to James Frey, Diversification Specialist, Manitoba Agriculture and Resource Development for analysis. All plant material was destroyed after the plant data was collected. Non-narcotic cannabinoid samples were collected and sent to InnoTech Alberta, 250 Karl Clark Rd NW, Edmonton, AB while fibre samples were collected for the dual purpose varieties and sent to the Composites Innovation Centre, 158 Commerce Dr., Winnipeg, MB. Basic summary of the data collected from the Cocagne site are provided by Dr. Privé (Table 1) but the multi-site (14 national grower test sites) statistical analyses will be contracted by the CHTA and is presently pending. As this trial is a multi-year project, this year-end summary satisfies the requirements of our license.

The three project deliverables for 2019 were realized: 1) the establishment of 14 hemp varieties in Cocagne, NB allowed for close inspection, testing and evaluation by Dr. J-P. Privé and MHI; 2) the data was collected as per the 2019 Protocol Manual of the National Industrial Hemp Variety Evaluation Trials and 3) the ongoing communication of this hemp project was shared with hemp growers, provincial and federal research personnel and other interested parties at meetings and tailgate sessions. An additional deliverable was added this year when two students from Universite de Moncton assessed the disease and insect pressures within our plots throughout the growing season.

The research protocol and project details were outlined in the license application and were followed exactly as indicated therein. In summary, all varieties were replicated and randomized so that their attributes could be analyzed objectively. Data collected included: plant emergence counts, seedling mortality, early vigour, mature plant height, harvested grain yield, grain test weight and quality, harvested fibre yield and quality, lodging, insect and disease incidence, days to maturity, male/female ratios, and non-narcotic cannabinoid levels during the growing season. Dr. Privé contributed research expertise on experimental design and analyses and oversaw the land preparation, fertilisation, seeding, data collection, bird control, harvesting, drying, cleaning, laboratory sample preparations and the compilation, verification, and primary analysis of the data.

The data presented herein is divided into two groups because they were planted as separate plots, as per the protocol. The first contained the Grain varieties while the second contained the Dual Purpose (DP) varieties. CRS-1 was used as out check variety in both plots. The results are presented and discussed together (Table 1).

<u>Plant Growth & Development</u>

Looking at the results for seedling mortality, it would seem that the DP varieties suffered much greater seedling mortality than the Grain varieties (Table 1). However, upon closer inspection of the data, it was noted that most of the varieties with high seedling mortality were planted 1 week later than the others (we were waiting for seed to arrive). This is evidenced by the fact that Earlina (Grain variety) had the highest seed mortality in the Grain group and was the only variety planted at the later date. This factor demonstrates the importance of early seed sowing and that the date of sowing must be considered when evaluating seed mortality from other studies.

Early vigour, taken at canopy closure, was inconclusive as four of the DP varieties were not evaluated for this trait. Although we did not have a complete set of data for this trait, it seems vigour was not specific to Grain or DP variety. More research is required to confirm this.

The days to maturity or the number of days from plant emergence to physiological maturity are linked closely to the genetics of the variety. As such, most Grain varieties have been bred for an earlier harvest and hence all but 2 varieties (X59 and Judy) were harvested sooner than the DP varieties (other than our check variety CRS-1). However, even within the Grain group some varieties took 20 days longer to reach maturity (Earlina vs X59 or Judy) whereas within the DP group, the harvest window spanned only a 6 day differential. If we are to grow industrial hemp in all corners of NB, it will be necessary to choose varieties that can reach full maturity within their respective growing regions and so this trait is very important.

Naturally, all the tallest varieties came from the DP plots as these varieties were bred and grown for their fibre and hence require the longest stems for economic reasons. Nonetheless, one grain variety, Judy, was almost as tall as the shortest of the DP varieties (Rigel), excluding our check variety (CRS-1).

Biomass determinations were only done for the DP varieties in the trial. As was found in other years (data not presented), Petra, aka Petera, produced the most fresh and dry above ground biomass due to its very long and large stems. The only DP variety that resulted in poor biomass growth was the French variety Santhica 27. As we only have one year of data with the Santhica varieties, hopefully we will be able to obtain more seed (from France) again next year to examine whether these new DP varieties warrant further attention for our area.   Fibre samples of all DP varieties were sent for quality evaluation at the Composites Innovation Centre, 158 Commerce Dr., Winnipeg, MB and are their results are pending.

Grain yield

There were 3 varieties that had grain yields greater than 2MT/ha in 2019; CRS-1 (in the grain plots), Petra and X59 (also known as Hemp Nut). You may think this is surprising, especially since a DP variety out yielded many of the grain varieties, but this was consistent for Petra in 2018 as well. CRS-1 and X59 were also very high yielders in 2018 making them a good choice if your priority is seed production. Santhica 70, Judy and Silesia made up the next highest group, near 1.5 MT/ha followed by all the other varieties producing near 1.0 MT/ha. This is somewhat consistent with what we found in 2018. However, it is interesting to note that although our check variety (CRS-1) in both the grain and DP plots had very similar growth results; its yield was more than twice as high in the grain than in the DP plots. Because of this variability, it is imperative to continue these studies so that a comprehensive statistical analysis could be done over all years to mitigate these inconsistencies and provide a clear statement to our growers as to which varieties would be wisest to choose according to their end use. Nonetheless, some trends are emerging to suggest that choosing a DP variety that is both optimal for fibre production without sacrificing grain yield may provide the greatest economical sustainability.

Non-narcotic cannabinoids

Non-narcotic cannabinoid samples were taken at harvest and sent as per the 2019 protocol to InnoTech Alberta, 250 Karl Clark Rd NW, Edmonton, AB, T6N1E4 but these results are pending and therefore are not presented in this report.

Insects and Diseases

On a weekly basis, two students sampled the four blocks of the national hemp variety trial in Cocagne to assess their insect and disease pressures throughout the growing season. On average 120 plants were sampled and assessed weekly. Preliminary and qualitative results suggest that early in the growth cycle of the plant, flea beetles and springtail insects were important defoliators whereas later in the season, aphids were a problem. As no pesticides were applied to counteract these insects, the plants outgrew their early infestations and had natural predation by the ladybeetle larvae to control the aphids later in the season. The disease pressures were much less pronounced and present mainly late in the season. Most of these diseases were fungal in nature and although not found on our site, *Sclerotinia spp*. was one of the most detrimental at other hemp sites in 2019. We hope to continue this assessment in 2020 and look forward to our continued collaboration with UdeM.

Figure 1. From L to R, Flea beetle and springtail infestation, aphids on underside of leaves, adult lady beetles, Fusarium on hemp stem, and leaf spot.

<u>Conclusion</u>

As we continue our search for the most promising grain and DP varieties for NB, I am optimistic that with a few more years of testing, we will have acquired sufficient data to provide a base line of varieties best suited for grain, fibre, oil, protein, and non-narcotic cannabinoid production to our growers.

Table 1. Summary results for the 2019 CHTA National Hemp Variety Trial in Cocagne, New Brunswick.

Grain Varieties	Seedling Mortality (%)	Vigour (1-10)	Days to Maturity	Plant height (cm)	Male-female ratio (%)	Grain yield (MT/ha)	Above ground Biomass Fresh wt. (MT/ha)	Above ground Biomass Dry wt. (MT/ha)	Stems only Biomass Dry wt. (MT/ha)	Other Biomass (leaves, seeds,etc.) Dry wt. (MT/ha)
X59	22.9	7.8	110	155.6	86.3	2.26	N/A	N/A	N/A	N/A
Judy	9.6	8.0	110	185.4	82.7	1.51	N/A	N/A	N/A	N/A
CRS-1 (check)	15.9	7.6	103	178.3	72.0	2.60	N/A	N/A	N/A	N/A
Katani	21.4	7.7	96	134.8	73.1	0.71	N/A	N/A	N/A	N/A
Grandi	12.4	9.2	96	134.6	58.1	0.98	N/A	N/A	N/A	N/A
CFX-2	27.4	7.1	96	150.9	47.4	1.14	N/A	N/A	N/A	N/A
Earlina	33.9	4.0	90	171.2	1.7	0.86	N/A	N/A	N/A	N/A
Dual Purpose Varieties										
Silesia	17.6	6.2	110	214.2	22.9	1.42	35.7	14.8	8.2	6.6
Petra	14.6	7.2	110	232.6	31.5	2.33	43.6	18.3	12.6	5.7
CRS-1	43.8	8.1	103	183.0	71.1	1.24	33.4	14.2	8.6	5.5
Altair	29.9	7.5	110	198.0	0.0	1.03	36.4	14.4	8.8	5.5
Anka	32.6	-	104	209.0	35.3	1.13	33.3	14.2	9.1	5.1
Rigel	28.9	-	104	189.1	4.0	0.73	36.0	14.4	8.3	6.1
Santhica 27	44.0	-	104	204.8	0.9	0.85	25.4	10.4	6.1	4.3
Santhica 70	48.7	-	104	213.6	1.3	1.81	38.8	15.5	8.9	6.6

C1819-0246-Y2 NB Forage Variety Evaluation and Management Trials

Leigha Beckwith, NBSCIA General Manager, Coordinator,

Project Objectives:

To identify nutrient uptake and removal requirements of legume and grass forage stands at the higher forage yields being obtained and at medium fertility and pH levels.

To evaluate the effect of species interaction of Red Clover and Alfalfa (the legumes) with grass species with the potential for higher quality and yield in both complex and simple forage mixtures over the life of a sward.

To evaluate the role of annual forage species and cereal (oats, barley) companion crops as emergency forage crops on New Brunswick livestock farms.

Summary of Progress:

Plot Scale Assessment of Draft Legume Forage (Alfalfa) Fertility Recommendations

Project leader: Leigha Sandwith (NBSCIA) Collaborators: Pat Toner, Jason Wells and David Dykstra (NBDAAF), Hartland Agromart.

Objective: To determine how well alfalfa yield would respond to a new fertilizer recommendation for increased levels of potassium.

Summary of Progress: Past work with forage crops have suggested that current NB fertility recommendations should be reviewed for mainly the levels of potassium applied to alfalfa dominated forage stands. In doing so a review of forage recommendations in other jurisdictions such as Nova Scotia and Quebec was completed. Proposed recommendations were developed by adjusting Quebec recommendations to fit current NB soil test ranges. These proposed recommendations were compared to the current NB fertility guide (Table 1) below.

Preliminary testing of this new approach was done at the Richmond Corner Forage Evaluation site near Woodstock, NB. Soil samples taken at Richmond Corner in the spring of 2019 showed a high level of soil organic matter of 6.5%. Soil pH levels were 6.5 and an established alfalfa forage stand was well developed at this location. Phosphorous levels are high+ averaging 350 ppm and potassium levels in the soil are 109 ppm or medium+ on the NB scale of soil tests. As sites go around the province for forage production, this site would be well above average in terms of pH and soil fertility to produce alfalfa.

Treatments were chosen to assess the impact of no fertilizer vs 150 and 300 kg/K_2O/ha. Nitrogen was held at a constant 28 kg/ha as per spring maintenance requirements. P2O5 levels of only 30 kg/ha were required for the soil test levels at Richmond Corner, but for the purposes of this trial we did not want to have it limited so all fertilized treatments were increased slightly over recommended to 40 kg/ha

TABLE 1

Proposed Nutrient Recommendations-seeding & maintenance of Legumes and Grass Forages

Nitrogen		NB Legume Seeding kg/N/ha	NB Grass Seeding kg/N/ha	NB Legume Maint kg/N/ha	NB Grass Maint kg/N/ha
		28	48	28	48
					48 after each cut

Phosphorous

Soil Conc. ppm P	Rating	NB Legume Seeding kg/P2O5/ha	*New NB Grass Seeding kg/P2O5/ha	NB Legume Maint kg/P2O5/ha	NB Grass Maint kg/P2O5/ha
0-10	L-	120	120	120	90
11-19	L	100	100	100	68
20-39	M	68	68	68	48
40-58	M+	50	50	50	16
59-78	H	30	30	30	0
> 78	H+	30	30	30	0

*New NB for seeding grass made to equal legumes like in PQ

Soil Conc. ppm K	Rating	New NB Legume Seeding kg/K2O/ha	Old NB Legume Seeding kg/K2O/ha	New NB Grass Seeding kg/K2O/ha	Old NB Grass Seeding kg/K2O/ha	New NB Legume Maint kg/K2O/ha	Old NB Legume Maint kg/K2O/ha	New NB Grass Maint kg/K2O/h	Old NB Grass Maint kg/K2O/ha
0-18	L-	200	150	200	90	290	150	160	90
19-37	L	180	150	180	68	240	150	140	68
38-74	M	150	100	150	48	180	100	110	48
75-112	M+	110	68	110	0	110	68	75	0
113-148	H	70	50	70	0	60	50	45	0
148+	H+	60	50	60	0	50	50	30	0

Modeled after PQ research 2010

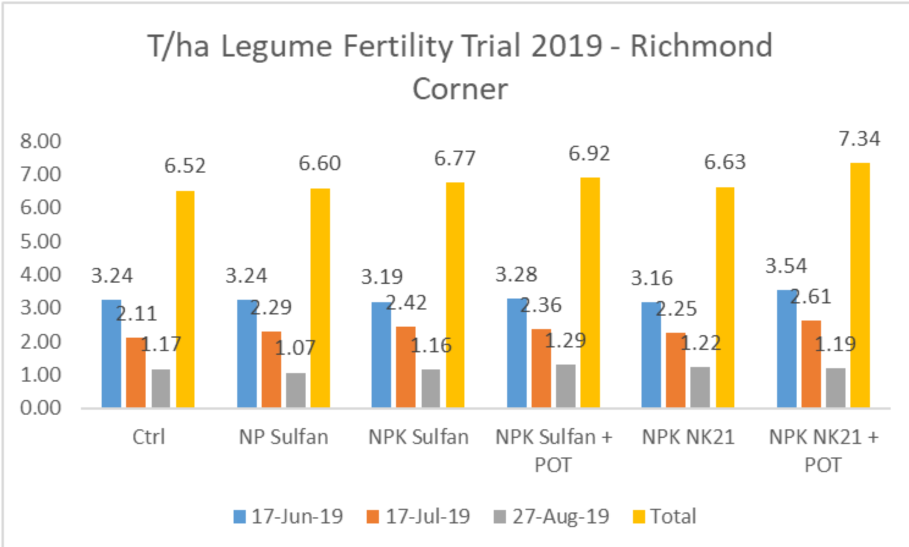
K_2O recommendations under the old NB fertility guide would have required only 68 kg/ha and the proposed would move it up to 110 kg/ha. But we also wanted to see how well the crop would react to potassium fertilizer. We set rates of application at 0, 150 and 300 kg/K_2O/ha. In our fertilizer blends we used NK21 (21-0-21) for our nitrogen source. This supplied some potassium as well nitrogen and was combined with 18-46-0 and 0-0-60 to make up a spring blend applied on 6 Jun, before the first cut. A maximum of 150 kg/K_2O/ha was made up in this blend as higher levels per application could cause damage to the crop. To reach the 300 kg/K_2O/ha levels, an additional 150 kg.K_2O/ha was applied after the first cut on 19 Jul. Hartland Agromart was our fertilizer supplier and donated the raw product for us. They asked if we could compare NK21 in our trial to a new product Sulfan. We did so and as a result, Sulfan would also supply some sulfur, calcium and boron. The final makeup of this randomized replicated block design is depicted in the treatment chart below along with treatment layout, Table 2.

TABLE 2

RC forage fert trial 2019

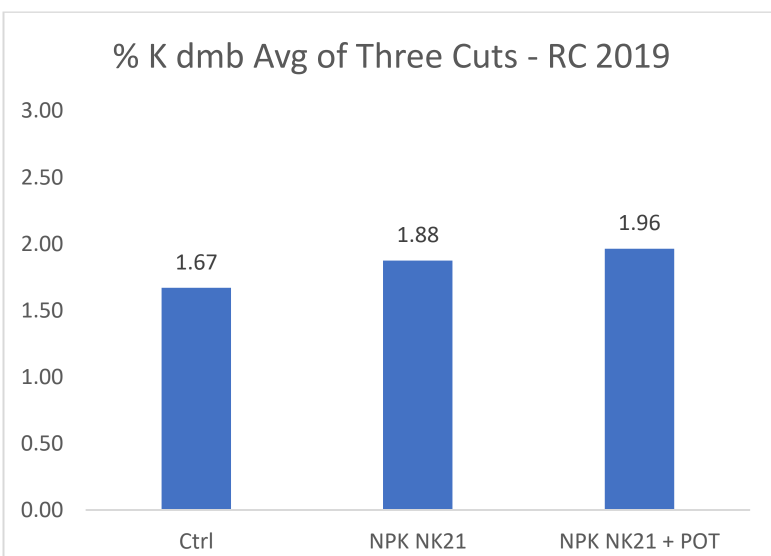
Trts	Name	Blend	Spring kg/ha 6 Jun	Post 1st cut kg/ha 19 Jul	N	P2O5	K2O	S	Ca	B
					kg/ha/season					
1	Ctrl	0	0	0	0	0	0	0	0	0
2	NP Sulfan	19.3-27.4-0+2.7S+2.1Ca+0.69B	145	0	28	40	0	4	3	1
3	NPK Sulfan	7-10-38+0.9S+0.7Ca+0.25B	394	0	28	40	150	4	3	1
4	NPK Sulfan + POT	7-10-38+0.9S+0.7Ca+0.25B	394	249 of potash	28	40	300	4	3	1
5	NPK NK21	7.3-10.3-39.3+0.26B	381	0	28	40	150	0	0	1
6	NPK NK21 + POT	7.3-10.3-39.3+0.26B	381	249 of potash	28	40	300	0	0	1
				Treatment						
				1.5M x 6.0M layout	6	4	3	2	5	1
					1	3	5	6	2	4
					3	2	6	4	1	5
					5	4	3	2	6	1

The treated areas were harvested on three occasions, 17 Jun, 17 Jul and 27 Aug. Samples were taken from the Hauldrop harvester for analysis at the PEI soils lab for forage quality and dry matter. Dry matter yield in T/ha was averaged across four replicates for each of the treatments in each harvest periods and an ANOVA were conducted between treatments at 5% confidence. The graph below depicts the yield across treatments and time.



No significant difference between treatments was indicated in this trial. At best, a trend towards higher yields could be seen with the highest fertilizer package. The site did experience some drought like conditions after the second cut, which likely explained the lower yields in the third cut. We would like to find a site with low fertility to really assess the value of these proposed recommendations against traditional fertility recommendations for alfalfa forage crops in NB.

The plant K concentration increased with increasing rates of K_2O application (Fig. 2) but were not significantly different among treatments. The treatments that included sulfur were not included in this interim report as those treatments were considered outside the scope of this investigation. Alfalfa is known to be a luxury consumer of potassium, but the investigators do not feel that occurred in this trial as the %K in the forage was not much different in the control versus the 300kg K_2O/ha treatment. If the investigators feel it is warranted, the effects of the K_2O applications on other minerals within the forage will be examined for the final report.



The removal of K_2O in the harvested material increased with increasing rates of K_2O application (Table 3). At the current medium K_2O soil test levels at the site, the 150kg K_2O /ha application rate matched what the crop removed.

Table 3. K2O removal and use efficiency

Treatment	Seasonal K_20 Application (kg/ha)	DM Yield (T/ha)	Forage K_2O Concentration (%)	K_2O Removal (kg/ha)	K_2O Use Efficiency (%)
Ctrl	0	6.52	2.00	130	
NPK NK21	150	6.63	2.26	150	13
NPK NK21 + Pot	300	7.34	2.35	172	14

This rate would maintain the current K_2O status of the soil. Where no K_2O application had occurred, the soil was able to supply 130kg K_2O/ha to the growing alfalfa crop. The high rate of application oversupplied K_2O without providing any significant yield advantage and would not be an economically viable practice to recommend on a similar soil.

K_2O use efficiency (Table 3) was extremely low, being 13% and 14% for the 150kg K_2O/ha and 300kg K_2O/ha treatments respectively. The current K_2O status of the soil at the test site and the dry climactic conditions at the site during the 2019 growing season may be responsible for this low efficiency.

GRASSES LEGUME MIXTURE EVALUATION

Objective: To evaluate the effect of species interaction of Red Clover and Alfalfa (the legumes) with grass species with the potential for higher quality and yield in both complex and simple forage mixtures over the life of a sward.

Companion or under seeding forage crops with a cereal crop has *been* a long standing practice on many livestock farms in New Brunswick with the objective being a pure forage crop stand in the subsequent year. The idea behind this practice is that the cereal crop competes with weeds early on in the growing season. On some farms the cereal crop is harvested as mature grain along with the straw. The cereal crop is also taken as silage and depending on the year a subsequent cut of forage is harvested in mid-August. This system can penalize forage production the following year when the cereal crop lodges, grain harvest and/or silage harvest is later than desired for the forage crop to get satisfactory growth going into winter or the cereal crop is seeded at too high a rate.

Complex forage mixtures sometimes containing a couple of legume species and more species of grasses are being promoted by sales persons in New Brunswick. Meanwhile forage researchers, such as Dr. Dan Undersander at UW and Dr Gerry Cherney at Cornell University are recommending simpler mixtures containing a legume and one or two grass species.

Summary of Progress

An area of approximately 1.4 acres at the Richmond Corner forage site was laid out with seven treatments of legume and grass species mixtures to accommodate various management treatments with fertility and harvest management commencing in 2020. Conventional seeding methods, rates and fertilizer was used and the strips were clipped as required for weed control. If continued in 2020 management treatments will be determined in 2020.

Approximately 0.9 acres was seeded at the Richmond Corner forage site to triple mix for the intended purpose of establishing a long term timothy management evaluation incorporating fertility and harvest management treatments in 2020. The area was fertilized with approximately 360 lb/ac of 19.6-6.6-19 and clipped for weed management.

The exceptionally dry climactic conditions at the site during the 2019 growing season had a negative impact on establishment for all mixtures and species.

EMERGENCY or ANNUAL FORAGE CROP EVALUATION

Management of annual crops or mixtures to re-establish winter failure or compensate for drought and weather extremes caused by global warming will become critical to NB livestock producers.

An extremely dry growing season in 2018 and widespread winter kill in 2019 left NB livestock producers scrambling to find crop options that would provide them enough feed for their animals. Annual species including as corn silage, forage pearl millet, sorghum-sudangrass, Italian ryegrass, teff, forage oats and peas, and forage soybeans were all established in replicated plots at the Richmond Corner site to assess their ability to provide a high yielding and high quality source of feed in a single season following challenging growing conditions. The parameters of evaluation were wet yield, dry matter yield, protein, NDF and NDF digestibility.

Summary of Progress

Potential annual forage species were established in randomized replicated split plots early and late planting for the warm season group.

Summary (Estimated Means) Specie	
Species/Mixture	DM (T/ha)
Corn Silage	10.5a
Soybean Silage	2.5b
Oat/Pea	2.2bc
Oats	2.1bcd
Peas	1.4bcde
Sorghum Sudan	1.0cde
Berseem clover	0.9cde
Tef	0.8de
Pearl Millet	0.8de
Italian ryegrass	0.5e
Pr > F (Model)	< 0,0001
Significant	Yes

Samples were taken from the Hauldrop harvester for analysis at the PEI Analytical Laboratory for forage quality and dry matter. Dry matter yield in T/ha was averaged across the four replicates for each of the species and mixture treatments and an ANOVA were conducted between treatments as reported in the table opposite. The exceptionally dry climactic conditions at the site during the 2019 growing season had a visible negative impact on establishment and growth of the late season group, as illustrated in the photo compared to the corn and earlier planted group.

Table 4 (below) illustrates the difference in dry matter yield per hectare with the corresponding significance between species. Obviously corn silage is the best option for an emergency forage species. However, the suitability of any crop is ultimately determined by the forage production system available on the farm.

Table 4: Specie / Tukey (HSD) / Analyse des différences entre les modalités avec un intervalle de confiance à 95% (DM (T/ha)) :

Contraste	Différence	Différence standardisée	Valeur critique	Pr > Diff	Significatif
Corn Silage vs Italian ryegrass	10.008	26.470	3.411	**<0,0001**	Oui
Corn Silage vs Pearl Millet	9.708	25.677	3.411	**0,0001**	Oui
Corn Silage vs Tef	9.697	25.648	3.411	**0,0001**	Oui
Corn Silage vs Berseem clover	9.613	25.427	3.411	**0,0001**	Oui
Corn Silage vs Sorghum Sudan	9.483	25.082	3.411	**0,0001**	Oui
Corn Silage vs Peas	9.081	24.019	3.411	**<0,0001**	Oui
Corn Silage vs Oats	8.426	22.288	3.411	**0,0001**	Oui
Corn Silage vs Oat/Pea	8.352	22.090	3.411	**0,0001**	Oui
Corn Silage vs Soybean Silage	8.011	21.189	3.411	**<0,0001**	Oui
Soybean Silage vs Italian ryegrass	1.997	5.281	3.411	**0.000**	Oui
Soybean Silage vs Pearl Millet	1.697	4.488	3.411	**0.003**	Oui
Soybean Silage vs Tef	1.686	4.459	3.411	**0.004**	Oui
Soybean Silage vs Berseem clover	1.602	4.238	3.411	**0.006**	Oui
Soybean Silage vs Sorghum Sudan	1.472	3.893	3.411	**0.016**	Oui
Soybean Silage vs Peas	1.070	2.830	3.411	0.172	Non
Soybean Silage vs Oats	0.415	1.099	3.411	0.981	Non
Soybean Silage vs Oat/Pea	0.341	0.901	3.411	0.995	Non
Oat/Pea vs Italian ryegrass	1.656	4.380	3.411	**0.004**	Oui
Oat/Pea vs Pearl Millet	1.356	3.586	3.411	**0.033**	Oui
Oat/Pea vs Tef	1.345	3.558	3.411	**0.035**	Oui
Oat/Pea vs Berseem clover	1.261	3.337	3.411	0.059	Non
Oat/Pea vs Sorghum Sudan	1.131	2.992	3.411	0.125	Non
Oat/Pea vs Peas	0.729	1.929	3.411	0.651	Non
Oat/Pea vs Oats	0.075	0.198	3.411	1.000	Non
Oats vs Italian ryegrass	1.581	4.182	3.411	**0.007**	Oui
Oats vs Pearl Millet	1.281	3.389	3.411	0.053	Non

Oats vs Tef	1.270	3.360	3.411	0.056	Non
Oats vs Berseem clover	1.187	3.139	3.411	0.092	Non
Oats vs Sorghum Sudan	1.056	2.794	3.411	0.184	Non
Oats vs Peas	0.655	1.731	3.411	0.770	Non
Peas vs Italian ryegrass	0.927	2.451	3.411	0.333	Non
Peas vs Pearl Millet	0.627	1.658	3.411	0.809	Non
Peas vs Tef	0.616	1.629	3.411	0.824	Non
Peas vs Berseem clover	0.532	1.408	3.411	0.915	Non
Peas vs Sorghum Sudan	0.402	1.063	3.411	0.985	Non
Sorghum Sudan vs Italian ryegrass	0.525	1.388	3.411	0.922	Non
Sorghum Sudan vs Pearl Millet	0.225	0.595	3.411	1.000	Non
Sorghum Sudan vs Tef	0.214	0.566	3.411	1.000	Non
Sorghum Sudan vs Berseem clover	0.130	0.345	3.411	1.000	Non
Berseem clover vs Italian ryegrass	0.395	1.043	3.411	0.987	Non
Berseem clover vs Pearl Millet	0.094	0.250	3.411	1.000	Non
Berseem clover vs Tef	0.084	0.221	3.411	1.000	Non
Tef vs Italian ryegrass	0.311	0.822	3.411	0.998	Non
Tef vs Pearl Millet	0.011	0.028	3.411	1.000	Non
Pearl Millet vs Italian ryegrass	0.300	0.794	3.411	0.998	Non
Valeur critique du d de Tukey :			4.824		

C1819-0977 NB Agricultural Weather Network

Leigha Beckwith, Ray Carmichael, NBSCIA Coordinators

This project activity acquired additional weather stations to address the deficiencies in the “potato belt area” and add stations throughout the Province. Fifteen Davies Vantage Pro weather stations were installed as follows: Upper Saint John River Valley (3); Central Region (2); Moncton/Chignecto (6); and Kings County (4).

Inclusion of all weather stations in the NB Potato Crop, Weather and Pest Information portal will improve the interpolation of climate mapping across NB, creating a real weather network to support crop growth and pest modeling in support of crop scouting and IPM programs.

The project objective to provide additional station locations leading to the establishment of a NB Agricultural Weather network was meet.

After interpolation the mapped data improves the definition and understanding of the microclimatic heat unit ratings applied to significant agricultural crops and improve integrated pest management and environmentally sustainable production practices.

When compared to the historical data available in NB Potato Crop, Weather and Pest Information portal the expanded NB Weather Network will serve as a reference bench mark for monitoring future climate change.

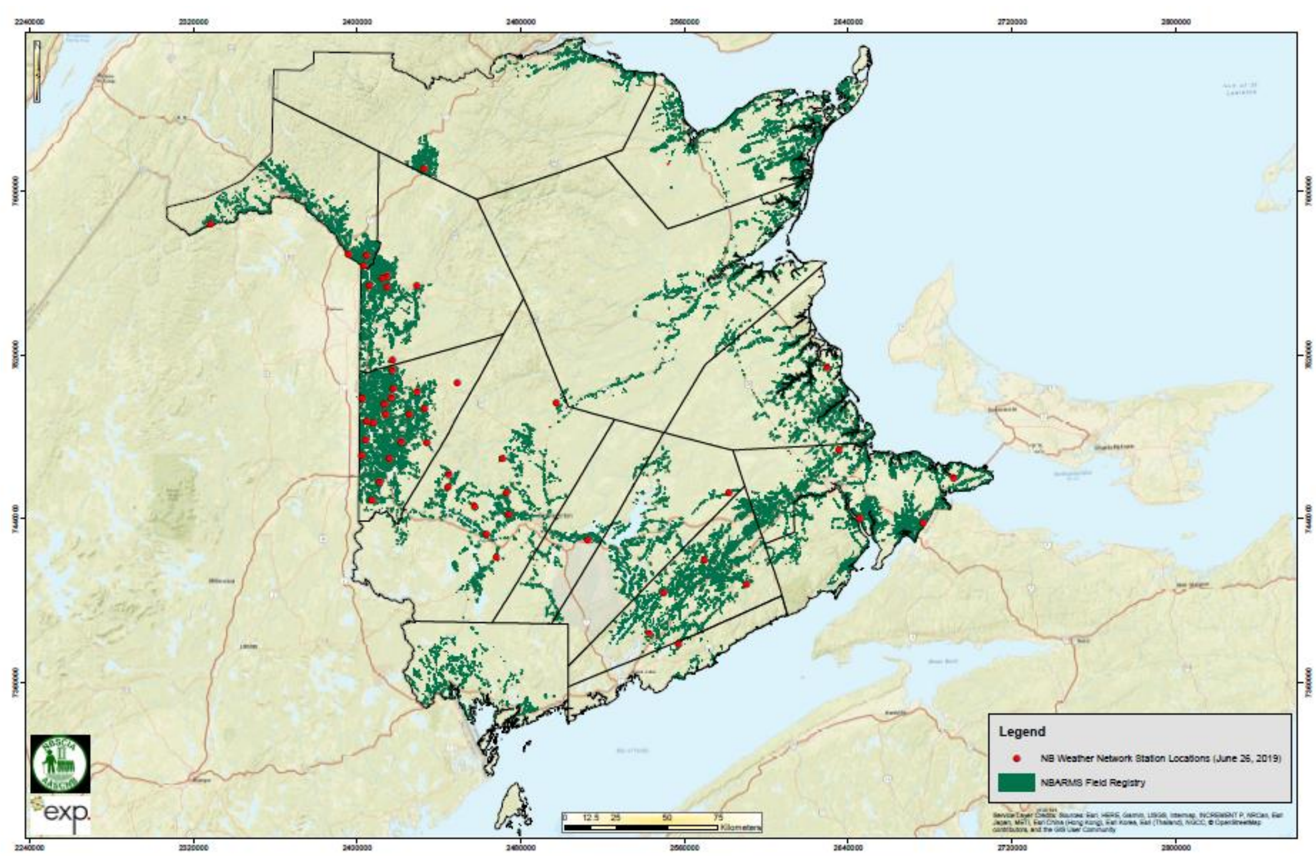
C1819-0977-Y2 NB Weather Mapping for Intensive Crop Management

NBSCIA Coordinators

NBSCIA has completed a series of projects (EMP15-003-3: NBSCIA Agricultural Geomatics Service), C1819-0557: Climate Mapping for Intensive Crop Production and C1819-0977 NB Agricultural Weather Network to enable export of the PAT data from the NB Potato Crop, Weather and Pest Information portal (http://agri.gnb.ca/010-001/WebServiceData.aspx) in a GIS compatible format.

The objective of this project activity is to establish a Province wide weather monitoring network to support environmentally sustainable crop production management practices through crop and variety selection and integrated pest management programs

Fifteen Davis Vantage Pro weather monitoring stations and four soil temperature sensor sets were installed prior to the start of 2019 crop season. Three in the Carleton Region, two additional stations, Central Region, four in the Kings Region and six stations in Moncton/Chignecto to complete the network of 53 stations as illustrated below.



NBSCIA members were provided station ids enabling them to access the Davis Weatherlink app on smart phones and read real time weather conditions at a particular station location. This was a very popular feature, particularly for determining wind speed for spraying decisions.

The proposed upgrades by NBDAAF to the NB Potato Crop, Weather and Pest Information portal to accommodate the additional stations was not accomplished as proposed. Consequently in season monitoring of all stations in the network was not provided by NBDAAF Potato Development Center staff. Alternatively NBSCIA Regional coordinators collected the station data from the Davies cloud link and transformed it using an .xlsx add on Kutools. The Project Leader downloaded the Web Service and manually combine the raw data sets from Davis Weatherlink to provide geo-referenced weather maps for three primary agricultural regions and climatic areas of the Province as identified in project C1819-0977, creating a NB Weather Network.

Significant technical issues regarding CHU methodologies and related coding issues were discovered while trying to merge the two data sets. Significant manual intervention on the part of NBDAAF and NBSCIA personnel was required to format the combined data for export to Arc GIS for interpolation and map presentation in .pdf format. As a consequence two deliverables were not accomplished: 1) improved definition and understanding of the heat unit rating for corn and soybean, in relation to physiological maturity in New Brunswick and 2) assessment of existing models for forecasting occurrence and severity of crop pests.

Month ending accumulations for CHU, GDD and rainfall for all stations were posted in a map format to the NBSCIA website: https://www.nbscia.ca/en/nb-weather-maps-2019.html This enhanced weather station network will provide New Brunswick farmers another valuable tool to remain competitive in an increasingly global market demanding environmentally sustainably produced commodities

The resolution or scale of interpolated surfaces generated from the weather station data varies with: (1) the locations of the weather stations, and (2) the spatial distribution of the stations. The further apart the stations are and/or the more unevenly they are spaced the greater the grid cell size required (or the smaller the scale). The best fit interpolation parameters for each region and general delivery of the interpolated weather maps on a regular basis was defined. However, this can also be impacted by the number of stations operating or recording data at a given point in time. Mechanical issues with stations varied from time to time but in general the number recording was good. Only four stations were not operational as of September 18-19, the date of the first crop damaging frost in some areas.

As a consequence of the previously identified technical issues the preparation of custom heat unit accumulations from the date of planting as proposed was not practical.

C1920-0201 Demonstrate Biofumigants as a Control of Root Lesion Nematode

Leigha Beckwith, Ray Carmichael, NBSCIA Coordinators

Collaborators: Carpenter Farms Ltd and Hillview Farms Ltd.

Root Lesion nematode have an economic impact on potato production that could be in the range of 10% in Atlantic Canada. Root lesion nematodes and Verticillium sp are associated with a major cause of potato yield reduction commonly referred to as Early Dying Complex (PED). Since nematodes usually attack underground plant parts, there are no reliable foliar symptoms to signify that nematodes may be the major cause of poor growth and reduced tuber yields in potatoes. In roots, injury by nematodes may be detected by the presence of lesions, cysts or galls. After a few weeks, however, roots are attacked by other pathogens such as bacteria and fungi (Verticillium sp.), and the original damage by nematodes may not be obvious. Consequently, nematode damage has often been attributed to other factors. Root lesion nematodes invade and migrate in potato roots, though tubers are sometimes invaded when nematode populations are very high. Root lesion nematodes and Verticillium sp are associated with a major cause of potato yield reduction commonly referred to as Early Dying Complex (PED).

Fumigant nematicides are an expedient way to control nematodes. The major disadvantage of chemical control is the cost of fumigants and the need for specialized equipment. Mustard is a well understood bio fumigant. Its bio fumigation properties have been studied for a number of years and scientists have developed a method to fully use these properties. Mustard has been shown to control a variety of soil born pests. These include Verticillium spp.,Rhizoctonia spp., Fusarium spp., Pythium spp., Sclerotinia spp., common scab and a range of nematodes. The use of mustard as a bio fumigant has also shown a decrease in damage caused by wireworm.

The objective of this project is to demonstrate the management of mustard varieties and green manure crops (oats, Sorghum-Sudan grass and Pearl Millett) in a system that is compatible with the potato rotation plan to suppress the nematode populations.

NBSCIA had access to a field in the 2nd year of a 3 year potato rotation where root lesion nematodes did impact the potato production in 2017(Carpenter) and a second field historically in a close potato rotation (Hillview

Carpenter indicated that one of his potato fields exhibited poor growth in sections of the field in 2017, similar to PED compared to a newly cleared section. Soil samples from the Carpenter field in the fall of 2018 identified higher levels of Root Lesion Nematode in sections of the field where the crop production was reduced compared to the "newer" area. However, nematode levels did not exceed the critical threshold of 2000 per kg.

Root Lesion Nematodes/kg of Dried Soil	
Plot	14-Sept-18
HW1	1440
HW2 (new area)	420
HW3	980
HW4	980

The subject field was set up with three replicated strips of Mighty, Attack and Centennial mustard on June 18, 2019. The mustard was incorporated on July 31, 2019, prior to seed formation. Oats, Pearl Millet and Sorghum Sudan grass were subsequently established as green manure crops fifteen days later.

A similar layout and management was conducted at the Hillview site.

Geo-referenced soil samples were collected from both sites prior to the establishment of the mustard and millet crops to get a base level of root lesion nematode populations in the spring. Samples from the same locations were collected in the fall and assessed for nematodes, Verticillum sp., soil organic matter and nutrient levels.

Pre-plant and fall nematode populations for the two field sites are reported in the table below. The Carpenter sites where marginally elevated compared to the 2018 samples. The difference is considered to be within the limits of random error due to timing and they are not geo-referenced locations. Root lesion nematode populations increased from spring to fall at three of the Carpenter sites and decreased at three of the Hillview sites. Overall populations of other nematodes increased during the season

		Root Lesion			Other		
Plot	Treatment	25-Jun19	26-Sep19	Difference Sept-June	25-Jun19	26-Sep19	Difference Sept-June
Carpenter Farms Number of Nematodes/kg of Dried Soil							
HW1	Mighty	1800	12341	10541	6301	32369	26068
HW2	Attack	1768	1549	-219	5894	19204	13310
HW3	Atta/Cen	3143	3990	847	6601	19338	12737
HW4	Centennial	1261	4494	3233	4414	40147	35733
Hillview Farms Number of Nematodes/kg of Dried Soil							
HV1	Centennial	5903	5589	-314	16528	28532	12004
HV2	Attack	6844	7518	674	23508	37012	13504
HV3	Mighty	8936	7016	-1920	29786	27479	-2307
HV4	HVFRotation	10435	10113	-322	14609	16656	2047

Verticillium sp. counts for each sample site as of October 16, 2019 are recorded in the table below. All sites exceeded the critical threshold for Veticillium dahlia of 500 cells per gram of soil.

Carpenter Farms Verticillium Status-Oct 2019			
		V.dahliae	V. albo-atrum
Plot	Treatment	cells per gram soil	cells per gram soil
HW1	Mighty	9030	0
HW2	Attack	4434	0
HW3	Atta/Cen	5201	8778
HW4	Centennial	2842	2519

Key physical and chemical soil factors that have a potential impact on soil and crop health for the Carpenter infield sample sites are reported below.

Organic Matter and Fertility Status							
Site_ID	OM	Ph	P_2O_5 (ppm)	K_2O (ppm)	Ca (ppm)	Mg (ppm)	CEC
HW-1	4.9	6.3	159	153	897	86	12
HW-2	4.7	6.2	87	108	723	89	11
HW-3	5.2	6.3	131	100	842	84	11
HW-4	5.6	6.3	98	89	860	101	11

At the Carpenter location the Pearl Millet and Sorghum Sudan grass did not establish following incorporation of the mustard bio fumigant species. The oats successfully established, The Pearl Millet and Sorghum Sudan grass germinated and emerged but simply died, which suggests a potential phytotoxicity from the mustards.

Geo-referenced soil samples were collected from a second field at Carpenter Farms to check for nematode and Verticillium infestation levels prior to the potato crop in 2020. The soil temperature on the collection date was recorded to be 4 C.

As recorded below average Root-lesion nematode populations are slightly below the critical threshold.

Nematodes/kg of Dried Soil (Nov.26)			
Plot	Root-lesion	Sprial	Pin
Home1	3680	260	
Home2	1680	80	
Home3	1400		
Home4	500		
Home5	1340	120	20
Home6	440		120
Average:	1507	153	70

Corresponding Verticillium sp. Infection levels are reported in the following table. Critical levels or thresholds for qPCR method of detection by Agricultural Certification Service have not yet been defined.

Sample ID	***V. dahliae***				***V. albo-atrum***			
	DNA ng/g soil	Standard Error (ng/g)	**cells per gram soil***	Standard Error (cells/g)	**DNA ng/g soil**	Standard Error (ng/g)	**cells per gram soil***	Standard Error (cells/g)
Home 1	**0.32**	0.03	**8776**	941	**0.00**	0.00	**0**	0
Home 2	**0.93**	0.18	**25494**	4871	**0.08**	0.04	**2113**	1118
Home 3	**0.35**	0.04	**9636**	1004	**0.00**	0.00	**0**	0
Home 4	**0.42**	0.08	**11624**	2326	**0.06**	0.04	**1690**	1082
Home 5	**0.47**	0.10	**12937**	2802	**0.00**	0.00	**0**	0
Home 6	**0.40**	0.08	**10841**	2139	**0.00**	0.00	**0**	0

*cells per gram soil estimate based on known DNA size of V. dahliae genome = 36.5 fg/cell

Conclusions: A single planting of a mustard bio fumigant crop did not reduce root lesion nematode populations. Pearl Millet and Sorghum Sudan grass did not establish following the mustard bio fumigant crop. Given the observed infield variability of PED symptoms all sampling should be geo-referenced to improve confidence in treatment effects.

NB Crop Production Optimization C1920-0035 Summary Report

Ray Carmichael, NBSCIA Coordinators

Collaborators:
Karon Cowan, AgTech GIS, yield mapping and summary
Bill Jones, Geomatics Analyst, exp, mapping and geospatial modeling support
Pat Toner, Soil Management Specialist, Crop Development Unit, NBDAAF
Zach Harmer, Practical Precision Inc. Tavistock, Ontario, SoilOptix support
Ryan Callahan, McCain Fertilizers Ltd. SoilOptix field operations
Brennan McCarthy, Hartland Agromart, grid sampling operations
Ben Wohlgemouth, Greenleaf Harvesting, owner/operator - forage yield data
Shawn Paget, Riverview Farms Corporation, owner/operator – potato, soybean and grain yield data
Chad Young, B&C Farms, owner/operator – soybean and grain yield data

1. *Introduction:*

The range of crop yield within a field is readily apparent to the naked eye, however such variability as observed cannot be quantified without some type of harvester mounted yield monitor. Similarly, production management practices to reduce the yield variability defined cannot be undertaken without a high level definition of soil parameters such as pH, organic matter and nutrient status.

2. *Objectives:*

1. To accelerate the adoption and utilization of commercially available crop production management technology or Precision Farming tools for forage, cereal, corn, soybean and potato crop management in New Brunswick.
2. To improve the knowledge and understanding of georeferenced data management and interpretation within the New Brunswick agricultural stakeholder community (producers, government specialists and service providers).
3. To quantify the potential yield improvement for forages, grains, oilseeds and potatoes in New Brunswick.
4. To identify primary soil chemical and physical characteristics limiting crop yield that may contribute to in-field yield variability.
5. To document the crop yield improvement or cost-benefit of implementing variable rate application of lime and fertilizer inputs over time.

4. *Deliverables:*

1. Quantification of the potential yield improvement for forage, cereal, corn, soybean and potato crops within existing field units
2. Definition or identification of correlation between crop yield and soil chemical and physical characteristics.
3. Benchmark (assessment and correlation) of the SoilOptix® mapping system compared to traditional and other geo-referenced soil sampling and analysis techniques.
4. Definition of optimum management zone size to accommodate commercial application and harvesting equipment swath widths
5. Demonstration of crop yield improvement with site specific fertility management (variable rate application of inputs).
6. Correlation of the SoilOptix® mapping of soil type with available soil survey maps.

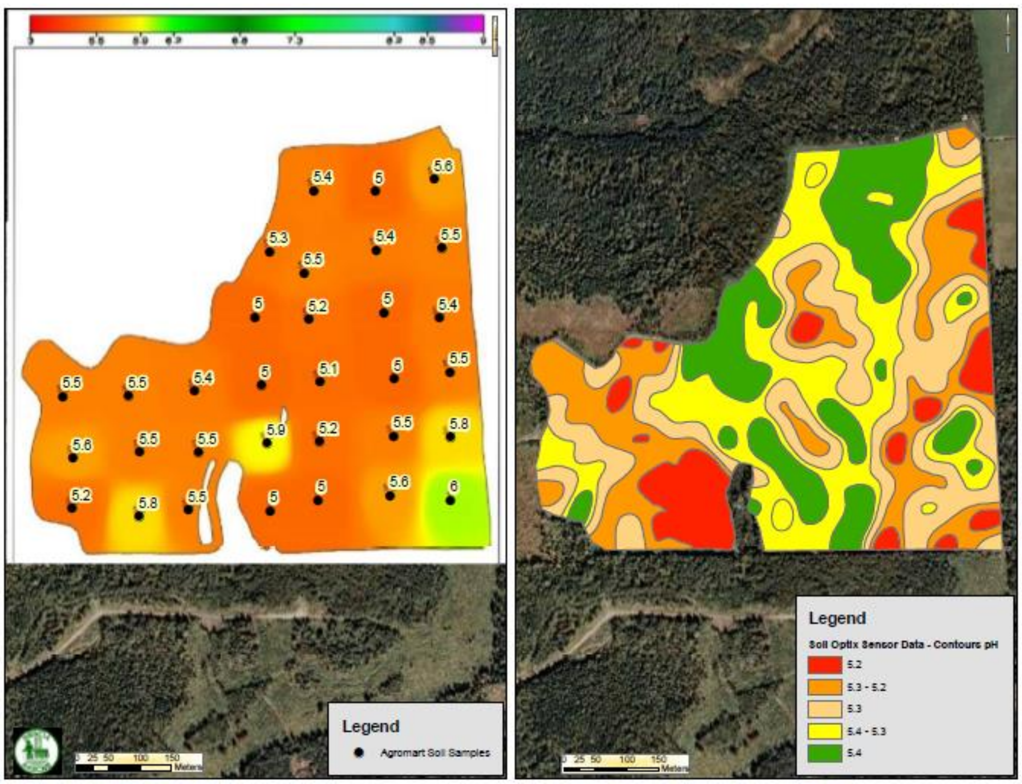
7. Distribution of the results to all industry stakeholders via e-mail, inclusion on the NBSCIA website and in the annual report.
8. Presentations of the yearly and composite results at producer, Local and NBSCIA meetings will be as requested bases.

5. *Results*:

Forage yield data was collected from seven farms using Greenleaf Harvesting services and cereal grain and soybean yields collected from two farms with combine yield monitors and interpolated in 2D and 3D layouts. Yield maps are available from the author upon request.

Grid soil sampling was compared to the SoilOptix methodology in five fields and the values presented to the cooperators by the respective service provider (Figure 1).

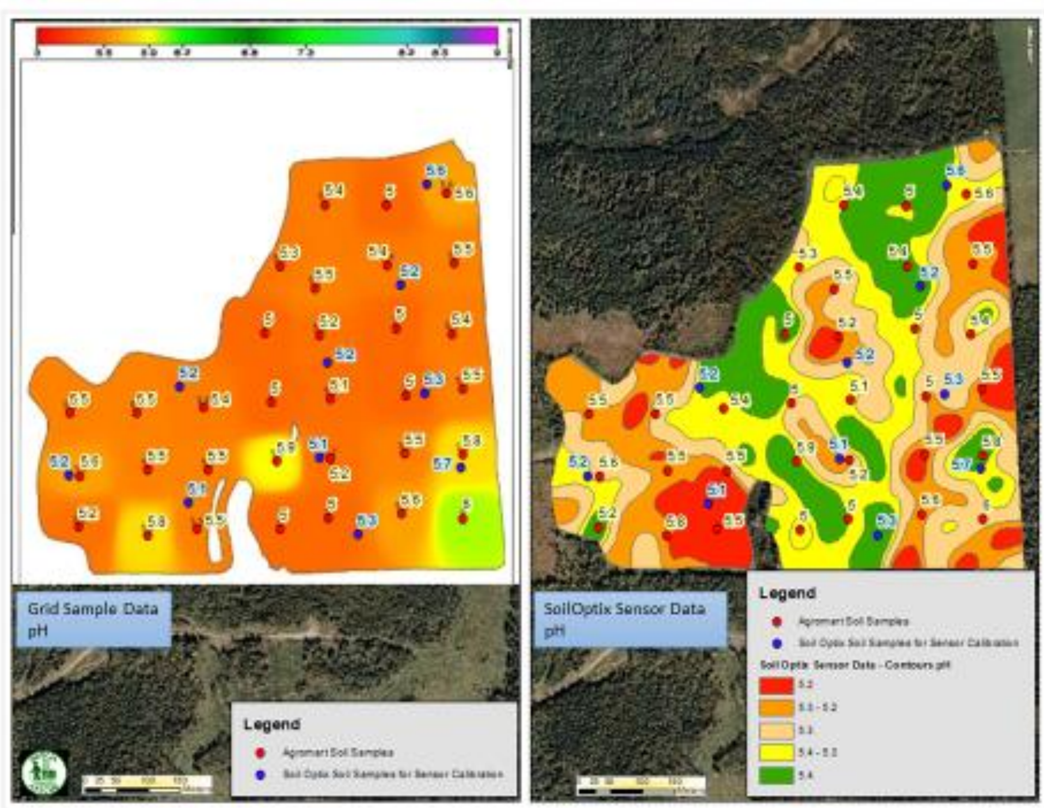
Figure 1: Illustration of map presentation of soil attributes by the service providers.



As illustrated below the SoilOptix method of soil status quantification provides a higher resolution of soil characteristics than the traditional hectare grid method. SoilOptix also provides additional characterization of soil type (% sand, silt and clay), available water and water infiltration.

The interpolated or contoured values for each sampling method were compared to the actual sample point values as illustrated in Figure 2 below.

Figure 2: Geo-referenced point value for soil pH compared to contour value.



By comparison the average value of selected soil parameters from physical samples collected in all fields are presented in Table 1 below. The significant difference in K level reported for Farm 3 is attributed to a fertilizer application between sample dates.

TABLE 1: AVERAGE VALUE OF ALL POINT SAMPLES ANALYZED

	Hectare Grid				SoilOptix			
Farm	OM (%)	pH	CEC	K (ppm)	OM (%)	pH	CEC	K (ppm)
1	8.0	5.4	17.3	100	8.8	5.3	15.7	102
2	4.4	6.1	9.0	291	4.3	5.8	9.1	216
3	6.7	5.9	13.1	237	6.4	5.1	15.8	110
4	4.8	6.4	9.8	163	4.8	6.2	12.8	183
5	4.9	5.9	12.9	196	4.8	5.7	15.3	196

The potential for in-field yield improvement varied between the seven crop species reported in 2019. Over the total crop area of 2235 acres the average yield improvement potential was approximately 80% of the total field area as reported in the table below. Approximately 20% of the field area was considered to have a limited potential for yield improvement.

2019 % Area for In-field Potential Yield Improvement for All Crops								
Crop	Total Area		% of Field Area with Yield Improvement Potential					
			Range 1	Range 2	Range 3	Range 4	Range 5	Range 6
Grain Corn	818		33	24	15	11	7	10
Barley	222		29	14	14	14	14	14
Oat	138		16	9	13	17	24	22
Soybean	339		8	32	36	16	6	2
Wheat	95		7	28	50	16	0	0
Corn Silage	215		0	5	36	40	18	1
Forage	408		21	25	22	12	5	15
All Crops:	**2235**	**Average=**	**16**	**19**	**27**	**18**	**11**	**9**
		Total Area with Improvement Potential =				**80%**		
			Area with Limited Improvement Potential=					**20%**

New Brunswick Soil & Crop Improvement Association Inc.

2-150 Woodside Lane Fredericton, NB E3C 2R9

Tel: 506-454-1736 Fax: 506-453-1985 www.nbscia.ca

CANADIAN AGRICULTURAL PARTNERSHIP

In total forage yield was collected for 408 acres and the within field potential yield improvement was estimated to average 1.1 ton per acre of forage dry matter as presented in Table 1 below.

Table 1: Forage Potential Yield Improvement by Field Area

														POTENTIAL IMPROVEMENT**							
		Dry Matter Yield Range (Tons)						% of Field Area						(Tons)						Total	Per Ac
Field	Area	< 1.0	1-1.5	1.5-2	2-2.5	2.5-3.0	>3.0	< 1.0	1-1.5	1.5-2	2-2.5	2.5-3.0	>3.0	2.5	1.5	1	0.5	0	0		
1	30.7	0.1	4.5	19.1	6.6	0.4	0	0.3	14.7	62.2	21.5	1.3	0.0	0.3	6.75	19	3.3	0	0	29.4	1.0
2	15.8	0.1	1.8	7	5.7	0.9	0.3	0.6	11.4	44.3	36.1	5.7	1.9	0.3	2.7	7	2.85	0	0	12.8	0.8
3	32.8	16.5	14.5	1.8	0	0	0	50.3	44.2	5.5	0.0	0.0	0.0	41.3	21.8	1.8	0	0	0	64.8	2.0
Home	51	34.3	7.5	3	2.9	2.1	1.2	67.3	14.7	5.9	5.7	4.1	2.4	85.8	11.3	3	1.45	0	0	101	2.0
Middle	59	17	30.4	11.3	0.3	0	0	28.8	51.5	19.2	0.5	0.0	0.0	42.5	45.6	11	0.15	0	0	99.6	1.7
Bens	18.1	0	0.4	0.5	1.2	3.5	12.5	0.0	2.2	2.8	6.6	19.3	69.1	0.0	0.6	0.5	0.6	0	0	1.7	0.1
4Lane	30	0.9	15	9.9	0.8	0.3	3.1	3.0	50.0	33.0	2.7	1.0	10.3	2.3	22.5	9.9	0.4	0	0	35.1	1.2
Derrah	36.2	0	0	0	0	0.6	35.6	0.0	0.0	0.0	0.0	1.7	98.3	0.0	0	0	0	0	0	0	0.0
1st	48.5	1.4	4.8	11.1	16.5	12	2.7	2.9	9.9	22.9	34.0	24.7	5.6	3.5	7.2	11	8.25	0	0	30.1	0.6
2nd	48.6	1.6	18.5	22.5	5.7	0.2	0.1	3.3	38.0	46.3	11.7	0.4	0.2	4.0	27.7	22.5	2.9	0	0	57.0	1.2
3rd*	48.5	36.8	11.7	0	0	0	0	75.9	24.1	0.0	0.0	0.0	0.0	55.2	0	0	0	0	0	55.2	1.1
1st	85.5	6.1	15.4	24.9	26.1	9.8	3.2	7.1	18.0	29.1	30.5	11.5	3.7	15.3	23.1	25	13.1	0	0	76.3	0.9
3rd	45.8	15.6	19.2	9.6	1.2	0.1	0.1	34.1	41.9	21.0	2.6	0.2	0.2	39.0	28.8	9.6	0.6	0	0	78	1.7
	408						**Avg.=**	**21.0**	**24.7**	**22.5**	**11.7**	**5.4**	**14.7**	**Overall Field Area Average(ton/ac):**							**1.1**

*adjusted for yield potential to next highest range only

Low yield range not adjusted for uncropped areas,swath width variance.

High yield range not adjusted for machine stops , swath width variance.

** Potential yield improvement calculated to second highest range recorded.

Corn silage yield was collected from three fields totaling 215 acres and a within field potential yield was estimated to average 2.6 ton per acre of dry matter as reported in Table 2 below.

Table 2: Corn Silage In-field Potential Yield Improvement for Field Area

		Dry Matter Yield Range (Tons)						% of Field Area						POTENTIAL IMPROVEMENT* (Tons)						Total	Per Ac
Field	Area	< 4.0	4-6	6-8	8-10	10-12	>12	< 4.0	4-6	6-8	8-10	10-12	>12	3	6	4	2	0	0		
Meadows	75.9	0.3	5	19.1	46.4	5	0.1	0.4	6.6	25.2	61.1	6.6	0.1	0.9	30	76	92.8	0	0	200	2.6
Apohaqui	63.4	0	0.8	6.2	25.7	29.3	1.4	0.0	1.3	9.8	40.5	46.2	2.2	0.0	4.8	25	51.4	0	0	81	1.3
DR2	75.4	0.1	5.4	56	13.9	0	0	0.1	7.2	74.3	18.4	0.0	0.0	0.3	32.4	224	27.8	0	0	285	3.8
Total	**215**						**Avg.=**	**0.2**	**5.0**	**36.4**	**40.0**	**17.6**	**0.8**	**Overall Field Area Average(ton/ac)**							**2.6**

*Potential improvement calculated to second highest yield range recorded for all fields.
Lowest yield range potential improvement adjusted by 1/2 for uncropped areas,swath width variance.
Higher yield ranges not adjusted for machine stops , swath width variance.

Wheat yield was collected from a single field of approximately 95 acres and a within field potential yield improvement was estimated to average 29.7 bushel per acre as reported in Table 3 below.

Table 3: Wheat In-field Potential Yield Improvement for Field Area

		Yield Range (bu)						% of Field Area						POTENTIAL IMPROVEMENT* (bu)						Total	Per Ac
Field	Area	<40	40-55	55-70	70-85	85-100	>100	< 20	20-30	30-40	40-50	50-60	>60	20	40	30	15	0	0		
Woodlawn	94.8	6.2	26.4	47	14.9	0.3	0	6.5	27.8	49.6	15.7	0.3	0.0	124	1056	1410	224	0	0	2814	29.7
Total	**94.8**													**Overall Field Area Average(bu/ac):**							**29.7**

*Potential improvement calculated to second highest yield range recorded for the field.
Lowest yield range potential improvement adjusted by 1/2 for uncropped areas,swath width variance.
Higher yield ranges not adjusted for machine stops , swath width variance.

Soybean yield was collected from five fields totaling approximately 339 acres and within field potential yield improvement was estimated to average 26.9 bushel per acre as reported in Table 4 below.

Table 4: Soybean In-field Potential Yield Improvement for Field Area

															POTENTIAL IMPROVEMENT*						
		Yield Range (bu)						% of Field Area						(bu)						Total	Per Ac
Field	Area	<20	20-30	30-40	40-50	50-60	>60	< 20	20-30	30-40	40-50	50-60	>60	15	30	40	10	0	0		
SD3	48.2	2.2	9.9	23.8	10.9	1.3	0.1	4.6	20.5	49.4	22.6	2.7	0.2	33	297	952	109	0	0	1391	28.9
GB1	22.5	6.4	11.1	2.8	1.2	0.4	0.6	28.4	49.3	12.4	5.3	1.8	2.7	96	333	112	12	0	0	553	24.6
RD1	112.1	4.4	63.8	38.5	3.9	0.7	0.8	3.9	56.9	34.3	3.5	0.6	0.7	66	1914	1540	39	0	0	3559	31.7
Anderson	137.9	3.4	17.8	37.2	41.9	32.9	4.7	2.5	12.9	27.0	30.4	23.9	3.4	51	534	1488	419	0	0	2492	18.1
Dick-Rd	18.6	0.2	3.6	10.9	3.5	0.3	0.1	1.1	19.4	58.6	18.8	1.6	0.5	3	108	436	35	0	0	582	31.3
Total:	**339.3**						**Avg.=**	**8.1**	**31.8**	**36.3**	**16.1**	**6.1**	**1.5**	**Overall Field Area Average(bu/ac):**							**26.9**
	*Potential improvement calculated to second highest yield range recorded for the field.																				
	Lowest yield range potential improvement adjusted by 1/2 for uncropped areas,swath width variance.																				
	Higher yield ranges not adjusted for machine stops , swath width variance.																				

Oat yield was collected from two fields totaling approximately 138 acres and within field potential yield improvement was estimated to average 10.9 bushel per acre as reported in Table 5 below.

Table 5: Oat In-field Potential Yield Improvement for Field Area

															POTENTIAL IMPROVEMENT*						
		Yield Range (bu)						% of Field Area						(bu)						Total	Per Ac
Field	Area	<75	95-105	105-115	115-125	125-135	>135	<75	95-105	105-115	115-125	125-135	>135	25	30	20	10	0	0		
SD	69.7	7.8	5.2	7	11.9	21.7	16.1	11.2	7.5	10.0	17.1	31.1	23.1	195	156	140	119	0	0	610	8.8
LP	68.7	15	6.7	10.6	11.3	11.3	14.1	21.4	9.8	15.4	16.4	16.4	20.5	368	201	212	113	0	0	894	13.0
Total:	**138.4**						**Avg.=**	**16.3**	**8.6**	**12.7**	**16.8**	**23.8**	**21.8**	**Overall Field Area Average(bu/ac):**							**10.9**
	*Potential improvement calculated to second highest yield range recorded for the field.																				
	Lowest yield range potential improvement adjusted by 1/2 for uncropped areas,swath width variance.																				
	Higher yield ranges not adjusted for machine stops , swath width variance.																				

Barley yield was collected from two fields totaling approximately 222 acres and within field potential yield improvement was estimated to average 9.3 bushel per acre as reported in Table 6 below.

Table 6: Barley In-field Potential Yield Improvement for Field Area**

														POTENTIAL IMPROVEMENT*							
		Yield Range (bu)						% of Field Area						(bu)						Total	Per Ac
Field	Area	<60	60-65	65-70	70-75	75-80	>80	<60	60-65	65-70	70-75	75-80	>80	10	20	15	10	0	0		
Up fr	84.7	24.2	12.1	12.1	12.1	12.1	12.1	28.6	14.3	14.3	14.3	14.3	14.3	242	242	182	121	0	0	787	9.3
Burt	137.2	39.2	19.6	19.6	19.6	19.6	19.6	28.6	14.3	14.3	14.3	14.3	14.3	392	392	294	196	0	0	1274	9.3
Total:	**221.9**						**Avg.=**	**28.6**	**14.3**	**14.3**	**14.3**	**14.3**	**14.3**	**Overall Field Area Average(bu/ac):**							**9.3**
	*Potential improvement calculated to second highest yield range recorded for the field.																				
	Lowest yield range potential improvement adjusted by 1/2 for uncropped areas,swath width variance.																				
	Higher yield ranges not adjusted for machine stops , swath width variance.																				
	** Harvested area and total yield adjusted to total field area.																				

Grain corn yield was collected from ten fields totaling approximately 818 acres and within field potential yield improvement was estimated to average 32.5 bushel per acre as reported in Table 7 below.

Table 7: Grain Corn In-field Potential Yield Improvement for Field Area

														POTENTIAL IMPROVEMENT*							
		Yield Range (bu)						% of Field Area						(bu)						Total	Per Ac
Field	Area	<80	80-100	100-120	120-140	140-160	>160	<80	80-100	100-120	120-140	140-160	>160	30	60	40	20	0	0		
Bottom	17.8	1.9	7.7	1.4	0.5	0.2	6.1	10.7	43.3	7.9	2.8	1.1	34.3	57	462	56	10	0	0	585	32.9
ByBob	41.9	2.7	5.9	16.5	10.8	3.5	2.5	6.4	14.1	39.4	25.8	8.4	6.0	81	354	660	216	0	0	1311	31.3
Big	325.2	31.4	38.4	66.3	125.5	34.9	28.7	9.7	11.8	20.4	38.6	10.7	8.8	942	2304	2652	2510	0	0	8408	25.9
School	135.7	69.3	11.2	15.3	10	14.1	15.8	51.1	8.3	11.3	7.4	10.4	11.6	2079	672	612	200	0	0	3563	26.3
Bedell	47.7	22.6	20.1	3.6	1.2	0.2	0	47.4	42.1	7.5	2.5	0.4	0.0	678	1206	144	24	0	0	2052	43.0
Limes	62.3	6.3	14.4	5.1	6.6	11.5	18.4	10.1	23.1	8.2	10.6	18.5	29.5	189	864	204	132	0	0	1389	22.3
BP1	42.4	41.0	1.4	0	0	0	0	96.7	3.3	0.0	0.0	0.0	0.0	1230	84	0	0	0	0	1314	31.0
BP3	51.6	28.5	15	7.2	0.9	0	0	55.2	29.1	14.0	1.7	0.0	0.0	855	900	288	18	0	0	2061	39.9
CS1	35.2	1.6	5	10.8	7.2	7.7	2.9	4.5	14.2	30.7	20.5	21.9	8.2	48	300	432	144	0	0	924	26.3
CS4	58.4	21.3	28.7	8	0.2	0.1	0.1	36.5	49.1	13.7	0.3	0.2	0.2	639	1722	320	4	0	0	2685	46.0
Total:	**818.2**						**Avg.=**	**32.8**	**23.8**	**15.3**	**11.0**	**7.2**	**9.9**	**Overall Field Area Average(bu/ac):**							**32.5**
	*Potential improvement calculated to second highest yield range recorded for the field.																				
	Lowest yield range potential improvement adjusted by 1/2 for uncropped areas,swath width variance.																				
	Higher yield ranges not adjusted for machine stops , swath width variance.																				

6. *Conclusions*:
Significant opportunity for yield improvement within a field for all crops reported exists. The quality of the yield data recorded is highly dependent on the operator's ability to managed swath width settings and calibration of the yield monitor and related sensors.

The SoilOptix method of soil status quantification provides a higher resolution of soil properties than the traditional hectare grid method. SoilOptix also provides additional characterization of soil type, available water and water infiltration. SoilOptix data quality can be improved with additional reference samples collected.

All stakeholders need an improved understanding of the analytical and interpolation methods used to create the various status and application maps presented from either method. This is particularly critical when attempting to compare methods of geo-referenced sampling, variable rate applications and undertaking correlations to crop yield.

The project generated a large amount of data which has only been partially analyzed. Further analysis by agronomists and GIS specialists will identify factors to potentially improve profitability, competitiveness and sustainability of crop production in New Brunswick.

C1920-0036 Soil Health Bench Marking-Reference Project

Ray Carmichael, NBSCIA Agro-environmental Co-ordinator

Project Collaborators: NBSCIA Club Agrologists; Project Lead
Cedric MacLeod, MacLeod Agronomics
NBDAAF Project Leads (Pat Toner, Khalil Al-Mughrabi)
Dr. David Burton, University of Dalhousie, Truro

1. *Project Objective:*
To undertake an initial survey of the range of soil health values or parameters across a range of soil types and/or management practices common to New Brunswick farm systems.

2. *Project Deliverable:* • An initial definition of soil health values around a specific agricultural systems or management practices in New Brunswick's major commodities.

3. *Summary of Progress:*

The initial soil sample collection procedures identified were an evolution of several academic research protocols for previous projects and directions from the Cornell Soil Health Manual and recently adapted by PEIAL for use in their soil health service. However, after one day of collection, these procedures using a spade quickly proved to be impractical in New Brunswick's stone infested soil. It is virtually impossible to get a 6" deep x 2" thick intact slice of soil the width of the spade, without it being interrupted with a stone. Assuming a stone was not encountered when pushing the spade into the soil.

Using the typical soil sample probe a uniform sample to the desired depth can be collected but is somewhat variable in grain stubble and plowed or harvested potato fields. It is also slow to collect the volume required because it is a small diameter core. The Dutch auger proved to work well in sod, plowed and post-harvest potato fields.

Given that overnight shipping is not guaranteed from most points in NB, the timing of collection and shipping is a challenge that can add to the overall cost. To be sure samples reach the lab on a Friday means shipment must occur on a Wednesday (assuming Canada Post and a pm mailing time). Therefore leaving only Monday and Tuesday for sample collection. Without a massive effort only a few samples can be collected in two days, therefore samples will have to be held over a few days which can be problematic for any biologic testing and particularly the Biological N supply analysis. PEIAL advises that, "if samples cannot be delivered to the lab within 24 hours, refrigerate or place in a cool area and submit to the PEIAL as soon as possible. Do not freeze the sample or allow the sample to dry out."

The Mobicool 12V AC/DC Powered Cooler can cool to a temperature 12 C below the ambient temperature and proved effective for this initial project year. The alternative is to arrange some type of sample drying prior to shipment.

The Outbound Styrofoam Cooler (opposite) provides a cost effective means to ship up to twenty samples including ice packs.

Alternatively, up to 5 samples, including ice pack, can be shipped using a Canada Post Flat Rate box.

The average values for selected soil fertility parameters with organic matter and pH for each region are reported in Table 1. Although soil organic matter ranges were variable within each district the coefficient of variability was similar for all regions except Northshore. This higher variability can be attributed to the inclusion of blueberry fields in the data set. Soil OM values for the "potato belt" area were found to be higher or comparable to other less intensively cropped regions, which could be a function of rotation management or the nearly universal loam soil type.

TABLE 1: Selected Soil Parameter Values for NBSCIA Regions

FIELD_ID	O. M.	pH	P_2O_5	K_2O	Ca	Mg	B	Cu	CEC
Carleton AVG:	5.5	6.1	245	199	1160	127	0.5	4.1	13
STDEV:	1.8	0.6	143	99	575	52	0.3	2.7	3
CV	**0.3**	**0.1**	**0.6**	**0.5**	**0.5**	**0.4**	**0.6**	**0.7**	**0.2**
Northwest AVG:	7.0	5.9	281	126	1274	105	0.5	3.2	15
STDEV:	2.6	0.7	243	82	948	64	0.3	2.1	4
CV	**0.4**	**0.1**	**0.9**	**0.7**	**0.7**	**0.6**	**0.7**	**0.6**	**0.2**
Moncton AVG:	4.0	6.1	116	107	1445	167	0.4	2.5	14
STDEV:	1.0	0.5	94	59	514	115	0.2	5.3	3
CV	**0.3**	**0.1**	**0.8**	**0.6**	**0.4**	**0.7**	**0.4**	**2.1**	**0.2**
Central AVG:	7.6	6.0	237	92	1205	132	0.4	3.6	17
STDEV:	2.1	0.5	180	37	491	110	0.3	2.1	2
CV	**0.3**	**0.1**	**0.8**	**0.4**	**0.4**	**0.8**	**0.7**	**0.6**	**0.1**
Northshore AVG:	6.5	5.1	107	78	976	66	0.2	0.8	19
STDEV:	4.3	1.1	76	62	1327	53	0.2	0.8	4
CV	**0.7**	**0.2**	**0.7**	**0.8**	**1.4**	**0.8**	**0.7**	**1.0**	**0.2**
Kings AVG:	4.9	6.0	109	107	1198	114	0.2	1.1	12
STDEV:	1.6	0.5	56	58	469	53	0.2	0.8	3
CV	**0.3**	**0.1**	**0.5**	**0.5**	**0.4**	**0.5**	**0.8**	**0.8**	**0.2**

Comparative values for non-cropped areas such as fence lines and newly cleared field areas for the Carleton area are reported in Table 2. Although a limited number of samples are reported, it appears that an OM of 10% may be a possibility in some soil types. A larger sample set is required for more conclusive results.

TABLE 2: Comparative Values for Fields in Production to Newly or Non Cropped Areas

District	FIELD_ID	O. M.	pH	P_2O_5	K_2O	Ca	Mg	B	Cu	CEC
Carleton	WHI250-Fence	5.4	5.7	94	191	691	72	0.2	8.0	14
Carleton	WHI251-Crop	3.2	5.1	358	353	701	123	0.5	5.9	13
Carleton	WHI239-Longterm Pasture	6.2	5.4	45	136	495	58	0.2	1.0	13
Carleton	FAR289-New-1 Crop	6.2	6.8	59	156	1559	120	0.4	5.1	11
Carleton	FAR289-Crop	4.3	6.7	326	202	1076	224	0.4	9.1	9
Carleton	ESD261- Forage Rotation	10.3	6.2	117	110	1649	174	0.8	3.5	17
Carleton	GUI353-New- 1 Crop	10.6	6.9	65	175	2930	187	1.2	2.8	19
Carleton	GUI353-Crop	4.4	6.3	276	265	1247	89	0.6	2.3	11

As of the date of writing the DalAC Atlantic Soil Health Lab had not completed the analysis as proposed. The results received are presented in TABLE 3 below. The single point soil texture classification was calculated from the percent sand, clay and silt values using the USDA Natural Resources Conservation Service online Soil Texture Calculator.

All soils were classified as a loam with varying degrees of sand or silt. Only one sample from Carleton County was identified with a percentage of clay.

Benchmark values for Active Carbon (mg/kg soil) and Water Stable Aggregates (%) have yet to be defined.

New Brunswick Soil & Crop Improvement Association Inc.

2-150 Woodside Lane Fredericton, NB E3C 2R9

Tel: 506-454-1736 Fax: 506-453-1985 www.nbscia.ca

TABLE 3: Texture, Active Carbon and Water Stable Aggregate Values for Project Fields

FIELD_ID	WATER_PH	CROP	ORG_MTR_RS	CEC	Sand %	Silt%	Clay %	Texture Classification	Active Carbon (mg/kg soil)	Water Stable Aggregates (%)
Carleton										
BRO169	5.8	Alfalfa - >/= 50% legume	5.7	15	36.84	49.07	14.10	Loam	774	83.50
BRO168	5.1	Potatoes	5.4	17	28.86	56.34	14.80	Silt Loam	664	77.35
WIL098	7.1	Soybeans	4.2	12	33.58	51.15	15.28	Silt Loam	590	22.39
WHI250-Fence	5.7	Fenceline	5.4	14	27.05	54.14	18.82	Silt Loam	707	97.60
WHI251	5.1	Potatoes	3.2	13	27.03	53.96	19.01	Silt Loam	491	31.76
WHI239-Past	5.4	Pasture (long term sod)	6.2	13	49.67	38.80	11.52	Loam	522	99.53
TPA116	5.7	Corn	5.9	13	25.97	57.54	16.49	Silt Loam	485	91.06
FAR289-New	6.8	Barley (1 crop yr)	6.2	11	27.58	55.12	17.31	Silt Loam	653	60.68

FAR289	6.7	Barley	4.3	9	32.08	52.39	15.53	Silt Loam	407	47.58
MOO370	6	Potatoes organic	5.2	12	30.17	52.38	17.45	Silt Loam	531	60.69
POL207	6.2	Soybeans	6	13	27.85	53.17	18.98	Silt Loam	520	90.52
POL188	5.7	Green manure	4.8	16	32.38	47.50	20.12	Loam	492	37.83
POL285	6.6	Soybeans	6	15	57.20	29.30	13.50	Sandy Loam	654	42.82
POL286	5.9	Best Pasture sod	8.6	18	43.01	37.07	19.91	Clay Loam	815	75.84
ESD261	6.2	Grass Forage - </= 50% legume	10.3	17	47.30	39.64	13.07	Loam	812	86.69
NIX242	6.3	Corn silage	4.4	12	43.64	46.48	9.88	Loam	534	33.71
BAT233	6.1	Strawberries	4.9	13	42.47	46.32	11.21	Loam	508	53.86
BAT393	6.7	Oats	5	11	32.02	53.63	14.35	Silt Loam	474	41.25
GUI353-New	6.9	Potatoes (1 crop yr)	10.6	19	20.86	62.80	16.34	Silt Loam	1060	54.80
GUI353	6.3	Potatoes	4.4	11	34.50	52.74	12.76	Silt Loam	389	38.40
KNO303	4.7	Xmas trees	4.1	16	31.72	54.18	14.10	Silt Loam	400	51.80
FIE070	5.7	Grass Forage - </= 50% legume	6.8	16	40.03	48.13	11.84	Loam	430	66.86

ELM 053-1	6.3	Mustard	4.9	12	39.37	45.47	15.17	Loam	499	53.95
ELM053-2	6.2	Mustard	4.7	11	39.82	44.25	15.94	Loam	473	44.45
ELM 053-3	6.3	Mustard	5.2	11	41.24	44.01	14.76	Loam	595	47.08
ELM 053-4	6.3	Mustard	5.6	11	39.12	43.70	17.18	Loam	551	47.27
WAT 421	5.7	Potatoes	3.3	13	33.33	49.45	17.22	Loam	503	37.96
ELM 027-1	5.5	Potatoes	3	10	36.70	46.84	16.47	Loam	440	22.29
CHE409	6	Potatoes	2.6	11	59.19	28.72	12.10	Sandy Loam	302	41.82
CHE404	6.9	Potatoes	6.6	17	29.83	53.64	16.54	Silt Loam	549	51.31
Avg.	6.1		5.5	13.4	36.3	48.3	15.4	Loam	560.8	56.4
Moncton										
HIC887A	6	Clover - >/= 50% legume	4.6	15	34.48	42.96	22.56	Loam		49.82
HIC887B	6.6	Clover - >/= 50% legume	3.9	17	43.16	38.96	17.87	Loam	362	38.92
URY805	6	Grass Forage - </= 50% legume	3	12	59.86	29.71	10.43	Sandy Loam	424	41.61
URY805-BO	6	Grass Forage - </= 50% legume	4.4	12	52.41	35.27	12.32	Sandy Loam		59.94

JPR246	6.5	Grass Forage - </= 50% legume	3	11	51.22	33.02	15.76	Loam	403	18.46
COL373A	6.8	Alfalfa - >/= 50% legume	3.2	14	42.55	44.16	13.29	Loam	403	18.40
COL373B	6.8	Alfalfa - >/= 50% legume	2.8	15	41.93	43.34	14.73	Loam	428	23.83
SYN211	6.4	Grass Forage - </= 50% legume	3.1	12	11.96	74.04	14.00	Silt Loam	428	74.71
OGD734A	5.1	Grass Forage - </= 50% legume	4.6	19				na	609	68.34
OGD734B	5.3	Grass Forage - </= 50% legume	5.2	19				na		45.75
COK428A	6.2	Winter Wheat	4.1	12	53.17	36.24	10.59	Sandy Loam	548	54.95
COK428B	6.7	Winter Wheat	3.8	10	54.41	35.44	10.15	Sandy Loam		62.52
URR192	5.9	Grass Forage - </= 50% legume	3.7	14	49.71	32.17	18.11	Sandy Loam	359	58.28
DOR008	6.2	Grass Forage - </= 50% legume	6.6	16	53.15	30.69	16.16	Sandy Loam		66.35
LAG093A	5.4	Sweet Corn	2.9	13	62.37	23.49	14.14	Sandy Loam	321	22.53
LAG093B	5.8	Sweet Corn	3.3	13	58.70	26.70	14.61	Sandy Loam		32.22
GIN730	6	Unknown	4.6	14	52.98	32.72	14.31	Sandy Loam	325	40.00
WES133	6.3	Unknown	5	13	61.08	26.31	12.61	Sandy Loam	621	62.65

Avg.	6.1		4.0	13.9	48.9	36.6	14.5	Loam	436.0	46.6
Central										
LAP060	5.7	Mixed Forage - </= 50% legume	8.4	20	59.44	27.64	12.93	Sandy Loam	844	85.81
GAW132	6.7	Mixed Forage - </= 50% legume	9	14	49.64	40.84	9.52	Loam	888	89.64
LYN800	5.9	Mixed Forage - </= 50% legume	10.5	17	64.68	27.58	7.74	Sandy Loam	926	95.91
QUN243	6.1	Mixed Forage - </= 50% legume	6.8	15	30.96	44.96	24.08	Loam	615	85.02
SHE203	5.7	Unknown	8.3	17	50.19	34.93	14.88	Loam	821	79.74
SHE206	5.2	Unknown	6.3	18	48.20	36.03	15.78	Loam	548	88.10
PRW100-9	6.4	Unknown	4.2	15	39.27	48.53	12.21	Loam	681	61.81
LAO995	6.4	Mixed Forage - </= 50% legume	10.5	16	58.79	30.70	10.51	Sandy Loam	973	96.39
Avg.	6.0		7.6	16.6	48.9	37.2	13.9	Loam	760.4	83.7
Northshore										
DAL326	6.4	Clover - >/= 50% legume	18.1	30				na		63.35
DUR093	5.9	Grass Forage - </= 50% legume	5.2	14	67.02	22.37	10.61	Loamy Sand	474	78.52
FRE148	5.7	Alfalfa - >/= 50% legume	10	16	39.52	42.51	17.97	Loam	627	87.57

NEP025	6.9	Clover - >/= 50% legume	6.4	13				na		58.06
Behind SAL298	6.4	Clover - >/= 50% legume	10	18				na	701	82.31
Etienne Godin	4.3	Unknown	3.5	20	80.79	14.49	4.73	Loamy Sand	259	70.02
MOR355	4.1	Unknown	3.7	20				na	357	54.16
Lane Stewart	4	Unknown	3.3	19	77.74	16.41	5.86	Loamy Sand	322	53.84
BAR188	4.1	Unknown	5.8	22	75.26	18.24	6.50	Sandy Loam	437	46.80
Alain Lepage	4.2	Unknown	5.1	20	75.52	17.51	6.97	Sandy Loam	439	62.08
Elzear Savoie	4.4	Unknown	2.8	18	78.24	14.44	7.31	Loamy Sand	293	55.07
OSE001	4.6	Unknown	4.6	16	67.47	21.11	11.42	Loamy Sand	277	74.52
Avg.	5.1		6.5	18.8	70.2	20.9	8.9	Loamy Sand	418.6	65.5
Northwest										
65060-345/204	5.1	Barley	3.7	14	42.75	44.32	12.92	Loam	427	21.25
650-66-409	5.5	Potato - Late Season	4.5	13	46.82	38.70	14.48	Loam	518	30.05
351-05-733	6.2	Grass Forage - </= 50% legume	6.8	11	43.27	37.30	19.42	Loam	853	89.54
352-56-510	5.1	Grass Forage - </= 50% legume	8.7	15	52.58	35.53	11.89	Sandy Loam	835	95.90

350-48-107	7	Grass Forage - </= 50% legume	9.8	19	45.64	40.49	13.88	Loam	1068	95.53
350-46-651	6.5	Grass Forage - </= 50% legume	10.7	13	55.02	32.08	12.91	Sandy Loam	842	92.62
350-31-186	6.6	Grass Forage - </= 50% legume	8	11	52.34	36.34	11.31	Sandy Loam	856	96.17
350-23-076	5.6	Grass Forage - </= 50% legume	6.2	14	42.87	46.30	10.84	Loam		81.71
500-14-133	5.6	Grass Forage - </= 50% legume	5.1	14	28.20	52.17	19.63	Silt Loam		82.55
500-17-615	6.6	Oats	11.3	21	38.15	46.59	15.26	Loam	534	69.17
352-13-008	6.5	Alfalfa - >/= 50% legume	5.3	10	41.10	49.15	9.76	Loam	805	70.88
500-14-257	4.9	Potato - Late Season	6.7	19	39.84	44.29	15.87	Loam	594	77.83
650-60-202	5.8	Barley	3.7	20	44.73	40.09	15.17	Loam	599	16.65
Avg.	5.9		7.0	14.9	44.1	41.8	14.1	Loam	721.0	70.8
Kings										
CHA063A	6.6	Unknown	5.6	8	41.12	47.87	11.01	Loam	337	89.74
CHA063B	6.3	Unknown	6.4	11	45.15	44.05	10.80	Loam	680	87.99
TIT352	6.3	Unknown	5.7	12	37.09	49.69	13.22	Loam	625	66.02

WIC452	5.5	Unknown	5	14	67.28	23.15	9.57	Sandy Loam	369	84.99
PHI351	6.9	Unknown	3.3	14	57.34	28.01	14.66	Sandy Loam		17.49
SUS137	6.1	Unknown	3.6	12	47.34	40.78	11.89	Loam	369	49.45
ORT012	6.5	Unknown	6.2	13	47.64	38.67	13.68	Loam	560	83.65
SUS617	6.3	Unknown	5.4	13	39.30	44.84	15.86	Loam	481	75.23
SUS413	5.8	Unknown	3.8	11	56.08	30.87	13.05	Sandy Loam	486	51.27
WEL119	5.7	Unknown	8.5	19	53.80	34.59	11.60	Sandy Loam	620	96.98
TIT525	5.7	Unknown	2.4	12	43.90	41.75	14.36	Loam	261	40.54
DIC311	5.6	Unknown	3.7	10	69.13	21.70	9.17	Sandy Loam	417	31.19
OHN211	5.2	Unknown	4.6	13	52.93	35.38	11.69	Sandy Loam	394	87.58
Avg.	6.0		4.9	12.5	50.6	37.0	12.4	Loam	466.6	66.3