New Brunswick Soil & Crop Improvement Association Inc.
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CANADIAN AGRICULTURAL PARTNERSHIP

Enabling Agricultural Research and Innovation
Interim Report

Element 1, Innovative Research and Development

This report will be for multi-year projects in progress. Interim reports will be used to evaluate the progress of the project and help determine future funding decisions on the project. Sections of the interim report may be used for promotional or outreach material for the EARI Program.

Interim reports must include the following sections:

1. *Project title and project number*: Soil Health Bench Marking-Reference Project C1920-0036

2. *Project leader and collaborators*:
   NBSCIA Club Agrologists; Project Lead Ray Carmichael
   Cedric MacLeod, MacLeod Agronomics
   NBDAAF Project Leads (Pat Toner, Khalil Al-Mughrabi)
   Dr. David Burton, University of Dalhousie, Truro

ABSTRACT/RÉSUMÉ

This report details the progress made on this project from April 1, 2019, to March 12, 2020. The goal of the project is 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. Typical soil sample probes were used to collect the soil samples due to New Brunswick's typically rocky soil. Another obstacle was New Brunswick's inadequate overnight shipping system that could impact the results from the sample in biological testing. The Outbound Styrofoam cooler was used to mail up to 20 samples at a time for analysis. Soil fertility values, pH, and organic matter values are reported, finding a fairly constant coefficient of variability for all regions barring North Shore. The DalAC Atlantic Soil Health Lab had not completed soil analysis as of the writing of this report. Single point soil texture classification was calculated from the percentage of 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. Going forward PEI Analytical Laboratories (PEIAL) will undertake the following standard soil sample analysis: pH, OM, P2O5, K2O, Ca, Mg, Cu, Zn, Fe, Mn, S, B, Na, Al, Lime Index, CEC, % Base Saturation, in addition to Soil Respiration, Aggregate Stability, Active Carbon, Biological Nitrogen Availability, and Soil Texture. NBSCIA will collaborate with Bradford Rooney, Soil Health Research Coordinator, PEI Department of Agriculture & Land to define appropriate methods, logistics and benchmarks for New Brunswick.

Ce rapport détaille les progrès réalisés dans le cadre de ce projet du 1er avril 2019 au 12 mars 2020. Le projet a pour but d'entreprendre une enquête initiale sur la gamme de valeurs ou de paramètres de la santé des sols dans un éventail de types de sols et/ou de pratiques de gestion communes aux systèmes agricoles du Nouveau-Brunswick. En raison du sol typiquement rocheux du Nouveau-Brunswick, les échantillons de sol ont été prélevés au moyen de sondes d'échantillonnage conventionnelles. Parmi les contraintes, citons le système d'expédition express

inadéquat du Nouveau-Brunswick, susceptible d'avoir une incidence sur les résultats de l'échantillon lors des tests biologiques. Les échantillons étaient expédiés au nombre de 20 unités simultanément aux fins d'analyse dans une glacière en polystyrène de type Outbound. Les valeurs de fertilité du sol, de pH et de la matière organique figurent dans le rapport, révélant un coefficient de variabilité assez constant pour toutes les régions, sauf la Côte-Nord. Au moment de la rédaction du présent rapport, le laboratoire de santé des sols de l'Atlantique du campus agricole de Dalhousie n'avait pas encore effectué d'analyse des sols. La classification de la texture du sol en un seul point a été calculée à partir du pourcentage de sable, d'argile et de limon en recourant au calculateur de texture du sol en ligne du USDA Natural Resources Conservation Service. Tous les sols ont été qualifiés de terre glaise assortie de divers degrés de sable ou de limon. Seul un échantillon du comté de Carleton a été identifié comme présentant un pourcentage d'argile. À l'avenir, les laboratoires analytiques de l'Î.-P.-É. (PEIAL) effectueront les analyses standard suivantes des échantillons de sol : pH, MO, P2O5, K2O, Ca, Mg, Cu, Zn, Fe, Mn, S, B, Na, Al, indice de chaux, CEC, taux de saturation en bases, en plus de la respiration des sols, de la stabilité structurale, du carbone actif, de la biodisponibilité de l'azote et de la texture des sols. L'AASCNB collaborera avec Bradford Rooney, coordonnateur de la recherche sur la santé des sols, ministère de l'Agriculture et des Terres de l'Î.-P.-É., pour définir les méthodes, la logistique et les points de référence appropriés pour le Nouveau-Brunswick.

3. *Specify period of time for which the interim report is being submitted.*
   April 1, 2019- March 12, 2020

4. *Project Objective(s):*
   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.

5. *Project Deliverable(s):* As stated in the Letter of Offer:
   - An initial definition of soil health values around a specific agricultural system or management practice in New Brunswick's major commodities.
   - A final report documenting the project results and recommended protocols.

6. *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). This only leaves 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 biological 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.”

NBSCIA coordinators do not have access to refrigeration for samples other than their personal fridge. 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

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 North Shore. 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.

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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
North Shore										
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

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7. *Adjustments*:
The DalAC Atlantic Soil Health Lab is primarily a research facility and not equipped or staffed to provide routine and timely analysis for commercial application.

Since the inception of this activity PEI Analytical Laboratories announced the establishment of a Soil Health Test as a commercial service.

Going forward PEI Analytical Laboratories (PEIAL) will undertake the following standard soil sample analysis: pH, OM, P2O5, K2O, Ca, Mg, Cu, Zn, Fe, Mn, S, B, Na, Al, Lime Index, CEC, % Base Saturation, in addition to Soil Respiration, Aggregate Stability, Active Carbon, Biological Nitrogen Availability, and Soil Texture.

NBSCIA will collaborate with Bradford Rooney, Soil Health Research Coordinator PEI Department of Agriculture & Land to define appropriate methods, logistics and benchmarks for New Brunswick.