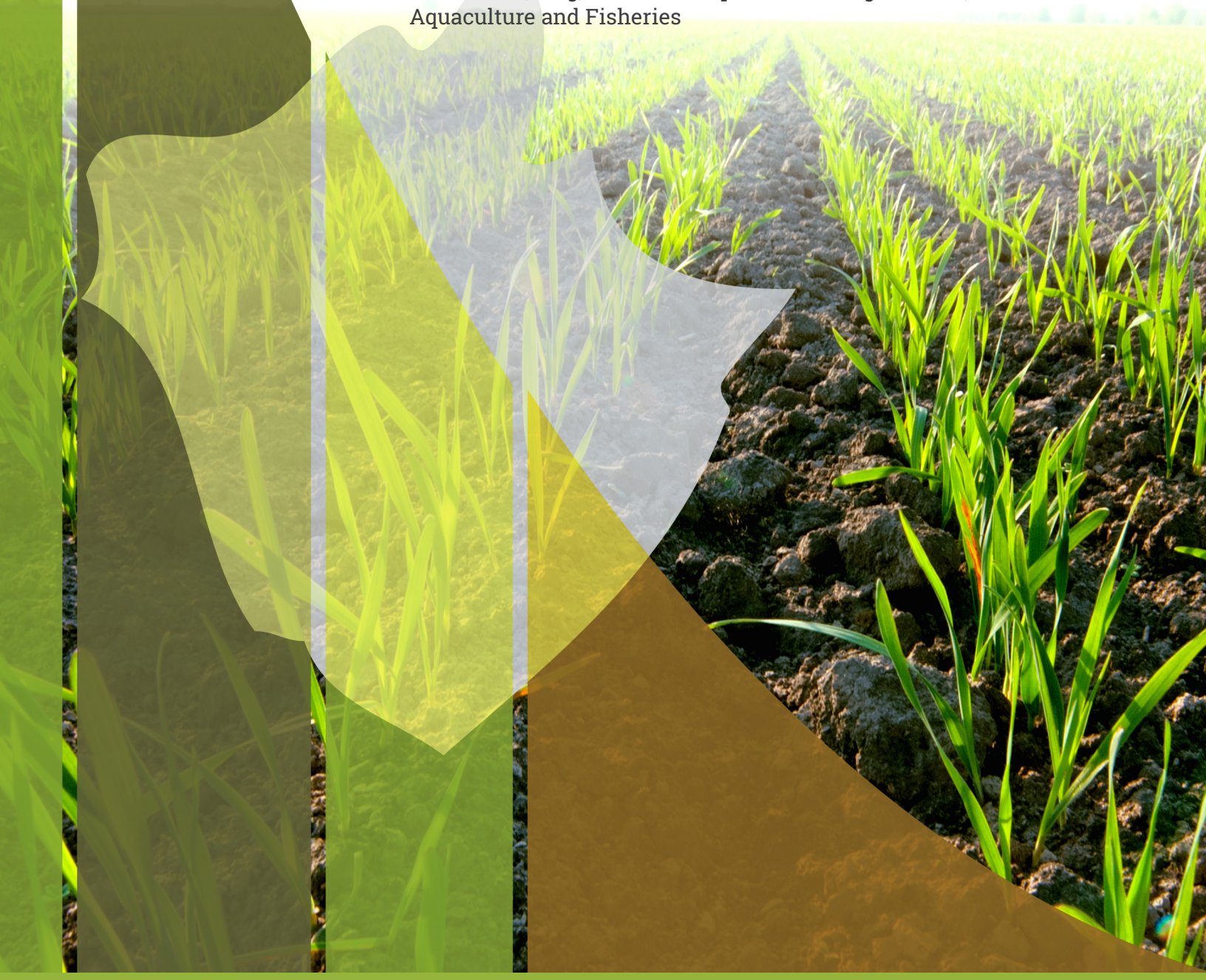
nutrient stewardship

4R Nutrient Stewardship in New Brunswick 2015 Report

Prepared by: Amy McFadgen, P.Ag, CCA-NBSCIA
& Pat Toner, P.Ag, CCA – NB Department of Agriculture, Aquaculture and Fisheries



FERTILIZER CANADA
FERTILISANTS CANADA

Prepared by:

Amy McFadgen, P.Ag, CCA-NBSCIA

Pat Toner, P.Ag, CCA – NB Department of Agriculture, Aquaculture and Fisheries

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1. Introduction

The New Brunswick Soil and Crop Improvement Association (NBSCIA) and the New Brunswick (NB) Department of Agriculture, Aquaculture and Fisheries (NBDAAF) have been working with producers in Nutrient Management Planning over a number of years. 4R Nutrient Stewardship (Right Source @ Right Rate, Right Time, Right Place ®) in New Brunswick can balance the provinces need to maintain agricultural productivity — one of the provinces most profitable industries, while promoting environmental sustainability. Early in the 2015 cropping season, the NBSCIA selected five NB producers to collaborate in 4R Nutrient Stewardship demonstration farms conducted by the NBSCIA Agro Environmental Clubs and the NBDAAF. Grower practices were used as industry standards and compared to 4R Nutrient Stewardship best management practices (BMPs).

Producers with crops in grain, corn silage, and soybeans were chosen. The crops were monitored throughout the growing season and harvested for yield data. After establishing the practices in 2015, this new data will be used to form recommendations for 2016.

2. Methodology

NBSCIA engaged five NB Producers in distinct regions to participate in the demonstration trials. Participants included:

Participant	Location	Crop
Brian Connor	Central	Corn Silage
Travis Friesen	Carleton	Grain Corn
Bruce MacNichol	Moncton	Soybeans
Kier Miller	Sussex	Grain Corn
Mike Smith	North Shore	Soybeans

Figure 1. provides an overview of farm locations. Sites were implemented across NB counties and an agrologist was assigned to each site to allow the information to be easily communicated back into the farm community.

Following field selection by the grower, the agrologist reviewed the current soil test report, previous crop history, and current cropping plans using this data. The program was developed for each site based on these parameters. Growers treated a section in their field according to 4R Nutrient Stewardship protocols.

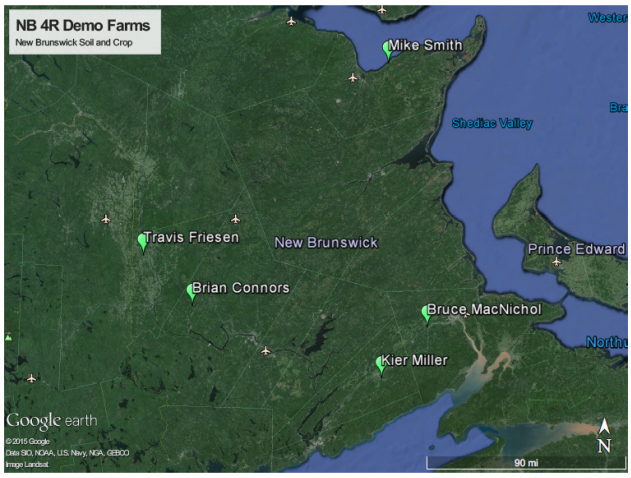


Figure 1. 4R Nutrient Stewardship demonstration growers and farm locations in NB for 2015 trials

4R Nutrient Stewardship Program

Strategies included:

Grain Corn:

1. Assessing poultry manure used in corn production and side dressing Nitrogen (N) through the use of strip trials with the following treatments:
    - Zero side dress N check strips
    - Three side dressings of Urea Ammonium Nitrate (UAN) applied 17 July at V6 with drop tubes to avoid burning.
2. Method of nitrogen side dress, along with a split rate. Treatments looked at the method of nitrogen application:
    - Injection or knifed in between the rows vs Y drop tubes either side of the rows around mid-July V6 stage
    - A treatment to look at a later application to gauge the impact of side dress near tassel time and another was split at V6 and VT

Corn Silage:

1. Using a split N application at the 4-5 leaf stage based on the infield N test using a strip in the producers' field.
    - Treatment held back full application of N Fertilizer

Soybeans

1. Comparing yields and profits using high sulfur fertilizer
    - Treatments compared different types of fertilizer applications at different pHs
2. Top dressing N for soybean production.
    - Top dressed N strip was done in field next to regular fertilizer application

Recommended applications were based on recent soil samples, prior to any nutrient application, evaluated using the NB FertiPlan program . In the corn fields, the Pre Side Dress Nitrogen Test (PSNT), Green Index, and, in some cases, SPAD readings were done to determine the in season N rates. In the grain corn, stalk nitrate samples were taken. Corn silage had tissue samples taken mid-season. In the soybean fields, nodulations counts were taken. All fields had quality samples taken.

The methodology for the testing during the season was as follows:

Soil Samples

- All soil samples collected were at the 0-6 inch depth using a composite sampling method. Samples were tested for pH, micro- and macronutrients and, in some cases, organic matter. All samples were submitted to the Prince Edward Island (PEI) Analytical Laboratory.

Nitrogen Side Dressing

- Over the years, the NBSCIA has been working with side dressing trials to evaluate the PSNT soil test relative to other methods of interpreting a corn crop's N needs. Other non-invasive plant assessments have been tried such as the greenseeker, SPAD meter and Field Scout Green Index+ app to determine N needs. These tools are believed to fit well with the 4R Nutrient Stewardship program to achieve the Right Rate (at side dress), Right Time, Right Place and Right Source of N to use, while protecting leaves from damage and maximizing the photosynthetic ability of the plant to produce a crop.

- Corn was assessed for a side dress rate of application using a SPAD meter along with a worksheet from PennState supplied with their Spad Calc Factsheet for SPAD meters. In addition to this, leaves were cross referenced to the Spectrum Technologies FieldScout Green Index+ app used on an ipad Mini. The later method of assessment sets a nominal SPAD reading to make its recommendations.

Tissue sampling

- In season tissue sampling was done on corn silage to see how the soil nutrients translocated to the plant while growing. The method of collection was based on the NBDAAF Factsheet Plant Tissue Sampling. The ear leaf was taken at corn tasseling for the sample and a sample was taken from each treatment. Testing was done at the PEI Analytical Laboratory.

Nodulation Counts

- In soybeans, counting of nodulation occurred at the V3 stage. By this stage the nodulation should have commenced in the plant. For each treatment. variation in the field, 30 plants were randomly selected over the treatment area. The plants were carefully lifted out of the soil with the aid of a small shovel/trowel so as to not lose any nodules which may be loosely attached. The nodules were counted on the tap root and side roots separately.

Corn Stalk Nitrate

- Late season stalk nitrate samples were taken by removing a sample of corn stalk six inches above the ground for a further eight inches of stalk. These were later dried and sent off for nitrogen analysis, as additional nitrogen over and above what a crop needs tends to accumulate within that part of the corn stalk. Samples were sent to the PEI Analytical Laboratory for testing.

Yield and Quality

- Samples harvested from the strips were weighed using a portable weight wagon or scales which could be placed under the equipment tires. Sub-samples were taken to measure quality and tested at the PEI Analytical Laboratory.

3. Results and Discussions

As part of the 4R Nutrient Stewardship Demonstration farms, experiments were conducted to evaluate the effects of delayed N application on corn silage and grain corn demonstration crops. This is in response to what one would term a false spring, when all looks well for planting any crop, only to be followed by a wet period three weeks into planting. This leads many producers to ponder as to whether N is still available for corn crop to develop. In response, corn producers have been saving some of their N for side dressing at the 4-5 leaf stage. One of the downfalls of top dressed fertilizer is that in many cases it burns the crop and can still be subject to rain and runoff. In some regions, application at the 6-8 leaf stage is encouraged as maximum nitrogen uptake is believed to be closer to tassel time.

Grain Corn

Side dress Nitrogen Site with Manure – UAN @ Three Rates V6

The first location was that of Travis Friesen in Centerville, NB, a corn and soybean producer with less dependence on inorganic fertilizers. His rotation is soybeans, corn, potatoes and back to soybeans. He utilizes 5 t/ac of poultry manure, which is incorporated within one day of application. After disking in his manure, he plants grain corn with a 3-18-18 liquid pop up at 20 L/ac. Past work with this program has seen that in most cases, the poultry manure will supply all if not most of the N needed for this corn crop. With the use of poultry manure, PSNT soil tests have always exceeded 25 ppm N and as such would suggest that no further side dress

of N fertilizer be required. This producer had drop tube application equipment that would not burn the crop with UAN, and wanted to see if later applications of side dress N at different rates would result in a yield increase.

Table 1 below is a nutrient balance sheet of the nutrient needs for this crop. NB recommendations for corn call for150 kg/N/ha. With the manure levels Travis is using along with previous crop of soybeans, this level can be taken down to 125 kg/N/ha. 5 t/ac of poultry manure translates to 11.2 T/ha; when coupled with manure analysis and method of application this could easily supply an additional 66.1 kg/avalN/ha, further reducing the N requirement for this crop to 58.9 kg/N/ha. A pop up fertilizer, when converted to metric units, would supply an additional 2 kg/N/ha taking the crop need down to a theoretical 56.9 kg/N/ha. Past experience with this producer has seen that the rate of manure applied for corn growth has resulted in excellent yields along with high soil test levels (greater than 25 ppm) for nitrate, which under most sources would mean that no further N is required.

The crop's nutrient requirement is determined and then applications are made to meet these requirements leaving a balance. The colours are a guide where yellow indicates caution, red indicates enough nutrients have been applied, and green indicates more nutrients can be added.

A new field was picked that did not have the established rotation and manure history of Travis's other fields and was considered to be land that had been farmed hard under potato production. In this field, a side dress strip trial was established 24 rows wide. These rows were subdivided into sections based on the combine

Table 1. The NB Ferti Plan Crop Requirements based on the In Field Soil Sample Results

PSNT1	2014				
	Corn (Grain)				6.7 T/ha
Nutrient Requirements / Besoins			N	P_2O_5	K_2O
Recomm. NBAAF/MAAPNB *(kg/ha)*	Est yield/A. étab.	6.7	150	30	30
User changes to recomm./Modifoication					
Total nut. Recomm. totale *(kg/ha)*			150	30	30
N-Credits-N					
OM-N-MO			15		
Previous crop N culture précédente	Soybeans		10		
Service crop N de la culture éponge??			0		
Nutrients needed / Besoins*(kg/ha)*			125	30	30
Organic Amendments oraganique	Rate/Taux	Type			
Manure Application fumier#1 *(kg/ha or/ou L/ha)*	0	TF-PT1		0.0	0.0
Org. N (Current Yr./cette année)	Previous Fall (Automne précédent)		0.0		
Org. N (Last Yr/l'année dernière)					
NH4-N	Incorporated within 1 day/Incorporé 1		0.0		
Manure Application fumier #2 *(kg/ha or/ou L/ha)*	11,200	TF-PT1		66.7	105.2
Org. N (Current Yr./cette année)	Spring/Summer (Pri		35.6		
Org. N (Last Yr/l'année dernière)					
NH4-N	Incorporated within 1 day/Incorporé 1		30.5		
Wood ash/Cendre de bois *(kg/ha)*				0.0	0.0
Nutrients needed/Besoins *(kg/ha)*			58.9	(36.7)	(75.2)
Starter Fertilizer / Fertilisants au semis	Rate/Taux	Type			
Starter Band/Démarreur *(kg/ha)*			0.0	0.0	0.0
Liquid(e) pop-up/ appliqué avec la semence (kg/ha)	49.4	3-18-18	2.0	11.8	11.8
PSNT recomme(a)ndations		25+ ppm	0		
Nutrients needed/Besoins *(kg/ha)*			0.0	(48.5)	(87.1)

width into treatments. Two zero side dress N check strips were done at the beginning and end. In between, three treatments of side dressings of UAN were applied on July 17th at V6 with drop tubes to avoid burning. The rates of N on these three strips were 22, 45 and 67 kg/N/ha (20, 40 & 60 lbs/N/ac). Corn was assessed for a side dress rate of application using a SPAD meter along with a worksheet from PennState supplied with their Spad Calc Factsheet for SPAD meters. In addition to this, leaves were cross referenced to the Spectrum Technologies FieldScout Green Index+ app used on an ipad Mini. The later method of assessment sets a nominal SPAD reading to make its recommendations. For example, the SPAD meter itself and in conjunction with the PennState worksheet recommended no further N be applied to this crop. However, the Field Scout had a lower average nominal SPAD produced and as a result had side dress recommendations in the order of 67 kg/N/ha. These two recommendations conflict with each other. Selecting the acceptable range for the SPAD within the Field Scout GreenIndex+ to a lower value to compensate for the different recommendations could result in a zero application recommendation. Further discussion with the makers of the Field Scout product is now warranted this winter regarding adjustments to the settings. Still, side dress applications were followed by default to see what the reaction would be in crop yield and quality.

The strips were harvested using a grain yield monitor for statistical yield comparisons; 2015 data has yet to be downloaded from the combine. Harvest of the strips were weighed using a portable weight wagon, with sub samples taken to measure dry matter, protein and bushel weight. In addition to this, prior to harvest, late season stalk nitrate samples were taken by removing a sample of corn stalk six inches above the ground for a further eight inches of stalk. These were later dried and sent off for N analysis as additional N over and above what a crop needs tends to accumulate within that part of the corn stalk. Please note that the rate of N and yield of corn are all in English units.

In Table 2 above, albeit not being statistically based, indicates no real change in yield and quality as a result of side dressing N. In fact, as per New York state ranges for corn stalk nitrate N, greater than 2000 ppm is deemed excessive for a corn crop. In all cases this was exceeded with standard use of poultry manure in this operation,

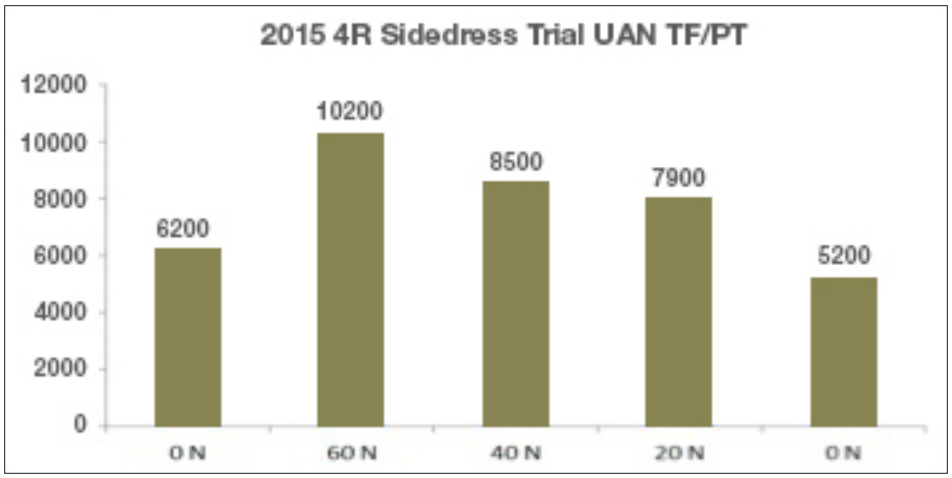
Table 2. Data collected during Harvest and Sample Results

Trial sites by Travis Friesen near Centerville					18-Nov-15
Index	A	B	C	D	E
Treatment	0 N	60 N	40 N	20 N	0 N
Timing	V6	V6	V6	V6	V6
% Moist.	26.6	27.0	27.8	26.8	26.6
lbs/ac @ 15.5 %	8257	7998	8171	8066	8018
t/ac @ 15.5 %	4.1	4	4.1	4	4
% Crude Protein dry basis	9.85	10.88	9.45	10.12	10.50
Test wt (lbs/bu) as rec'd	49.28	48.96	49.76	49.28	49.6
Corn Stalk Nitrate Lvls (ppm)	6200	10200	8500	7900	5200
Interpretation of CSNT Lvls	Excess	Excess	Excess	Excess	Excess

and it would appear that side dressing UAN accumulated in the corn stalk at varying rates of application as depicted in Table 3 below.

Pending the yield monitor data, it would appear that all of the corn crop's N requirements were met with high rates of poultry manure pre-plant incorporated from the strip trial weights plus corn and stalk sample results. Side dress of UAN at various rates and around the V6 stage of growth did not appear to increase or decrease yields. Maturity was not pushed further out with the addition of UAN at any rate of application and it appears any surplus accumulated within the corn stalk, so much of it made it into the plant.

Table 3. Graph showing Corn Stalk Nitrate Levels in each of the treatments.



Side dress Nitrogen Site – Inorganic UAN, Three Methods of Application @ V6 and one Split Application

The second location was that of Kier Miller in Sussex, NB. He is a corn and soybean producer, with a keen interest in reducing his fertilizer input cost while still achieving a decent corn crop. The field that was chosen has a history of producing hay crops and is on interval land. This is the first year that it has been put into corn production by spring glyphosate burn down and no-till planting methods. Kier's fertilizer regiment is 56 L/ha of liquid 6-24-6, 224 kg/ha of 21-6-18 and 224 kg/ha of 0-0-60. This will provide him with 4.5 kg/N/ha liquid starter and 47 kg/N/ha from the dry banded fertilizer for a total N rate at planting of 51.5 kg/N/ha. As this field possesses a long history of hay production, it can be assumed that an additional 15 kg/N/ha would be available during the 2015 season, taking total N to around 66.5 kg/N/ha.

In this trial, no control was established as it only looked at the method of N side dress, along with a split rate. Table 4 shows the various treatments tested. Treatments A and B looked at the method of N application, i.e. injection or knifed in between the rows vs. Y drop tubes either side of the rows around mid-July V6 stage. Treatment C looked at a later application to gauge the impact of side dress near tassel time and treatment D was a split at V6 and VT. Past work with this producer has shown via PSNT soil test on the same interval soil but on another field that soil nitrate levels are high enough to warrant a side dress of only 40-60 lbs/N/ac. Kier would still be applying N at rates lower than recommended for corn production in NB, but his yield is not suffering. Perhaps our N recommendations for corn are too high and should be taken down to 100 kg/N/ha, for further discussion down the road.

Side dress rates and methods of application had no real impact on yield or quality. Split N may have raised

Table 4. Data collected during Harvest and Sample Results

Trial sites by Kier Miller near Irving Mill in Sussex				20-Nov-15
Index	A	B	C	D
Treatment	Injection	Y drops	Late Y drops	6 Leaf Y Drop + late Side dress
Rate of N, UAN 28%N @ 15 USG, 10.7 lbs/USG	45 lbs/N/ac	45 lbs/N/ac	45 lbs/N/ac	45 lbs/N/ac + 45 lbs/N/ac
Timing	V6 mid Jul	V6 mid Jul	VT mid Aug	V6 mid July & VT mid Aug
% Moist.	26.6	22.6	22.7	22.4
lbs/ac @ 15.5 %	6743	7035	6628	6415
t/ac @ 15.5 %	3.4	3.5	3.3	3.2
% Crude Protein dry basis	7.24	7.35	7.60	8.07
Test wt (lbs/bu) as rec'd	49.44	50.56	50.24	50.56
Corn Stalk Nitrate Lvls (ppm)	5600	5300	5100	6000
Interpretation of CSNT Lvls	Excess	Excess	Excess	Excess

corn protein levels. The soils and nutrients combined easily met the crop's N requirements. All strips were 12 rows wide and yields were measured using portable scales on site.

Corn Silage

The corn silage demonstration farm was on the farm of Brian and Calvin Connors in Hawkins Corner, NB. They are cash crop producers growing soybeans, canola, alfalfa, corn and small grains. This year they grew silage corn to sell to a local dairy farmer. In the past they have grown grain corn and normally had issues and concerns with N applications.

A soil sample was used to help make guide nutrient recommendations, as shown in Tables 5a and 5b.

Table 5a. Soil Sample Results

Field	pH	P2O5	P	P Rating	P:Al	P:Al Rating	K2O	K	K Rating
4R	5.1	225	98.253	PH+	7.45%	PM	133	110.83	KM+
Rest of Field	5.4	180	78.603	PH+	5.68%	PL	112	93.333	KM+

Table 5b. Soil Sample Results

Field	Ca	Ca Rating	Mg	Mg Rating	Mg:K	B	Cu	Zn	S	S Rating	Mn	Fe	Al	Na	Buffer pH
4R	1004	CaM+	120	MgM+	1.08	0.3	14.8	3.1	27	SM	37	166	1318	25	6.4
Rest of Field	911	CaM+	124	MgM+	1.33	0.3	12.2	4.5	21	SL	30	154	1383	17	6.4

The Connors had their fertilizer purchased and treated the field as normal when planting. The main concern to investigate was the N application. They first broadcasted 350 kg/ha of 29-0-13.1 and then, with the planter, 150 kg/ha of Mes Zn was applied. According to the NB Fertiplan and based on the soil sample provided, with this application they were short of N, over applying phosphorus, and short of Potassium (Table 6). In the 4R Nutrient Stewardship test strip, the same amount was placed with the planter, but during broadcast application 50 kg/ha was held back until the 4-5 leaf stage when a PSNT test could be performed. The 4R Nutrient Stewardship strip width was based on the broadcast spreader width.

Table 6. The New Brunswick FertiPlan crop requirements based on the in field soil sample results for each treatment

REST OF FIELD	2015			
	Corn (Silage)			26.5 T/ ha
Nutrient Requirements / Besoins			N	P2O5	K2O
Recomm. NBAAF/MAAPNB (kg/ha)	Est yield/A. étab.		150	30	75
User changes to recomm./Modifoication					
Total nut. Recomm. totale (kg/ha)			150	30	75
N-Credits-N					
OM-N-MO			15		
Previous crop N culture précédente			0		
Service crop N de la culture éponge??			0		
Nutrients needed / Besoins(kg/ha)			135	30	75
Organic Amendments oraganique	Rate/Taux	Type			
Manure Application fumier#1 (kg/ha or/ou L/ha)				0.0	0.0
Org. N (Current Yr./cette année)			0.0		
Org. N (Last Yr/l'année dernière)					
NH4-N			0.0		
Manure Application fumier #2 (kg/ha or/ou L/ha)				0.0	0.0
Org. N (Current Yr./cette année)			0.0		
Org. N (Last Yr/l'année dernière)					
NH4-N			0.0		
Wood ash/Cendre de bois (kg/ha)				0.0	0.0
Nutrients needed/Besoins (kg/ha)			135.0	30.0	75.0
Starter Fertilizer / Fertilisants au semis	Rate/Taux	Type			
Starter Band/Démarreur (kg/ha)	150	Mes Zn	18.0	60.0	0.0
Liquid(e) pop-up/ appliqué avec la semence (kg/ha)			0.0	0.0	0.0
PSNT recomme(a)ndations			0		
Nutrients needed/Besoins (kg/ha)			117.0	(30.0)	75.0
Fertilizers / Fertilisants	Rate/Taux	Type			
Application #1 (kg/ha or/ou L/ha)	350	29-0-13.1	101.5	0.0	45.9
Application #2 (kg/ha or/ou L/ha)			0.0	0.0	0.0
Application #3 (kg/ha or/ou L/ha)			0.0	0.0	0.0
Balance (kg/ha)			15.5	(30.0)	29.2

4R Nutrient Stewardship					
	Corn (Silage)				26.5 T/ ha
Nutrient Requirements / Besoins			N	P2O5	K2O
Recomm. NBAAF/MAAPNB (kg/ha)	Est yield/A. étab.		150	30	75
User changes to recomm./Modifoication					
Total nut. Recomm. totale (kg/ha)			150	30	75
N-Credits-N					
OM-N-MO			15		
Previous crop N culture précédente			0		
Service crop N de la culture éponge??			0		
Nutrients needed / Besoins(kg/ha)			135	30	75
Organic Amendments oraganique	Rate/Taux	Type			
Manure Application fumier#1 (kg/ha or/ou L/ha)				0.0	0.0
Org. N (Current Yr./cette année)			0.0		
Org. N (Last Yr/l'année dernière)					
NH4-N			0.0		
Manure Application fumier #2 (kg/ha or/ou L/ha)				0.0	0.0
Org. N (Current Yr./cette année)			0.0		
Org. N (Last Yr/l'année dernière)					
NH4-N			0.0		
Wood ash/Cendre de bois (kg/ha)				0.0	0.0
Nutrients needed/Besoins (kg/ha)			135.0	30.0	75.0
Starter Fertilizer / Fertilisants au semis	Rate/Taux	Type			
Starter Band/Démarreur (kg/ha)	150	Mes Zn	18.0	60.0	0.0
Liquid(e) pop-up/ appliqué avec la semence (kg/ha)			0.0	0.0	0.0
PSNT recomme(a)ndations			0		
Nutrients needed/Besoins (kg/ha)			117.0	(30.0)	75.0
Fertilizers / Fertilisants	Rate/Taux	Type			
Application #1 (kg/ha or/ou L/ha)	300	29-0-13.1	87.0	0.0	39.3
Application #2 (kg/ha or/ou L/ha)			0.0	0.0	0.0
Application #3 (kg/ha or/ou L/ha)			0.0	0.0	0.0
Balance (kg/ha)			30.0	(30.0)	35.7

The crops nutrient requirements are determined and then applications are made to meet these requirements leaving a balance.

Figure 2. Field Identification and Treatment Location

The week of July 22nd a site visit was made to the field and samples were acquired to perform the PSDN test. A sample was taken from each treatment based on the sampling process found in the following factsheet from the NBSCIA *here (http://www.nbscia.ca/sitebuildercontent/sitebuilderfiles/corn_psnt.pdf).*

Once the sample was tested, both tests indicated that there was sufficient N in the soil to grow the crop at this point. The rest of the field treatment did have a higher reading then the 4R Nutrient Stewardship strip. After discussion with Brian it was decided to not put any extra N on the crop at this point and do tissue samples later in the season and see how the crop is affected.

On August 11th tissue samples were taken from each treatment. Each nutrient tested fell within the NB Sufficiency Range. Zinc was on the lower end but a deficiency was not seen within the field (Table 7).

Table 7. Tissue sample Reports Compared to NB Sufficiency Ranges

	4R	Rest of Field	NB Sufficiency Ranges	
			Low	High
Nitrogen %	2.76	3.39	2.5	3.5
Phosphorus %	0.23	0.29	0.25	0.5
Potassium %	1.7	1.8	1.7	2.25
Calcium %	0.49	0.68	0.2	1.0
Magnesium %	0.25	0.36	0.2	0.6
Boron ppm	3.4	3.1	5	25
Copper ppm	11.18	13.87	5	20
Zinc ppm	17.6	33.3	20	70

On October 8th the crop was harvested. A section was harvested and weighed within each treatment using a truck with weigh scales. A sample was taken from each treatment and sent for a quality comparison (Table 8). This sample was sent to the Livestock Feed Specialist (NBDAAF) David Dykstra to review; feedback is pending.

Table 8. Feed Quality Analysis comparing Treatments

	4R		Rest of Field	
	Results as Fed Basis	Results Dry Matter basis	Results as Fed Basis	Results Dry Matter basis
Dry Matter	38.75		40.89	
Crude Protein	3.4	8.77	2.96	7.23
ADF	10.07	25.98	9.4	22.98
TDN	27.19	70.17	29.26	71.57
Nel Mcal/kg	0.62	1.59	0.66	1.62
Est DE Mcal/kg	1.2	3.09	1.29	3.15
Calcium	0.09	0.22	0.07	0.18
Phosphorus	0.08	0.2	0.08	0.2
Magnesium	0.06	0.16	0.07	0.17
Potassium	0.4	1.04	0.35	0.86
Copper ppm	2.79	7.19	1.73	4.22
Zinc ppm	13.37	34.51	6.71	16.41
NEg Mcal/kg	0.35	0.91	0.38	0.94
NEm Mcal/kg	0.62	1.61	0.67	1.64

The yield was calculated for each treatment. The 4R Nutrient Stewardship strip had 135 tonnes/acre in field and the rest of field had a yield of 160 tonnes/acre, indicating a higher yield in the rest of field crop than the 4R Nutrient Stewardship strip.

With the yield difference, there is certainly a potential for revisiting this process. Additionally, sinceplanting in 2015, the Connors have bought a new sprayer which will allow them to use liquid fertilizer. Over the winter months a plan will be discussed for 2016.

Soybeans

Mike Smith of Canobie NB grows field crops in the North Shore region. He is currently growing soybeans which are very new to the region. His soybeans were planted at 150,000 seeds/acreon June 2nd 2015. Each plot was 1.5 acres which was monitored by GPS and used for yield calculation. Mike was looking to compare the yields and profits of his soybean crop using high sulfur fertilizer (5-10-30-11s) when compared to a non-sulfur blend (5-10-30). This non sulfur blend is $650/ton and the sulfur blend is $950/ton. These blends were used at a pH of 6.0 and 6.5. Additionally, Mike compared his normal blend in both pH zones, 4.6-22-22-3.8Ca-3.8S, which costs $703/ton. All blends were applied at 155 lbs/ac in both pH zones. Lime was added to increase the pH of plots from 6.0 to 6.5 at 1.7 ton/acre.

Table 9. Plot Plan indicating treatments

East							West
No Lime Mixed Fertilizer	5-10-30 No Lime	4.6-22-22-3.8Ca-3.8S No Lime	5-10-30-11S No Lime	5-10-30 Lime	4.6-22-22-3.8Ca-3.8S Lime	5-10-30-11S Lime	No Lime No Fertilizer
Field Entrance							

A sample from the field taken in 2014 was used for recommendations. This sample was placed into the NBDAAF FertiPlan program for further insight (Tables 10a and 10b). With the indicated soil levels, N, P, and K are required to grow soybeans.

Table 10a. Soil Sample Results for 4R Field

Field/	OM/MO (%)	pH	P2O5	P	P Rating	P:Al	P:Al Rating	K2O	K	K Rating	Ca Rating	Mg Rating	Mg:K
12	4.6	6	195	85	PH+	5.71%	PL	54	45	KM	CaH	MgM	1.96

Table 10b. Soil Sample Results for 4R Field

Field/ Champ	B	S	S Rating	Al	Na	Buffer pH tampon	CEC	%K	%Mg	%Ca	%Na	%Total	2014	2015
12	0.6	15	SL	1488		6.5	17.6	0.7%	4.2%	44.1%	0.0%	49.0%	grain corn	Soybeans

The crops nutrient requirements are determined and then applications are made to meet these requirements leaving a balance (Table 11).

Table 11. The NB Ferti Plan Crop Requirements based on the In Field Soil Sample Results for Each Treatment

MS 12			2015		
	Soybeans				2.3 T/ha
Nutrient Requirements / Besoins			N	P2O5	K2O
Recomm. NBAAF/MAAPNB (kg/ha)	Est yield/A. étab.		15	20	55
User changes to recomm./Modifoication					
Total nut. Recomm. totale (kg/ha)			15	20	55
N-Credits-N					
OM-N-MO			0		
Previous crop N culture précédente			0		
Service crop N de la culture éponge??			0		
Nutrients needed / Besoins(kg/ha)			15	20	55
Starter Fertilizer / Fertilisants au semis	Rate/Taux	Type			
Starter Band/Démarreur (kg/ha)			0.0	0.0	0.0
Liquid(e) pop-up/ appliqué avec la semence (kg/ha)			0.0	0.0	0.0
PSNT recomme(a)ndations			0		
Nutrients needed/Besoins (kg/ha)			15.0	20.0	55.0
Fertilizers / Fertilisants	Rate/Taux	Type			
Application #1 (kg/ha or/ou L/ha)			0.0	0.0	0.0
Application #2 (kg/ha or/ou L/ha)			0.0	0.0	0.0
Application #3 (kg/ha or/ou L/ha)			0.0	0.0	0.0
Balance (kg/ha)			15.0	20.0	55.0

Nodulation counts were taken in each treatment at the V3 stage. In each instance, the lime treatment resulted in a higher nodulation count (Table 12).

Table 12. Nodulation Counts taken in Field at V3 Stage

	5-10-30-				5-10-30-11S				4.6-22-22-4.8-3			
treatment	lime		no lime		lime		no lime		lime		no lime	
	tap root	side roots	tap root	side roots	tap root	side roots	tap root	side roots	tap root	side roots	tap root	side roots
avg	1.14	1.33	0.56	0.26	0.85	0.60	0.78	0.53	0.8	0.63	0.58	0.27
Total	2.47		0.82		1.45		1.31		1.43		0.85	

The crop was harvested on November 5, 2015 and each treatment was weighed out separately with a weigh wagon (Table 13). Quality samples were not obtained.

Table 13. Fertilizer Cost Comparison for Treatment Blends

Treatment	Yield at 13% Moisture Tons/acre	Fertilizer Cost $/acre	Gross Revenue $/ acre	Gross Income-Fertilizer Cost $/acre
5-10-30 @155lbs/ac	0.896	45.8	336	290.2
4.6-22-22-3.8Ca-3.8S@1550lbs/ac	0.817	49.3	306	256.7
5-10-30-11S@155lbs/ac	0.936	63.85	351	287
5-10-30@1550lbs/ac + Lime @1.7tons/ac	1.161	45.8	435	389.2
4.6-22-22-3.8Ca-3.8S@155lbs/ac + Lime @1.7tons/ac	0.812	49.3	305	255.7
5-10-30-11S@1550lbs/ac + Lime @1.7tons/ac	0.772	63.85	289	225.2

The highest yield had a comparable cost per acre of fertilizer per acre. There was also a benefit seen from the lime application through the nodulation rates and the highest yield did receive the lime application. The sulfur level was low for this field so it is interesting that the sulfur blend did not have the highest yield. With this data available from 2015 we will sit down with the producer to determine how he would like to proceed and look at if another blend may be included. Going forward in the future it would be good to know the quality of the crop being harvested to include in the comparison.

Figure 3. Field with Treatment Locations

The second demo farm that participated in the Soybean portion was Bruce MacNichol, located in Salisbury NB. Bruce crops approximately 600 acres on a mixed farm (forage, grain and custom harvest). Currently he is growing sunflowers, soybeans, forages, barley and oats in rotation. Bruce has interest in top dressing his soybeans at a later date with Nitrogen. Treatment 1 was planted with 100 lbs/acre of 9.5-20.0-29.1, 1.5S and 0.24B. Treatment 2 had another 90 lbs/acre of the fertilizer blend added.

In Figure 3, note that plot 1 is located at the bottom of the hill with a small slope parallel to the road.

Unfortunately, precise mapping was not performed to determine the delimitation of the plots.

Table 14. Treatment Applications

Treatment	Total N	Total P205	Total K2O
100 lbs/ac of 9.5-20.0-29.1, 1.5S and 0.24B	9.5	20	29.1
190 lbs/ac of 9.5-20.0-29.1, 1.5S and 0.24B	18.1	38	55.3

The provincial recommendation for Soybeans is 15 lbs/ac of N. As shown in Table 13, one application is below and one is slightly above.

On July 14th 2015, Nodulation Counts were done on the treatments. Table 15 below shows that treatment 2 did have a higher average nodulation count.

Table 15. Nodulation Counts performed at V3 Stage on July 14th 2015

Fertilizer Treatment	1 100lbs/ac of 9.5-20.0-29.1, 1.5S and 0.24B			2 190lbs/ac of 9.5-20.0-29.1, 1.5S and 0.24B		
	tap root	side roots	Total	tap root	side roots	Total
Average	8	20	27	7	36	43

The crop was harvested and both plots had the same yield of 0.75 tons/acre at 15.8% moisture. Some visual observations made are Plot 1 seemed to have wiry thin stalks, compared to less wiry stalks in Plot 2. There were many small beans and many pods only had two beans. The plants were also short overall compared to previous years.

There is interest from the grower to investigate this further, even though the yield was lower for both plots. Bruce has spoken to many other producers who also claimed to have lower yields than normal.

Quality samples were sent from each treatment for analysis at PEI Analytical Laboratories, indicating that was not a major difference between the quality (Table 16).

Table 16. Feed Test Report from PEI Analytical Laboratories

Analysis Preformed	Treatment 1 Results As Fed basis	Treatment 1 Results Dry Matter Basis	Treatment 2 Results As Fed basis	Treatment 2 Results Dry Matter Basis
Dry Matter %	85.9		86.60	
Crude Protein %	35.32	41.12	36.39	42.02
Fat %	20.81	24.23	20.90	24.13

4. Conclusions

In its first year, the New Brunswick 4R Demonstration farms engaged five producers working with certified crop advisors across the province. 4R Nutrient Stewardship practices were implemented on grain, corn silage, and soybean farming operations. By monitoring the success of 4R Nutrient Stewardship BMPs that were incorporated into the trial sites, the benefits of making nutrient management decisions based on the Right Source, Rate, Time, and Place were demonstrated under New Brunswick conditions.

Corn crops, including grain and silage corn trials, focused on 4R Nutrient Stewardship BMPs that optimize Nitrogen fertilization. There are a variety of resources that producers use to make Nitrogen recommendations for corn, including the NB FertiPlan and Green Index iPad application. The 4R Demonstration farms conducted trials on various N rates and timing to investigate how the recommendations relate to in-field indicators throughout the growing season. On some of the fields, various rates, application methods, and timing of nitrogen application did not affect the yield and quality of the corn crop. For example, in some trials, the pre-plant manure treatment provided sufficient N to the crop, highlighting the importance of using this information to modify the 4R Plan in subsequent years to achieve continuous improvement in the 4R Nutrient Stewardship cycle. Other trials found that in-field PSNT testing provided a valuable indicator to asses if further N fertilization was required, resulting in decreased fertilizer inputs while maintaining crop nutrient requirements.

Being a relatively new crop in New Brunswick, soybean producers tested fertilizer blends and lime application in the 4R Demonstration Farm trials. Liming materials, applied to increase the soil pH, increased the nodulation count in soybean trials. Further work with the 4R Demonstration Farms will help to continuously improve the 4R Nutrient Stewardship approach for soybeans to improve yield and quality.

Further years of 4R Demonstration farms working in collaboration with local producers will continue to demonstrate how the right Rate, Source, and Timing and Placement of fertilizer application will ensure the sustainable future of farming in New Brunswick.

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