4R Nitrogen Management to Increase N Use Efficiency and Reduce N Losses

David Burton
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I am a soil scientist, not a farmer…

I can teach you about soils, but you have to teach me about how that relates to your farming practices.

In collaboration with…

- AAFC – Bernie Zebarth, Judith Nyiraneza
- PEI Department of Agriculture – Kyra Stiles
- PEI Potato Board – Ryan Barrett
- Fertilizer Canada & Genesis Crop Systems – Steve Watts
- East Prince, Kensington North and Souris Watershed groups

FERTILIZER CANADA

Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada

Prince Edward Island CANADA

Prince Edward Island PEI POTATOES

East Prince Agri-Environment Association Inc

Souris and Area Branch PEI Wildlife Federation

Kensington North Watersheds Association

Nutrient Management

Can we efficiently deliver nutrients to the crop without impacting the surrounding environment?

The Objective of N Fertilization

Soil Fertility – The objective in an N fertilization program is to realize the economically optimum yield.

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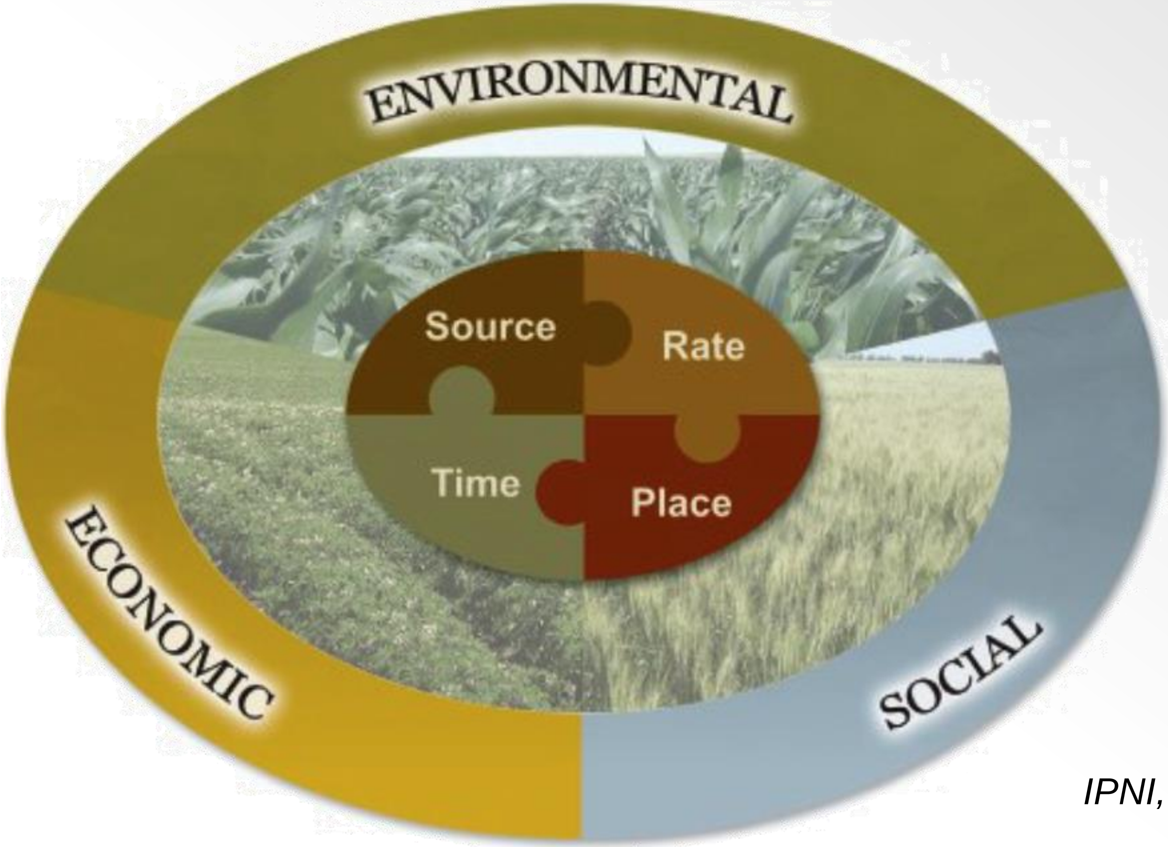
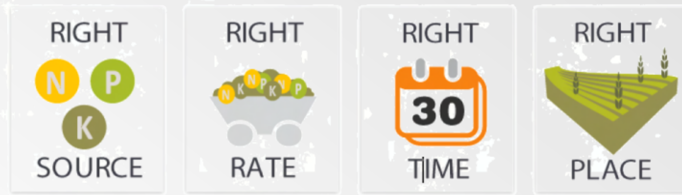
Nutrient Management – The objective in an N fertilization program is to not only realize the economically optimum yield but to also minimize environmental impacts.

To improve nutrient management the fertilizer industry has developed the framework of 4R management



IPNI, 2015

4R Frame work builds on science and offers practical solutions



	The Four Rights (4Rs)			
	Source	**Rate**	**Time**	**Place**
Examples of Key Scientific Principles	◆ Ensure balanced supply of nutrients ◆ Suit soil properties	◆ Assess nutrient supply from all sources ◆ Assess plant demand	◆ Assess dynamics of crop uptake and soil supply ◆ Determine timing of loss risk	◆ Recognize crop rooting patterns ◆ Manage spatial variability
Examples of Practical Choices	◆ Commercial fertilizer ◆ Livestock manure ◆ Compost ◆ Crop residue	◆ Test soils for nutrients ◆ Calculate economics ◆ Balance crop removal	◆ Pre-plant ◆ At planting ◆ At flowering ◆ At fruiting	◆ Broadcast ◆ Band/drill/inject ◆ Variable-rate application

IPNI, 2015

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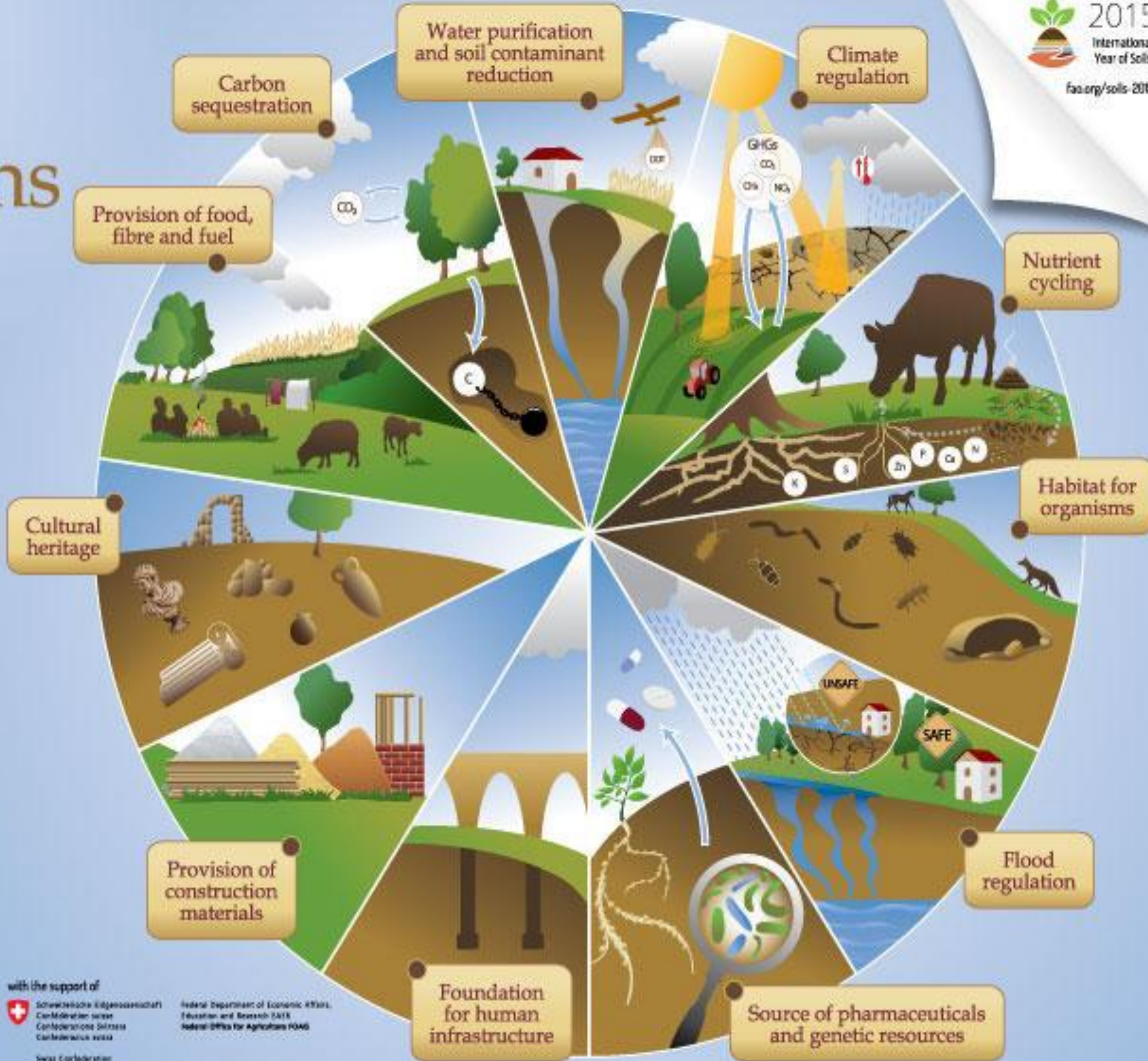
Soil Fertility – The objective in an N fertilization program is to realize the economically optimum yield.

Nutrient Management – The objective in an N fertilization program is to not only realize the economically optimum yield but to also minimize environmental impacts.

Soil Health Management – The objective in an N fertilization program is to not only realize the economically optimum yield but to also minimize environmental impacts and sustain the resource.

Soil
functions

Soils deliver ecosystem services that enable life on Earth



2015 International Year of Soils

fao.org/soils-2015

Food and Agriculture Organization of the United Nations

with the support of

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
Federal Office for Agriculture FOAG

Atlantic Soil Health Lab

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How do we determine the right rate of nitrogen for Potatoes?

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Constructing a Fertilizer N Recommendation

1. Calculate N Requirement
2. Credit for manure ammonium
3. Credit for manure organic N
4. Credit for previous crop
5. Credit for soil organic matter
6. Calculate fertilizer N recommendation
7. Apply 4R principles
   - We have calculated the right rate
   - What product should we use?
     - If we are using a enhanced efficiency product the rate should be adjusted
   - When should it be applied?
   - Where should it be placed?

Nitrogen Management for Potatoes: General Fertilizer Recommendations

Prince Edward Island

GHG Taking Charge Team Factsheet

Why do we need good nitrogen management?

Sound nitrogen management for potatoes makes good economic sense. Optimal nitrogen fertilization is essential for achieving commercial tuber yield and size requirements and results in maximum economic return. Excessive nitrogen inputs can reduce tuber specific gravity and can delay maturity, making vines difficult to kill.

Good nitrogen management also makes good environmental sense. Excess fertilizer nitrogen application increases environmental losses of nitrogen, including nitrate leaching to groundwater and emissions of nitrous oxide, a greenhouse gas. Good nitrogen management represents an effective and practical means for producers to reduce greenhouse gas emissions.

Optimizing nitrogen management for potatoes

Our goal in optimizing crop nitrogen management is to match the nitrogen supply to the crop nitrogen demand. The amount of nitrogen required by the crop is determined by the level of crop growth – the greater the growth, the higher the crop demand for nitrogen. Crop growth is influenced by management practices such as variety selection and planting date, and also by soil and climatic conditions.

The nitrogen supply for a potato crop comes from fertilizer, but also from manure and mineralization. Mineralization is the release of plant available nitrogen from soil organic matter and crop residues as a result of soil microbial activity. The optimal fertilizer nitrogen rate for a potato crop varies from field-to-field and from year-to-year due to variation in both crop nitrogen demand and soil nitrogen supply.

General nitrogen recommendations for potatoes

This factsheet provides general fertilizer nitrogen recommendations for potatoes. These recommendations require a soil test for organic matter content and a manure or compost analysis. If no manure or compost analysis is available, typical values for different types of manure or compost can be used.

How much fertilizer nitrogen to apply?

The general recommendation for fertilizer nitrogen rate (F_N) in kg N/ha is estimated by:

$$F_N = R - M_{AMM} - M_{ORG} - C - S$$

where R is the crop N requirement based on potato variety and planting date, M_{AMM} is a credit for ammonium in manure or compost, M_{ORG} is a credit for organic nitrogen in manure or compost, C is a credit for the crop grown in the previous year, and S is a credit based on soil organic matter content.

This factsheet provides a series of six steps to calculate the fertilizer nitrogen recommendation using the General Nitrogen Recommendation Worksheet (page 3). Complete Table 2 to calculate the information you need from your manure or compost analysis before you begin. The worksheet considers manure applied in the spring before planting, and manure applied in the previous fall. Complete steps 2 and 3 for each manure or compost application.

Cautionary note: According to CHC On-Farm Food Safety Guidelines, the time between application of liquid or solid manure and potato harvest should be a minimum of four months.

Step 1: Calculate crop N requirement (R)

Choose the base value for calculating crop nitrogen requirement from Table 1. These values represent our best guess as to the maximum fertilizer N application rate which may be required for these varieties. The base value is the same for irrigated and non-irrigated crops.

A shorter crop growth period results in a lower crop demand for N. The base value is decreased by 10% for seed crops or for crops that will be harvested early. The base value is also decreased for planting dates after May 25 by 11 kg N/ha (10 lb N/ac) for each week that planting is delayed.

1

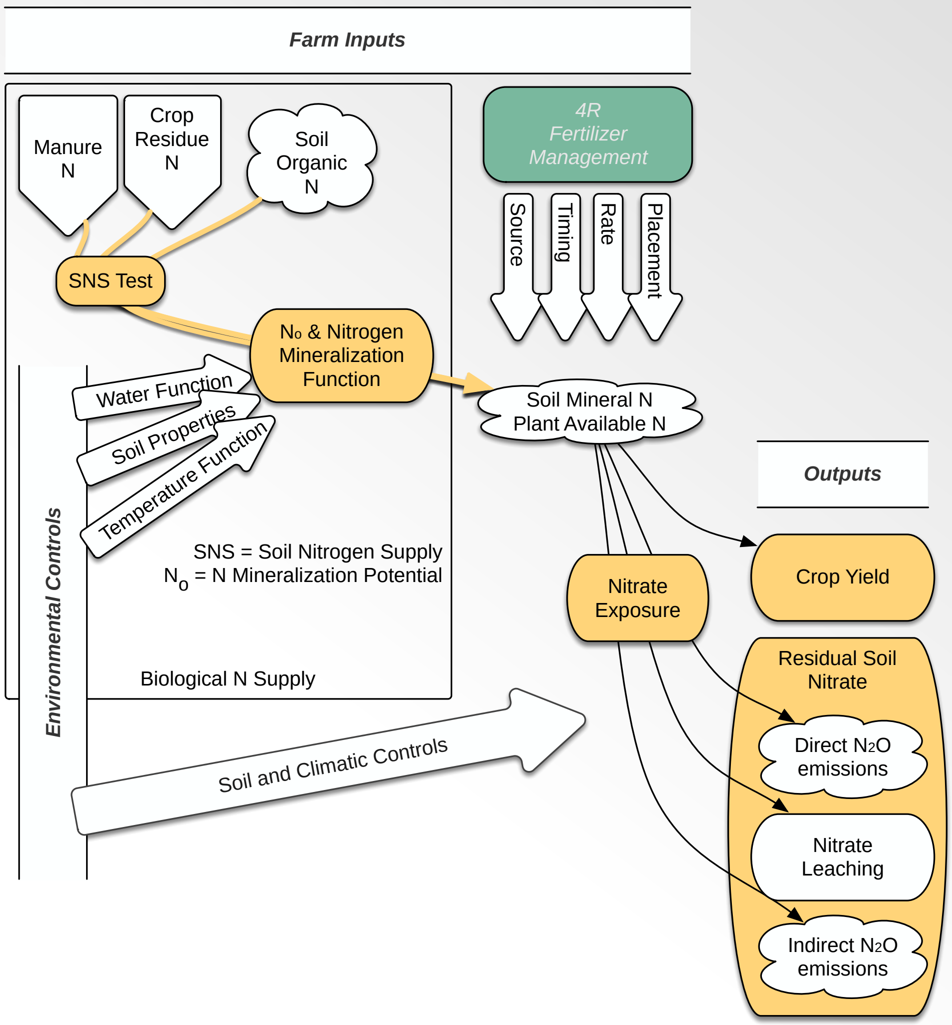
Tools to increase N use efficiency in Atlantic Canada

Need to quantify all sources of N.

Need site-specific information.

Therefore we need tools to measure all sources of N:

- soil N supply (SNS),
- climate impacts on N mineralization
- potential for N loss
  - Nitrate Exposure
  - Residual Soil N



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Theoretical Approach (Stanford, 1972).

- Determine what crop and variety you are growing
- Determine a realistic yield goal
  - How much nitrogen does the plant need?
  - Is yield the only factor in your consideration?
- Determine <u>all</u> sources of N
- What is the efficiency of N delivery

N fertilizer added = (Plant N Demand – N Supply)/efficiency

Theoretical Approach (Stanford, 1972).

- Determine what crop and variety you are growing

Current N requirements of different varieties?

There are published base values for N requirements for various potato varieties in PEI

Table 1. Base values for different potato varieties

Variety	Base value kg N/ha (lb N/ac)
Russet Burbank	208 (185)
Shepody	180 (160)
Russet Norkotah*	200 (180)
Superior	190 (170)
Prospect	135-150 (120-135)
Goldrush	190 (170)
Early table	135 (120)
Other mid-season	160-180 (140-160)
Other late season	180-200 (160-180)
Other low N requirement	135-160 (120-140)

*For standard clone, reduce value for new clonal selections

Regional Field Calibration Trials

- The response of crop to N fertilizer application is best determined using nitrogen rate response trials
- Measure yield response to increasing amounts of N fertilizer application
  - May include a calibration of soil testing procedures
- Will depend on variety, growing conditions (soil management, climate)
- Does not consider differences in soil nitrogen supply

Step 1: Crop N requirement (R)

Enter base value (in kg N/ha) from Table 1 based on potato variety __________ (a)

Enter 1.0 for full season crops or 0.9 for early harvested or seed crops __________ (b)

Enter 0 if planted on or before May 25; 11 if planted May 26 to June 1; 22 if planted June 2 to June 8; 33 if planted June 9 or later __________ (c)

R in kg N/ha = [_____ (a) x_____ (b) -_____ (c)]________ (1)

Theoretical Approach (Stanford, 1972).

- Determine what crop and variety you are growing
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  - How much nitrogen does the plant need?
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IPNI Nutrient Removal Calculator

The International Plant Nutrient Institute has published a nutrient removal calculator that provides a yield-based estimate of the nutrient removal for a wide range of crops.

IPNI Nutrient Removal Calculator

For a 350 cwt/acre potato crop the calculator estimates the following nutrient removals in the tubers

Back

Potato tuber

Yield Goal

350.0

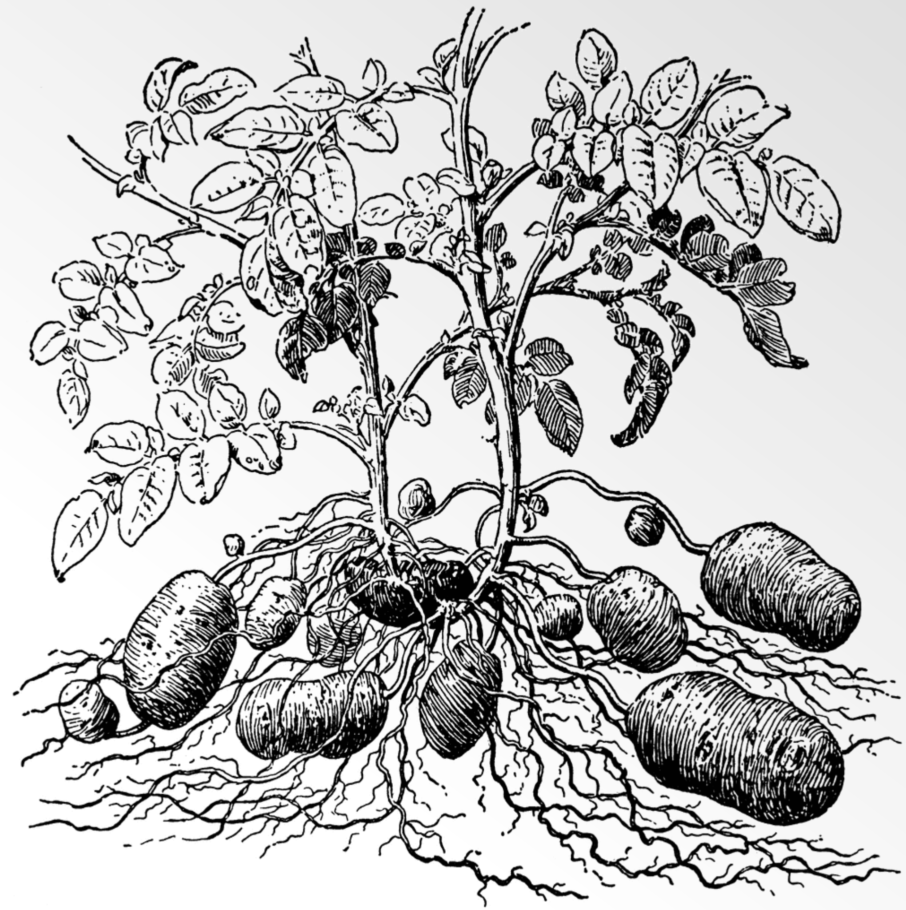
cwt/A

Nutrient	Removal, lb/A
N	105.0
P_2O_5	52.5
K_2O	227.5
S	10.5
P	22.9
K	188.8

Crops Favorites Settings About

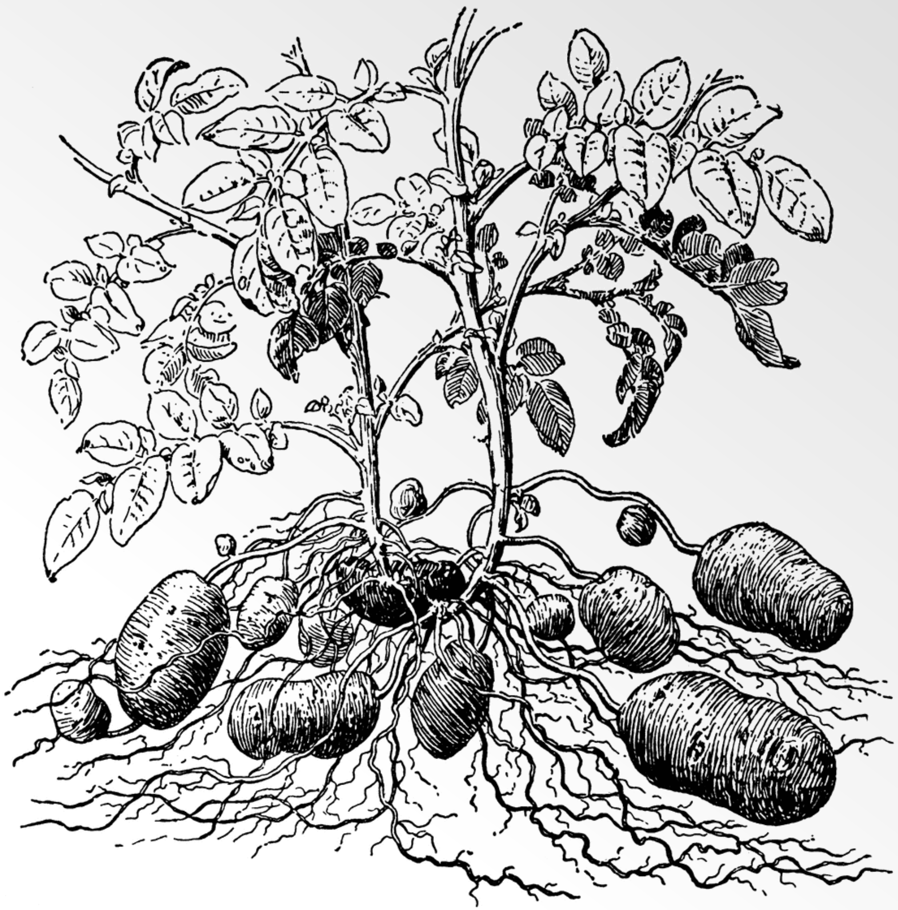
Partial Nitrogen Balance for Potato

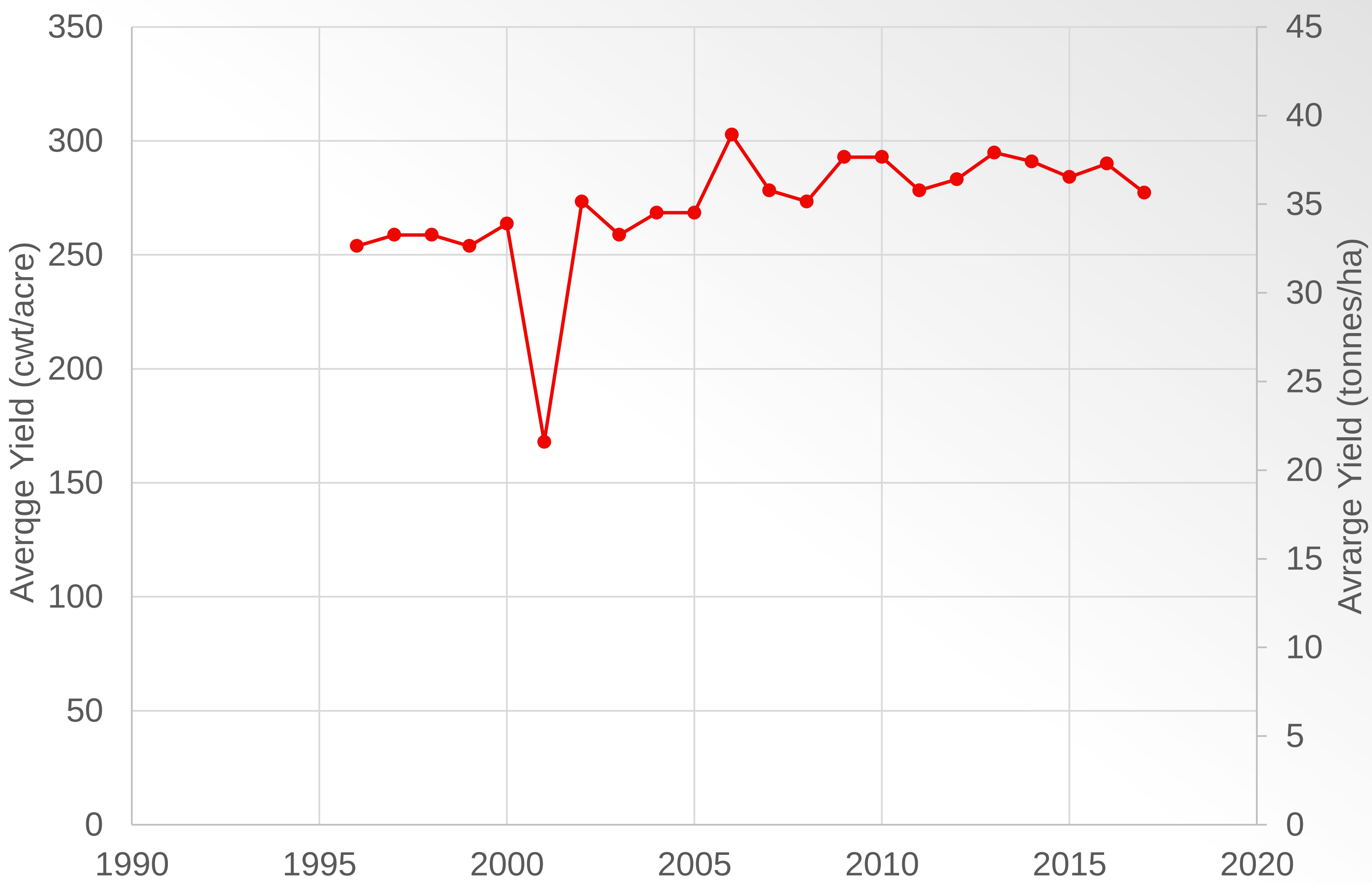
	Yield Goal (350 cwt/acre)
N Fertilizer (lb N/acre)	185
Crop N Removal (ib N/acre)	105



Partial Nitrogen Balance for Potato

	Yield Goal (350 cwt/acre)
N Fertilizer (lb N/acre)	185
Crop N Removal (lb N/acre)	105
Partial N Balance (lb N/acre)	75
Fertilizer N Use Efficiency (%)	58%





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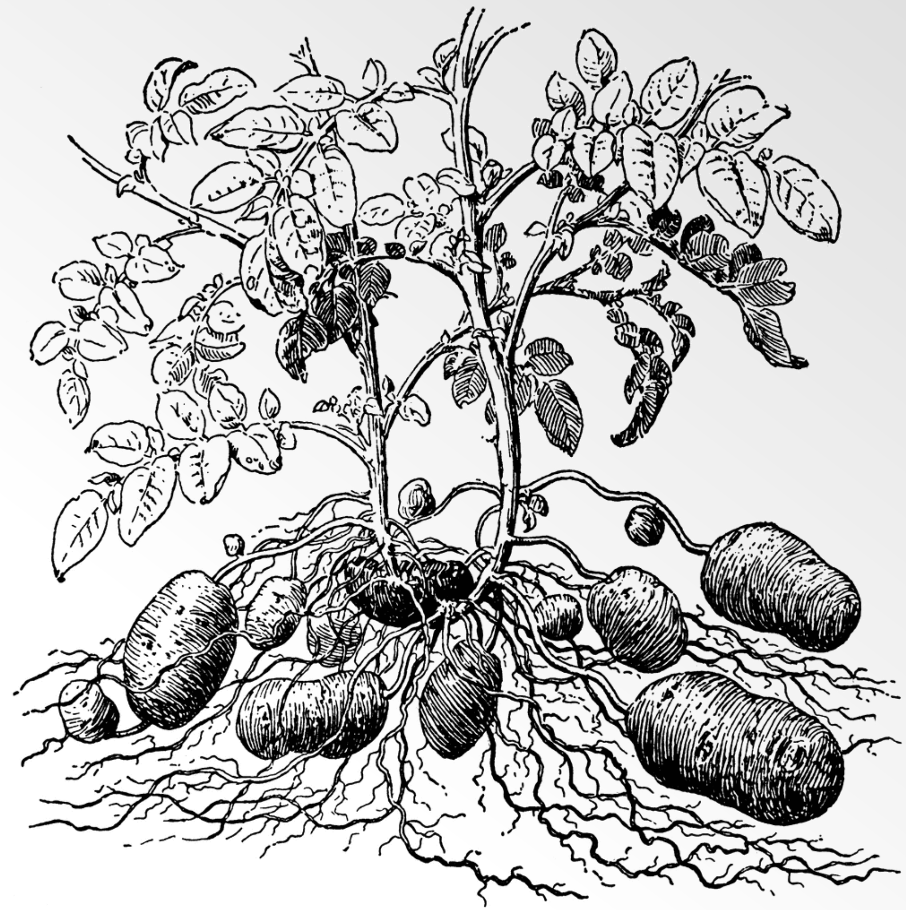
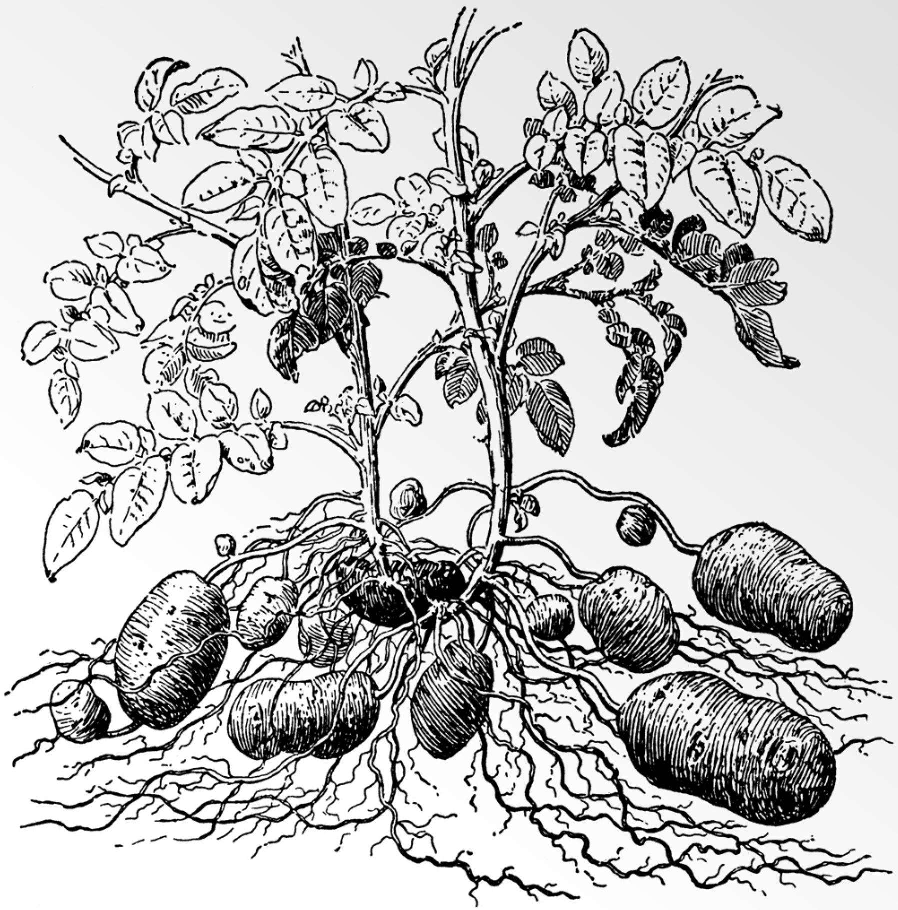
Partial Nitrogen Balance for Potato

	Yield Goal (300 cwt/acre)
N Fertilizer (lb N/acre)	185
Crop N Removal (ib N/acre)	90



Partial Nitrogen Balance for Potato

	Yield Goal (350 cwt/acre)
N Fertilizer (lb N/acre)	185
Crop N Removal (lb N/acre)	90
Partial N Balance (lb N/acre)	95
Fertilizer N Use Efficiency (%)	49%



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  - Is yield the only factor in your consideration?
- Determine all sources of N

Partial Nitrogen Balance for Potato

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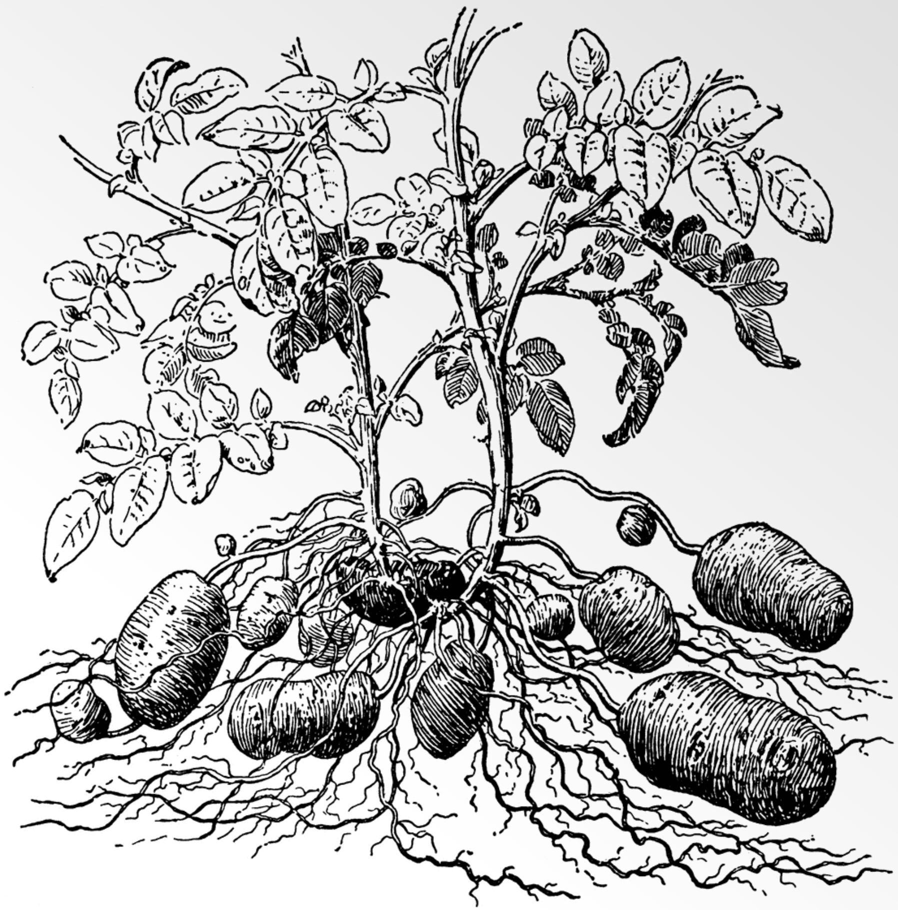
Crop N Removal (lb N/acre)	90
Partial N Balance (lb N/acre)	105
Fertilizer N Use Efficiency (%)	49%

	Yield Goal (300 cwt/acre)
N Fertilizer (lb N/acre)	+ 185
Soil Nitrogen Supply (lb N/acre)	+ 60
Crop N Removal (lb N/acre)	- 90
Residue and Root N return (lb N/acre)	- 40
Partial N Balance (lb N/acre)	115
Nitrogen Use Efficiency (%)	37%



Tools to increase N use efficiency in Atlantic Canada

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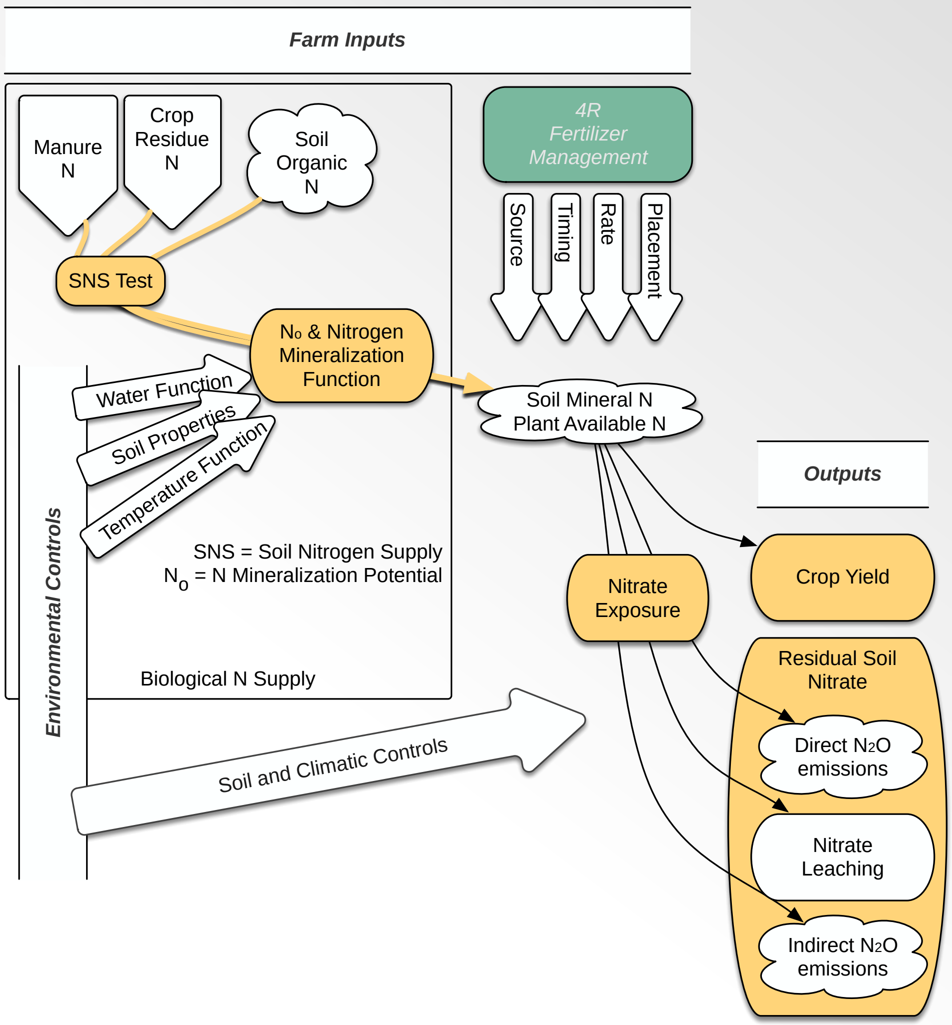

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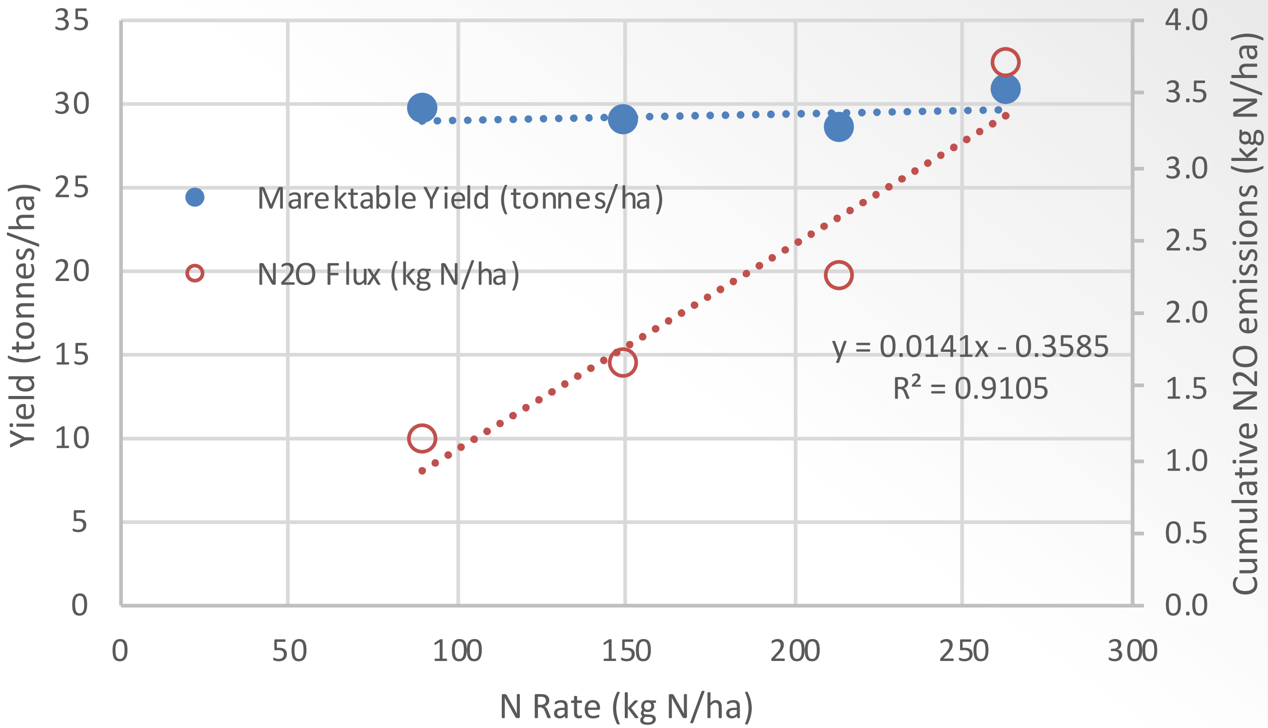
2017 Yield Response Trial



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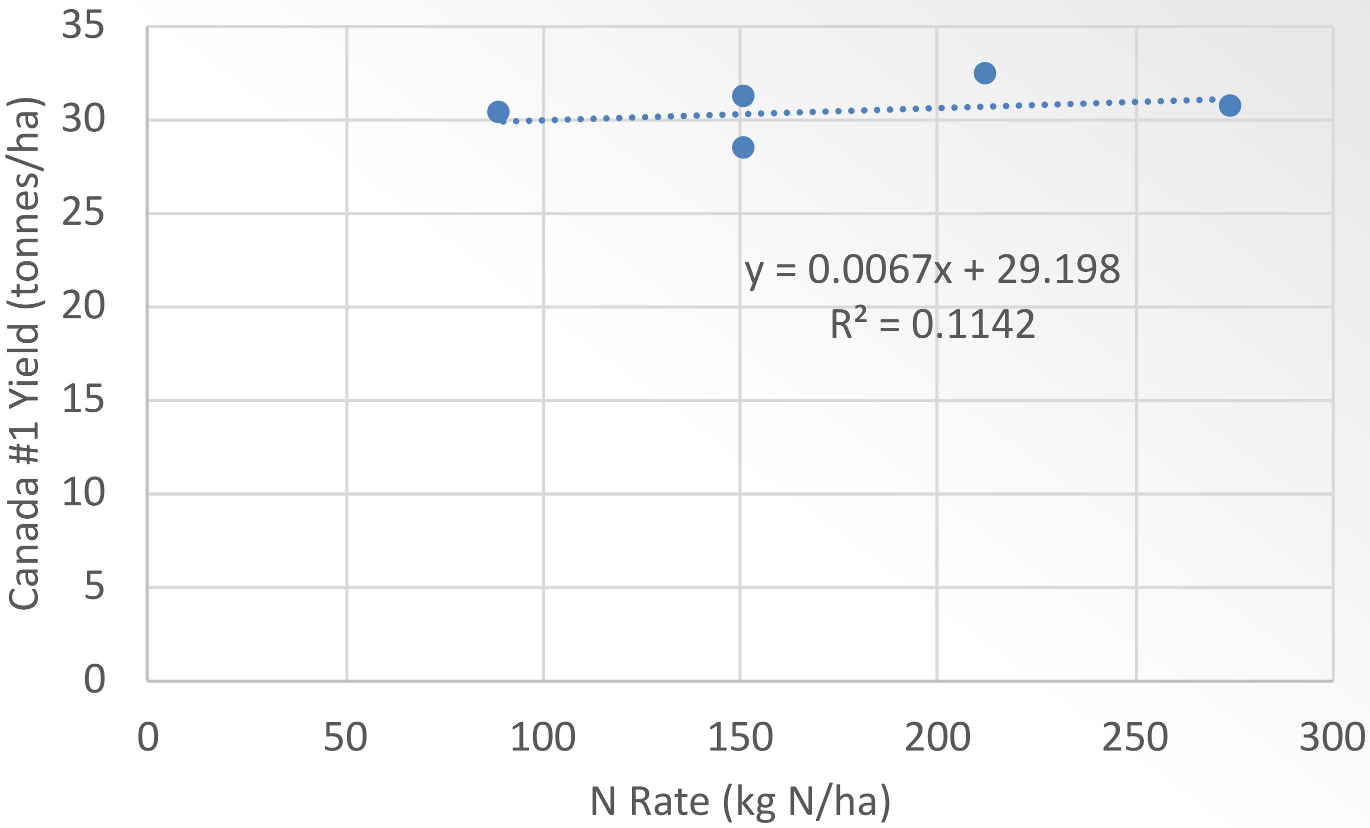
2018 N Response Trial - West



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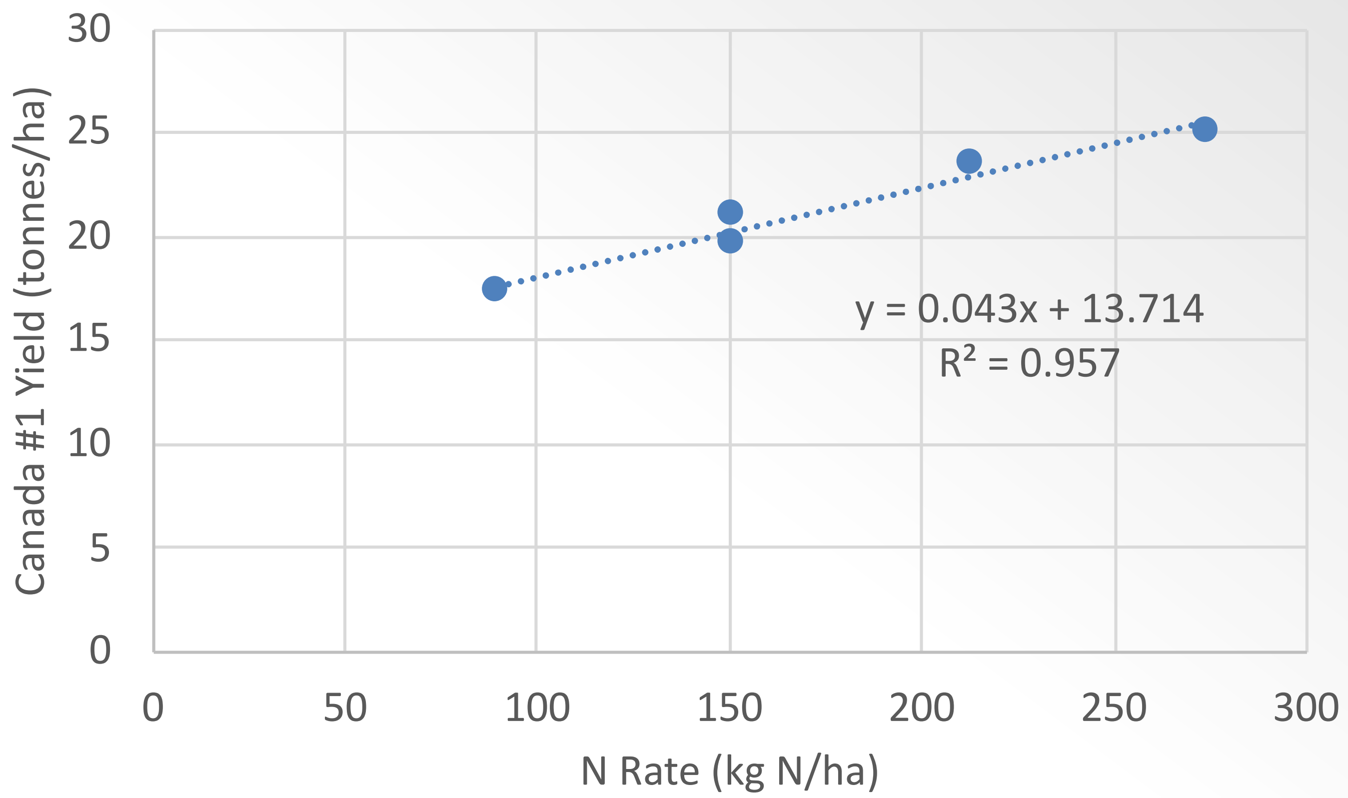
2018 N Response Trial - East



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N fertilizer added = (Plant N Demand – N Supply)/efficiency

Current N requirements of different varieties?

There are published base values for N requirements for various potato varieties in PEI

Discussion Point

- Do you agree with these numbers?
- How do you determine your N rate?

Table 1. Base values for different potato varieties

Variety	Base value kg N/ha (lb N/ac)
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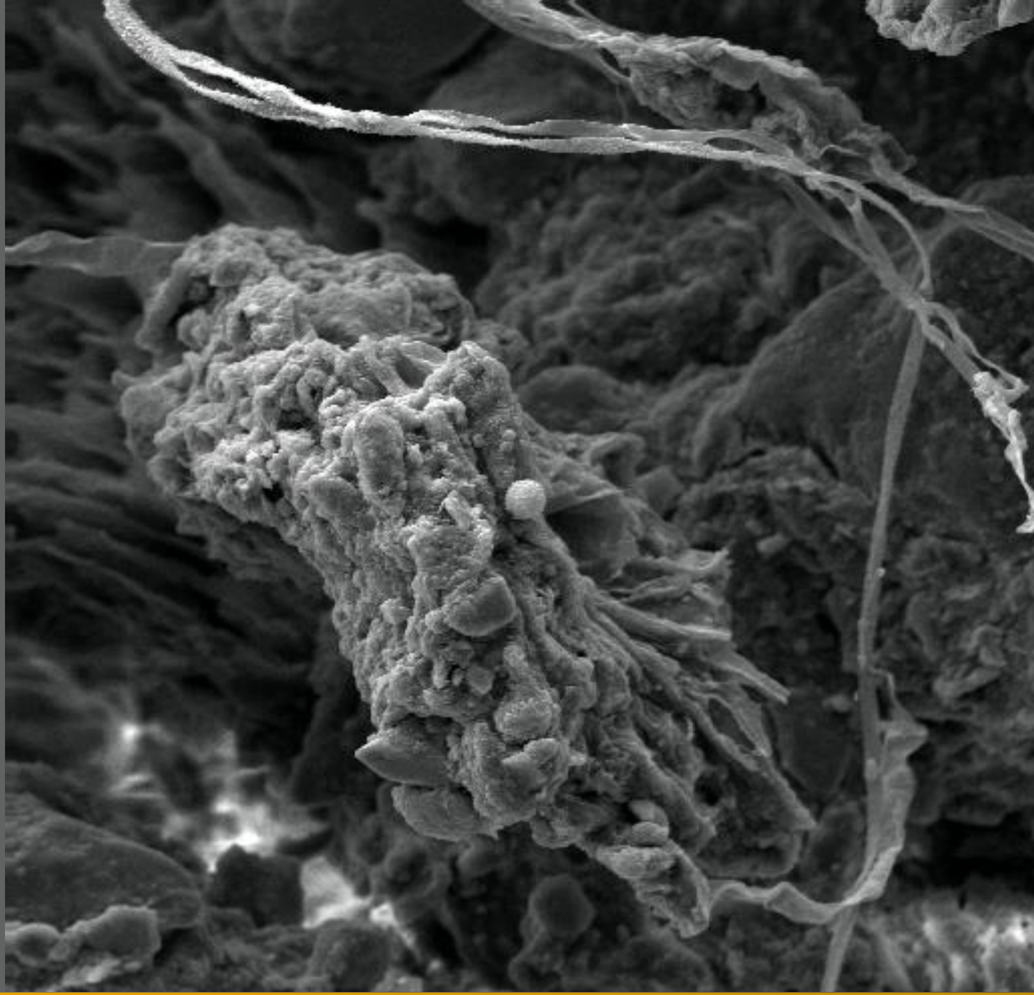
Importance of soil OM

How N rate applied should factor in soil OM



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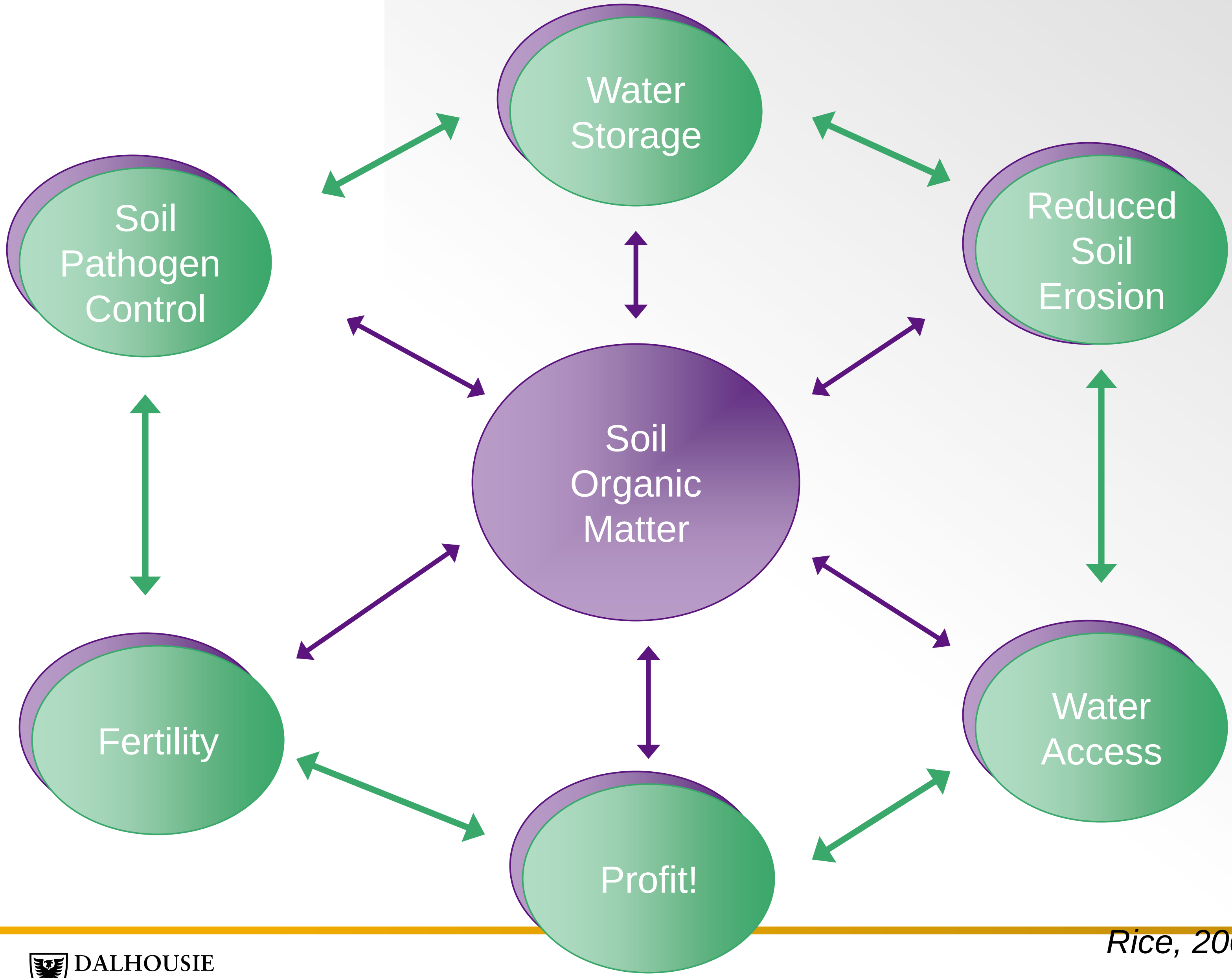
Soil qualities associated with soil organic matter



Rice, 2000

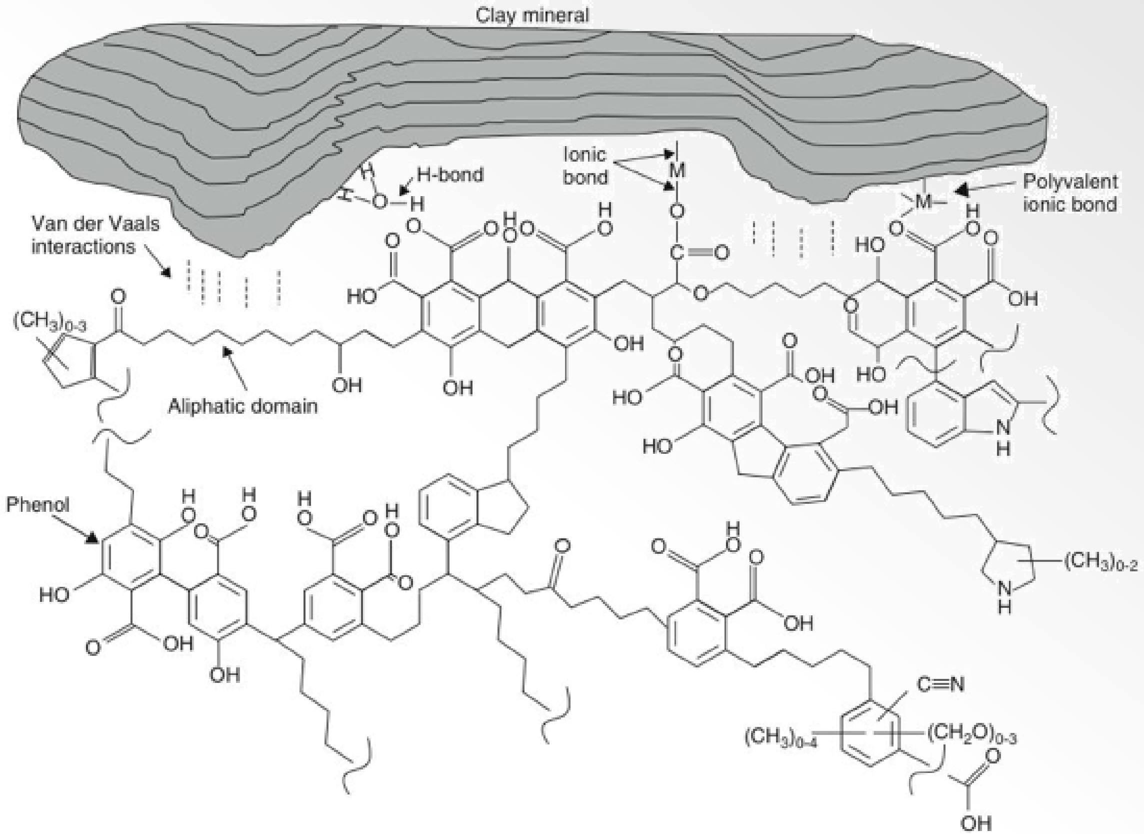


FIGURE 12.17 Idealized structure of humic acid showing high aliphatic content (adapted from Schulten and Schnitzer, 1993) showing physicochemical interactions with a clay mineral. Organomineral interactions M denotes various cations, such as iron and calcium.

Paul, 2007

Historically

- Soil organic matter has been declining in PEI
  - Adversely impacting soil structure and resistance to soil erosion
  - Reducing water-holding capacity
  - Reduced nutrient retention and supply

- What are the SOM building practices that we can recommend?
  - Reduced soil disturbance
  - The use of cover crops
  - Increased return of organic matter
  - Growing crops with more extensive, finer rooting systems
  - Increased perennial plant cover

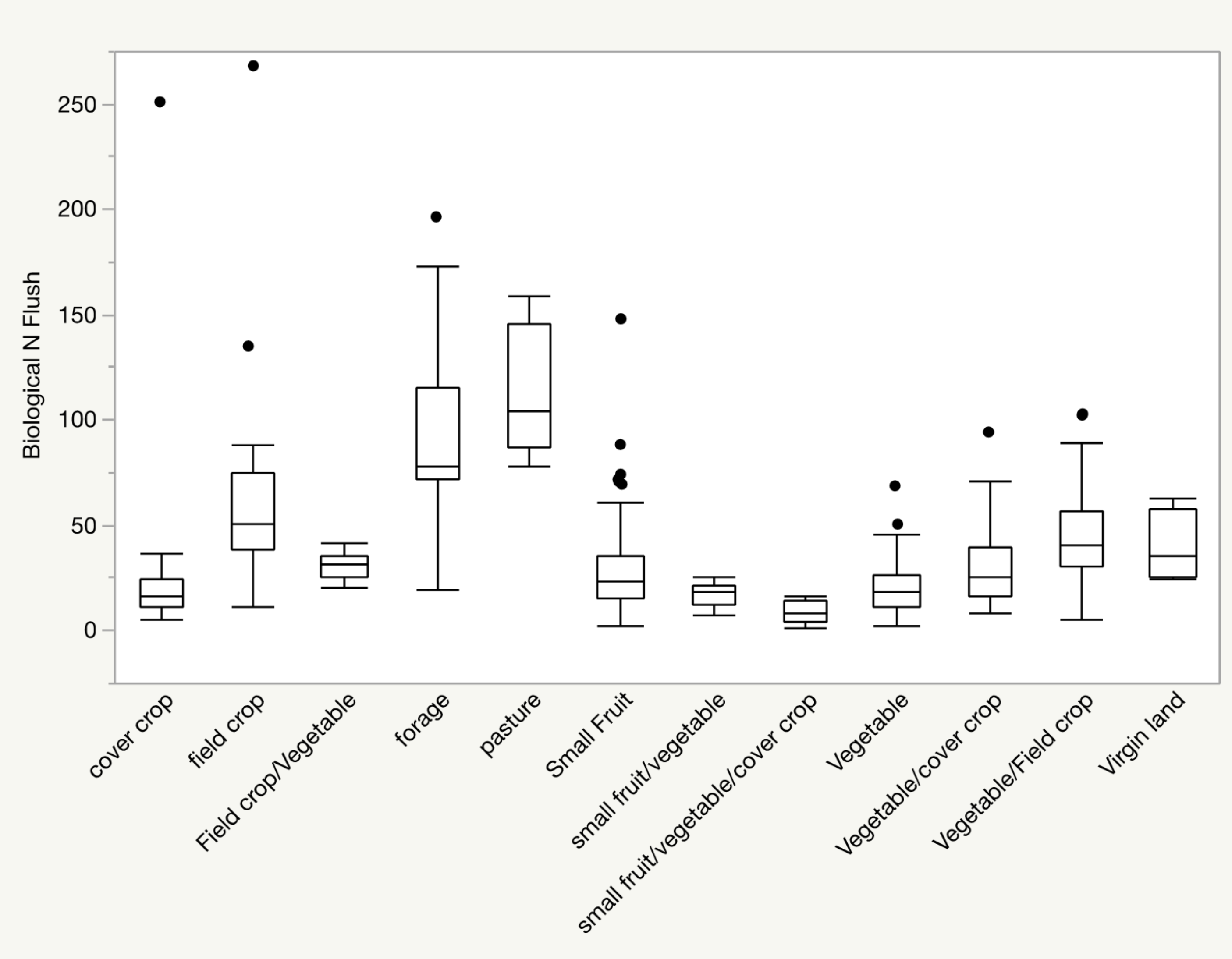
Credit for N Mineralization from Soil Organic Matter

Step 5: Credit soil organic matter content (S)

Soil organic matter greater than or equal to 3.5%	15
Soil organic matter less than 3.5%	0

S in kg N/ha = (enter appropriate value from above) = _________ (5)

Cropping System and Nitrogen Mineralization



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Calculating credits for plow down crops, accounting for N tie-up in straw, etc (N balance sheet)

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N Credits for the previous crop

Step 4: Credit crop grown in the previous year (C)

	Alfalfa	Red clover	Red Clover (2nd yr)	Soybean (seeding yr.)	Annual ryegrass
Poor Stand :	0	0	0	10	0
Fair Stand :	40	20	10	10	0
Good Stand :	80	40	20	10	-15

C in kg N/ha = _________ (4)

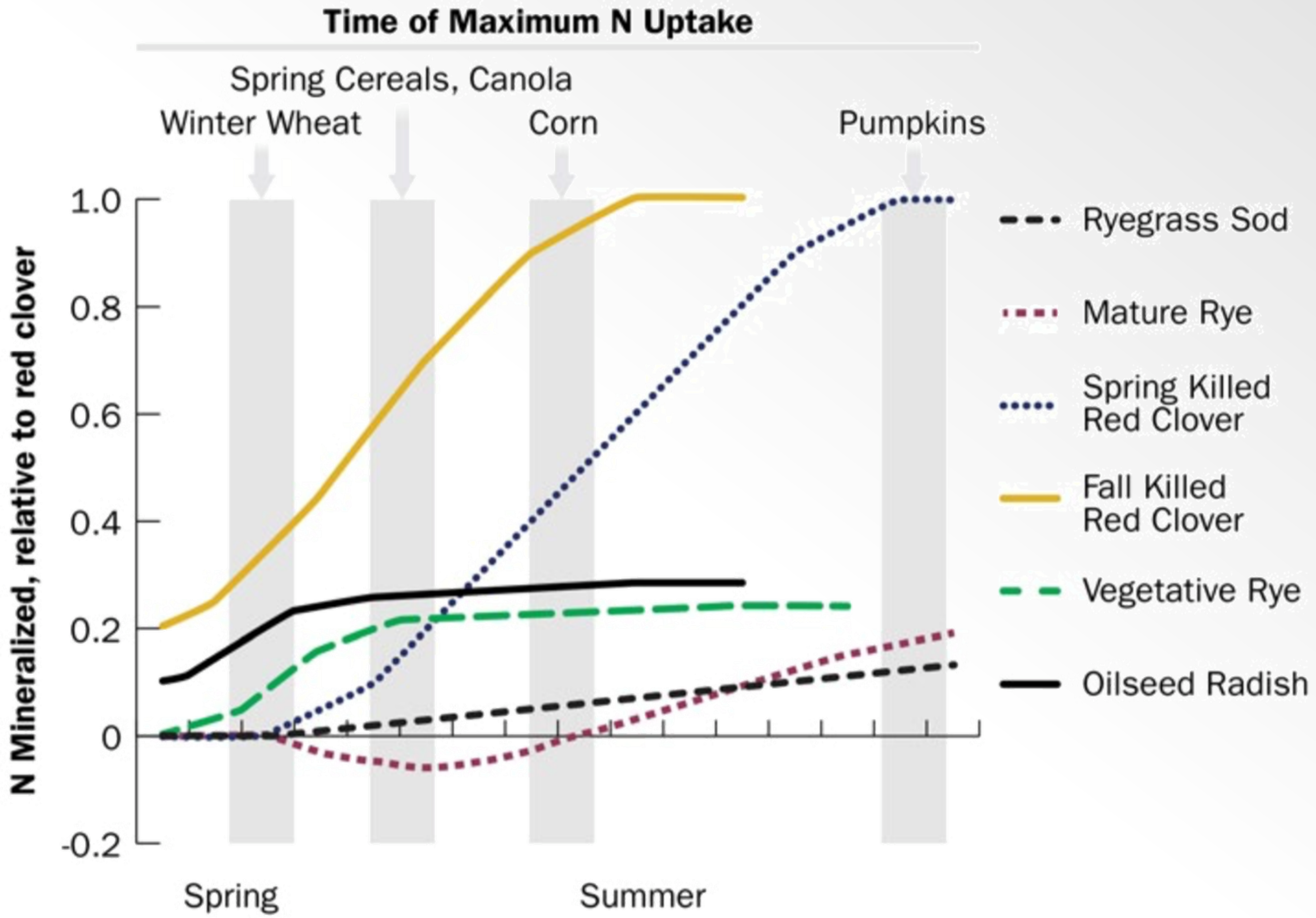
N Credits following Legumes (OMAFRA, pub 611)

Table 6–14. Adjustment of nitrogen requirement (i.e., N credit) following legumes

Type of crop	kg/ha	lb/acre
established forages — less than ⅓ legume	0	0
established forages — ⅓–½ legume	55	50
established forages — ½ or more legume	110	100
perennial legumes seeded and plowed in same year	78 (for field corn) 45 (all other crops)	70 (for field corn) 40 (all other crops)
soybean and field bean residue	30 (for field corn) 0 (all other crops)	27 (for field corn) 0 (all other crops)

OMAFRA, Pub 611

Timing of N release from previous crop



OMAFRA, Pub 611

Credit manure and other organic applications

- Must consider both ammonium application and organic N application
- Potential for ammonia loss
- C:N ratio of organic N and the potential for N immobilization

Step 2: Credit manure or compost ammonium nitrogen (M_{AMM}) in kg N/ha (Important to have a proper manure analysis)

Enter manure or compost application rate:

in gallons/acre	________	(a)	and (b) = 89,000
OR in m3/ha	__________	(a)	and (b) = 1,000
OR in tons/acre	_________	(a)	and (b) = 445
OR in tonnes/ha	_________	(a)	and (b) = 1,000

Enter manure ammonium concentration in ppm
(line 101 from Table 2) __________ (c)
Enter manure ammonium availability coefficient
(from Table 3) __________ (d)

M_{AMM} in kg N/ha = _____ (a) x _____ (c) x _____ (d) ÷ _____ (b) =______ (2)

Step 3: Credit manure or compost organic nitrogen (M_{ORG}) in kg N/ha (Important to have a proper manure analysis)

Enter (a) and (b) from Step 2: __________ (a) __________ (b)
Enter manure organic N concentration in ppm
(line 104 from Table 2) __________ (c)
Enter manure organic N availability coefficient
(from Table 4) __________ (d)

M_{ORG} in kg N/ha = ______ (a) x ______ (c) x ______ (d) ÷ ______ (b) =_______ (3)

Be sure to credit manure applications

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Enter manure ammonium availability coefficient (from Table 3) _________ (d)

M_{AMM} in kg N/ha = ____ (a) x ____ (c) x ____ (d) ÷ ____ (b) =_____ (2)

Table 2. Manure or compost analysis calculation table.

Enter values from your manure or compost analysis on an "as received" basis:

NH4-N (ppm) = _________ (101)

Nitrogen (%) = _________ (102)

Carbon (%) = _________ (103)

Calculate the following:

Organic N (ppm) = [(line 102) x 10,000] - (line 101) = _________ (104)

C:N ratio = (line 103) ÷ (line 102) = _________ (105)

Table 3. Manure or compost ammonium nitrogen availability coefficients

	Liquid./Semi-solid. Manure		Solid Manure or compost	
Application	**Spring / Summer**	**Fall***	**Spring / Summer**	**Fall***
Injected	1.00	0.80	1.00	0.90
Incorp. 1 day	0.75	0.60	0.80	0.77
Incorp.2 days	0.70	0.56	0.75	0.68
Incorp.3 days	0.65	0.52	0.65	0.59
Incorp.4 days	0.60	0.48	0.60	0.54
Incorp.5 days	0.55	0.44	0.55	0.50
Not incorp.- bare soils	0.34	0.27	0.50	0.45
Not incorp.- pretilled soils	0.70	0.56	0.70	0.63
Not incorp.- crop residues	0.50	0.40	0.70	0.63
Not incorp.- standing crops	0.70	0.56	0.60	0.54
Not incorp.- late fall	---	0.60	---	0.68

* Fall applied - late October / early November

Be sure to credit manure applications

Step 3: Credit manure or compost organic nitrogen (M_{ORG}) in kg N/ha (Important to have a proper manure analysis)

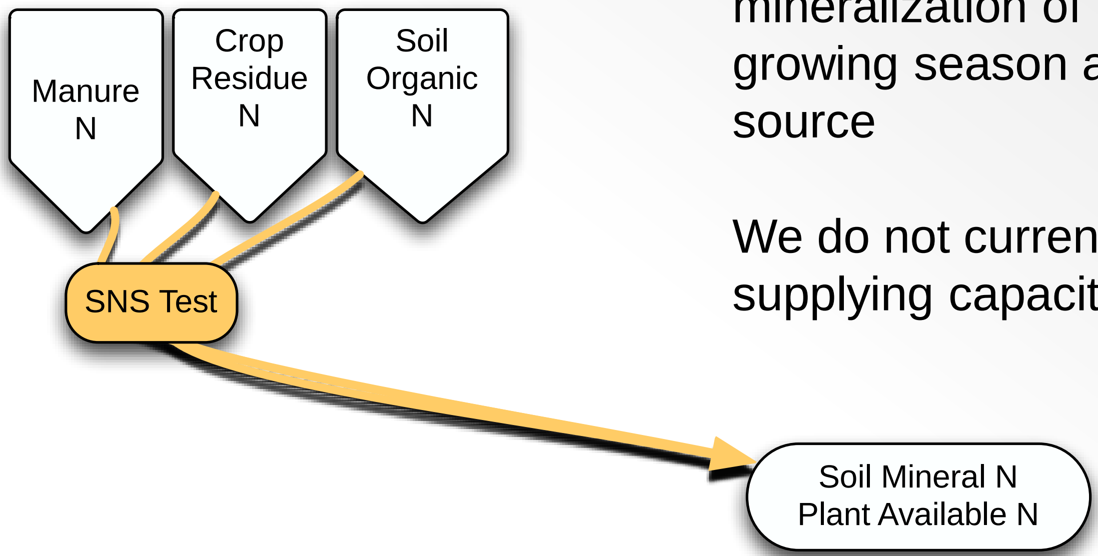
Enter (a) and (b) from Step 2: __________ (a) __________ (b)
Enter manure organic N concentration in ppm
(line 104 from Table 2) __________ (c)
Enter manure organic N availability coefficient
(from Table 4) __________ (d)

M_{ORG} in kg N/ha = _____ (a) x _____ (c) x _____ (d) ÷ _____ (b) =______ (3)

Table 4. Manure or compost organic nitrogen availability coefficients

Manure Type	Spring applied	Fall
Poultry manure:	0.30	0.30
Compost or other livestock manure:		
C:N < 15	0.20	0.30
C:N 15 to 25 (high in bedding)	0.10	0.10
C:N > 25 (very high in bedding)	-0.20	0.10

Measuring soil nitrogen supply

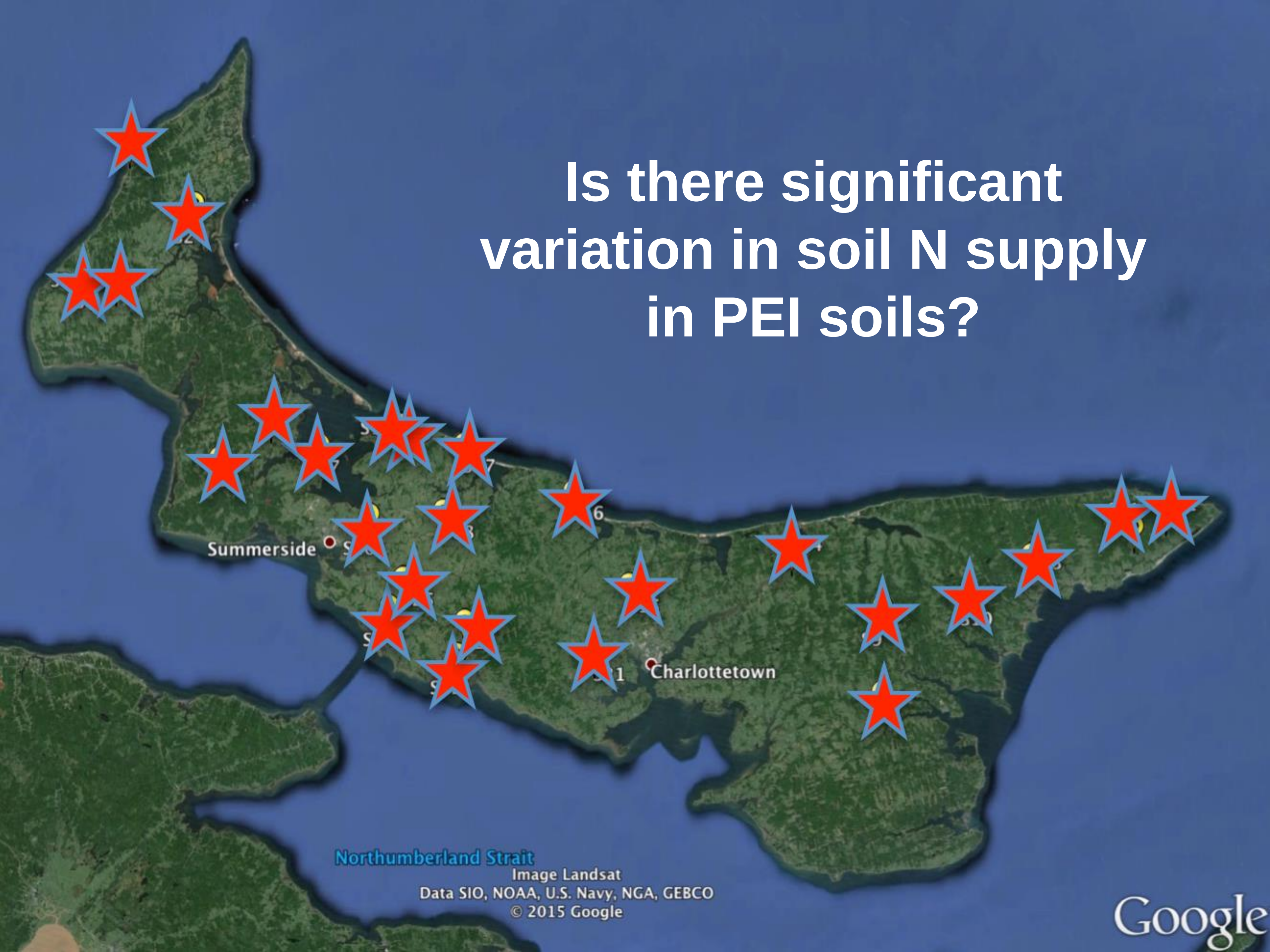


In Atlantic Canada high potential for over-winter nitrate loss makes the mineralization of N during the growing season an important N source

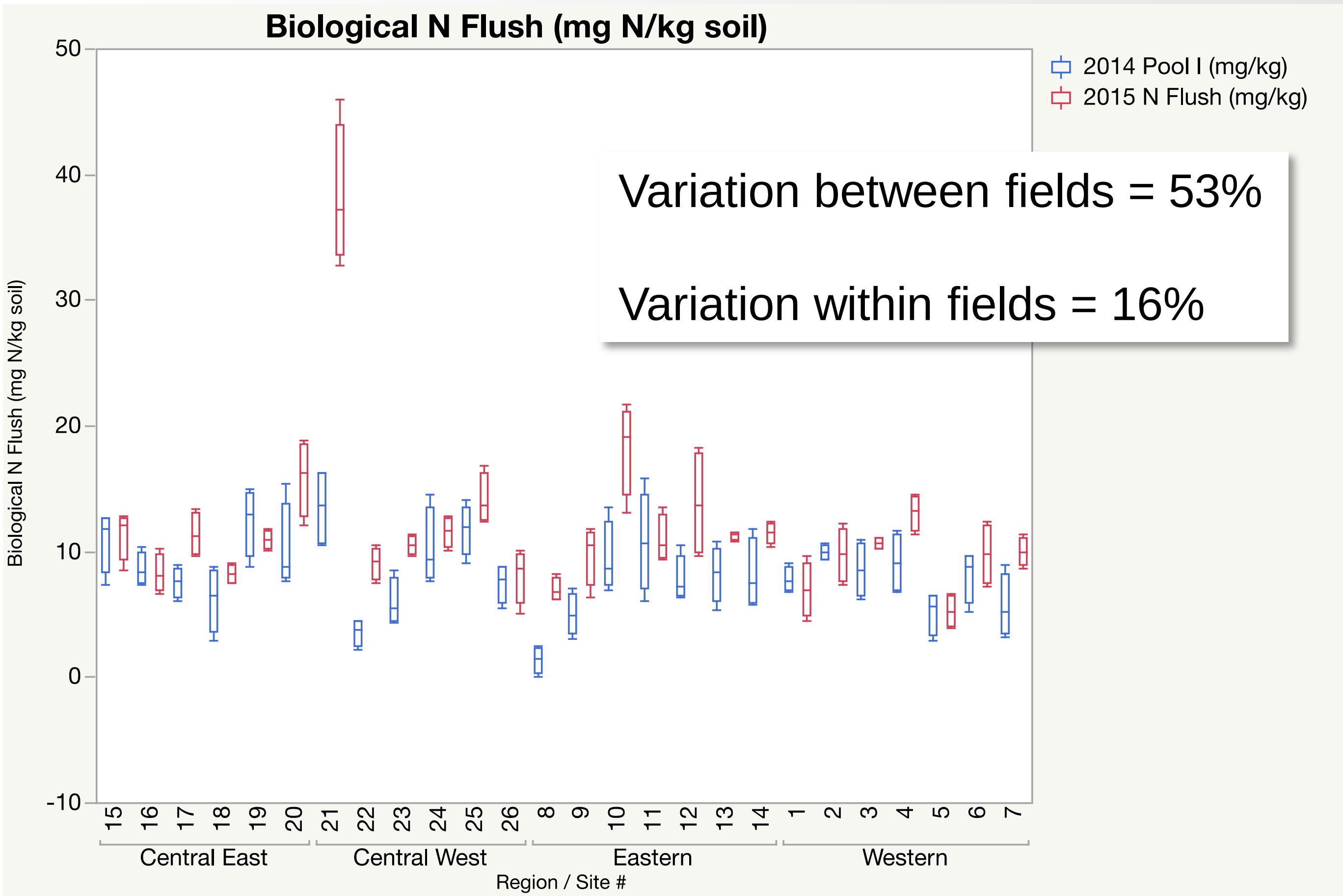
We do not currently measure the N supplying capacity of the soil

Can a simple, practical test be developed and implemented in regional soil test labs?

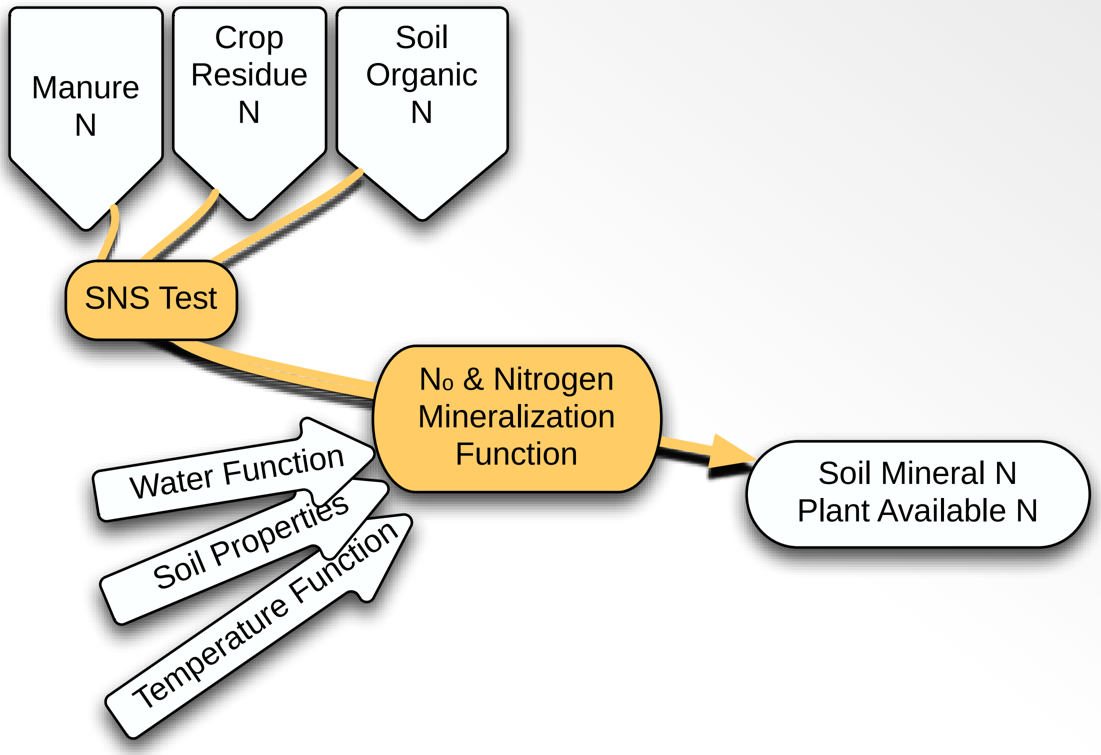
Is there significant variation in soil N supply in PEI soils?



Biological N flush is more constant from fall to spring

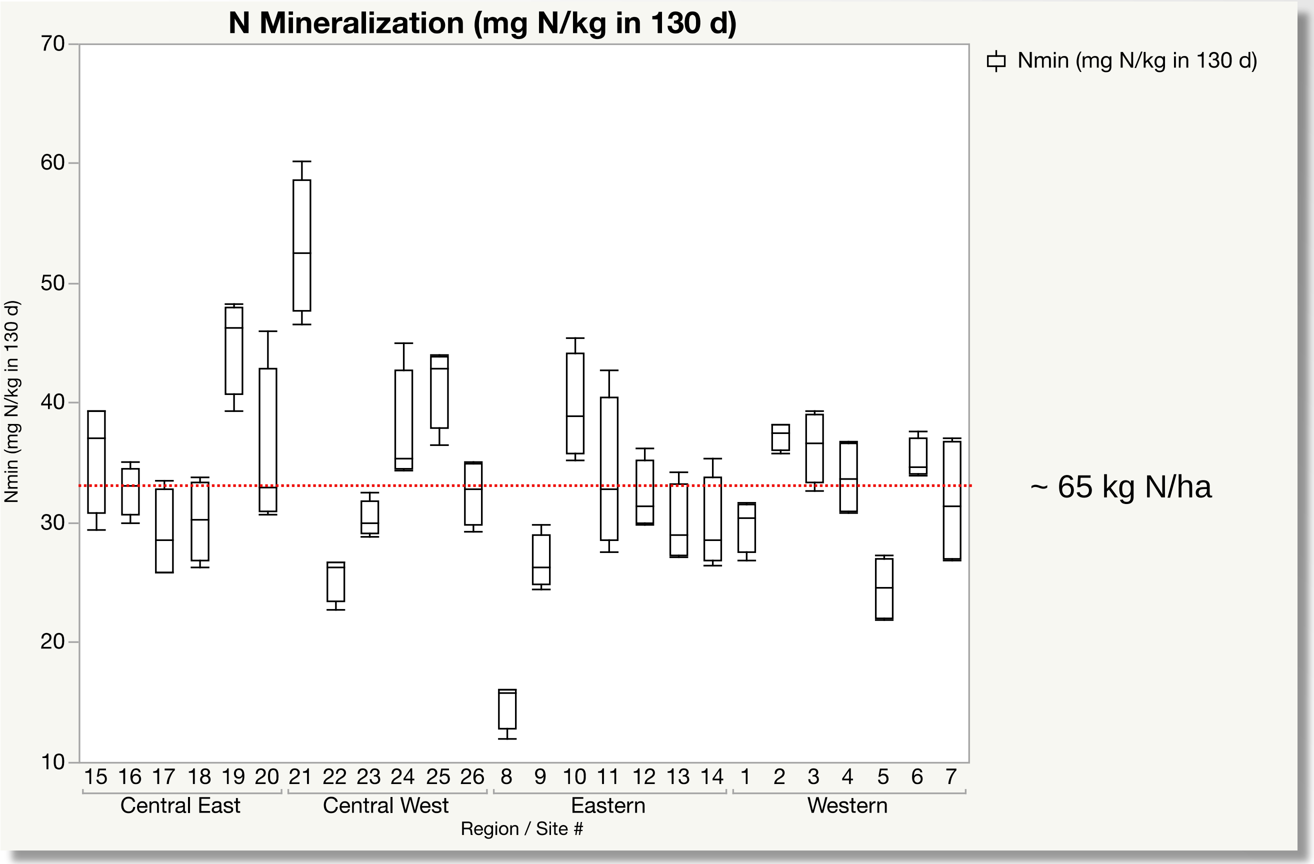


Soil Properties (Total N and N flush) and climate data (air temperature and precipitation) can be used to predict N mineralization



Leads to a better understanding the impact of <u>soil properties</u> and <u>climate</u> on soil N supply

Considerable farm-to-farm variation in estimated N mineralization of 130-day growing period



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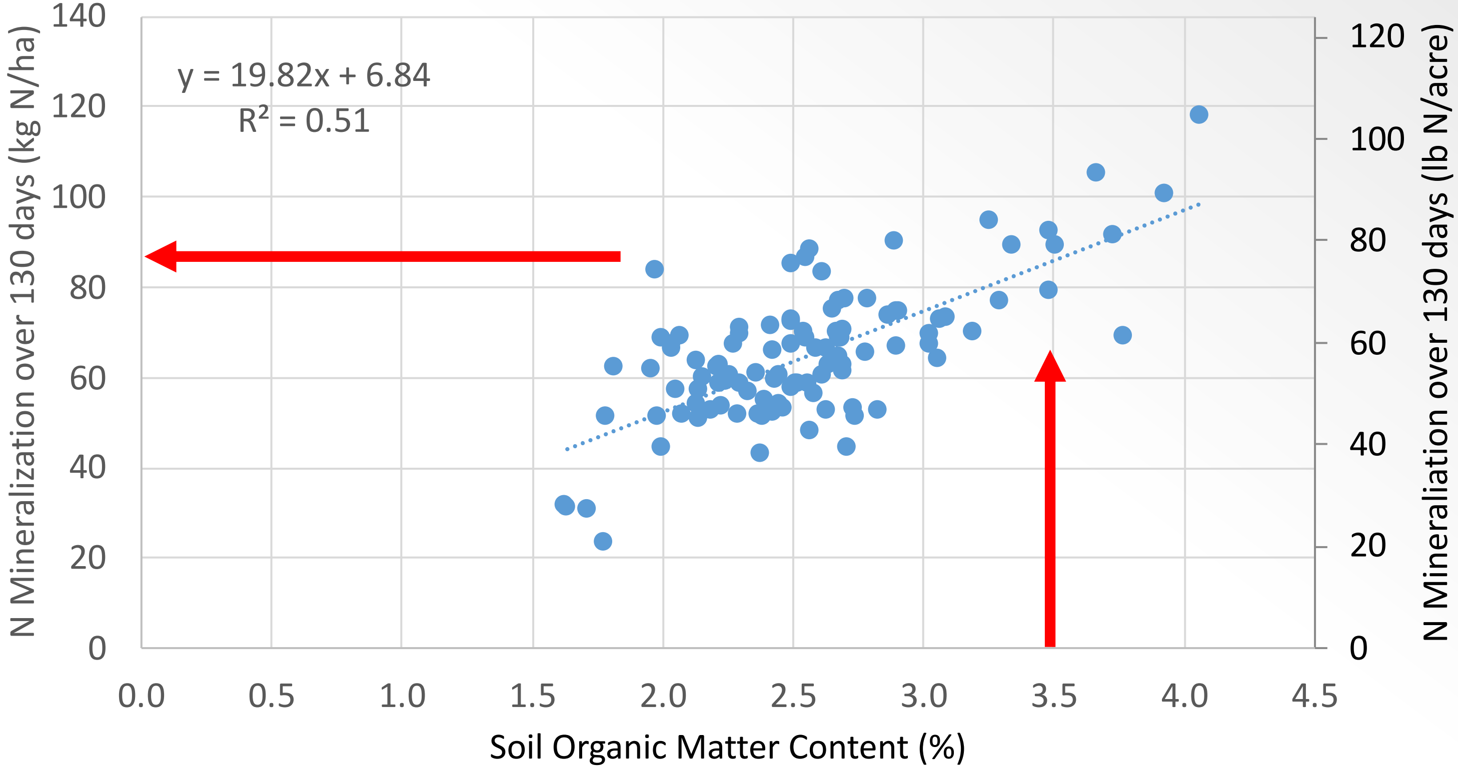
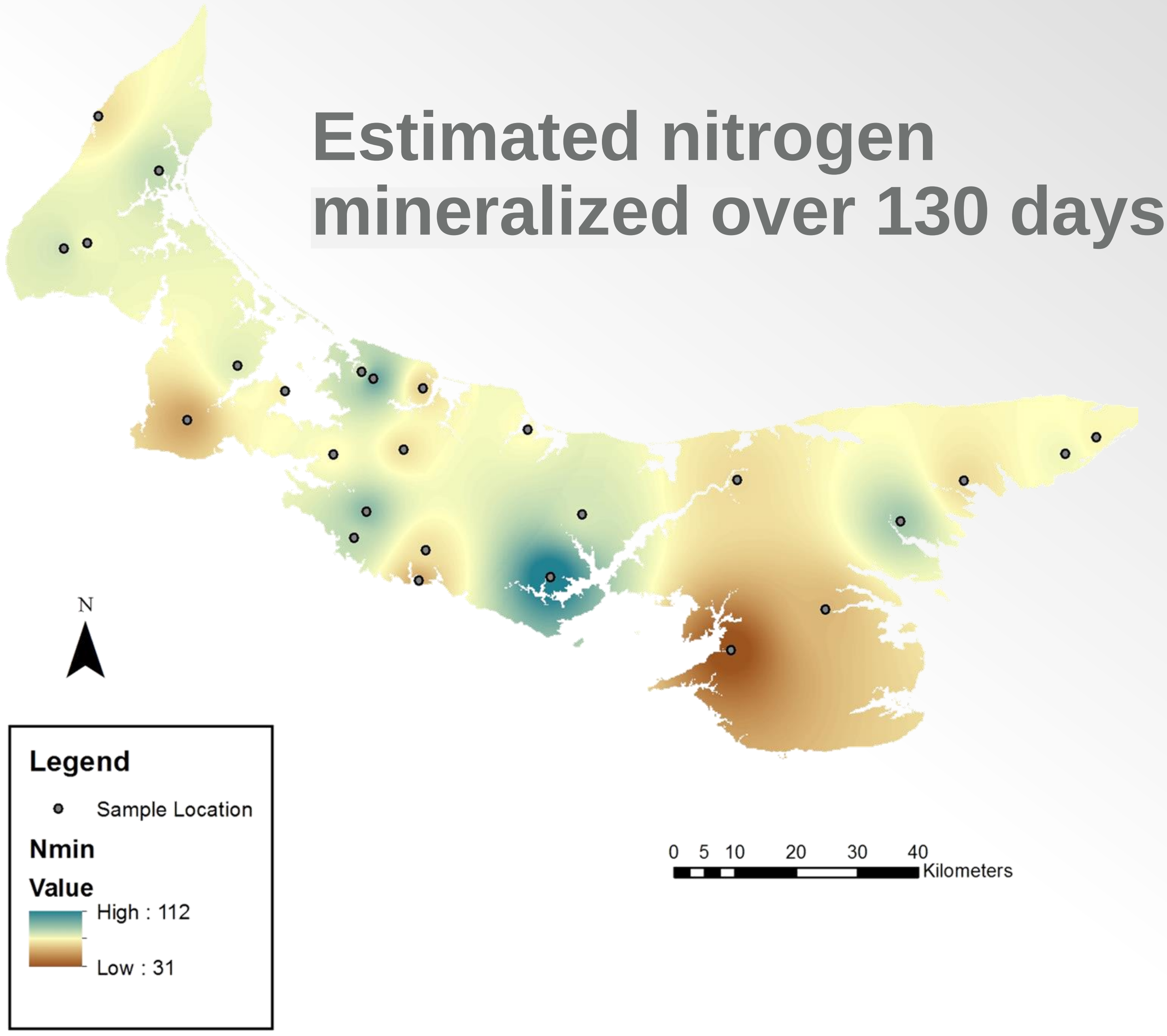
Credit for N Mineralization from Soil Organic Matter

Step 5: Credit soil organic matter content (S)

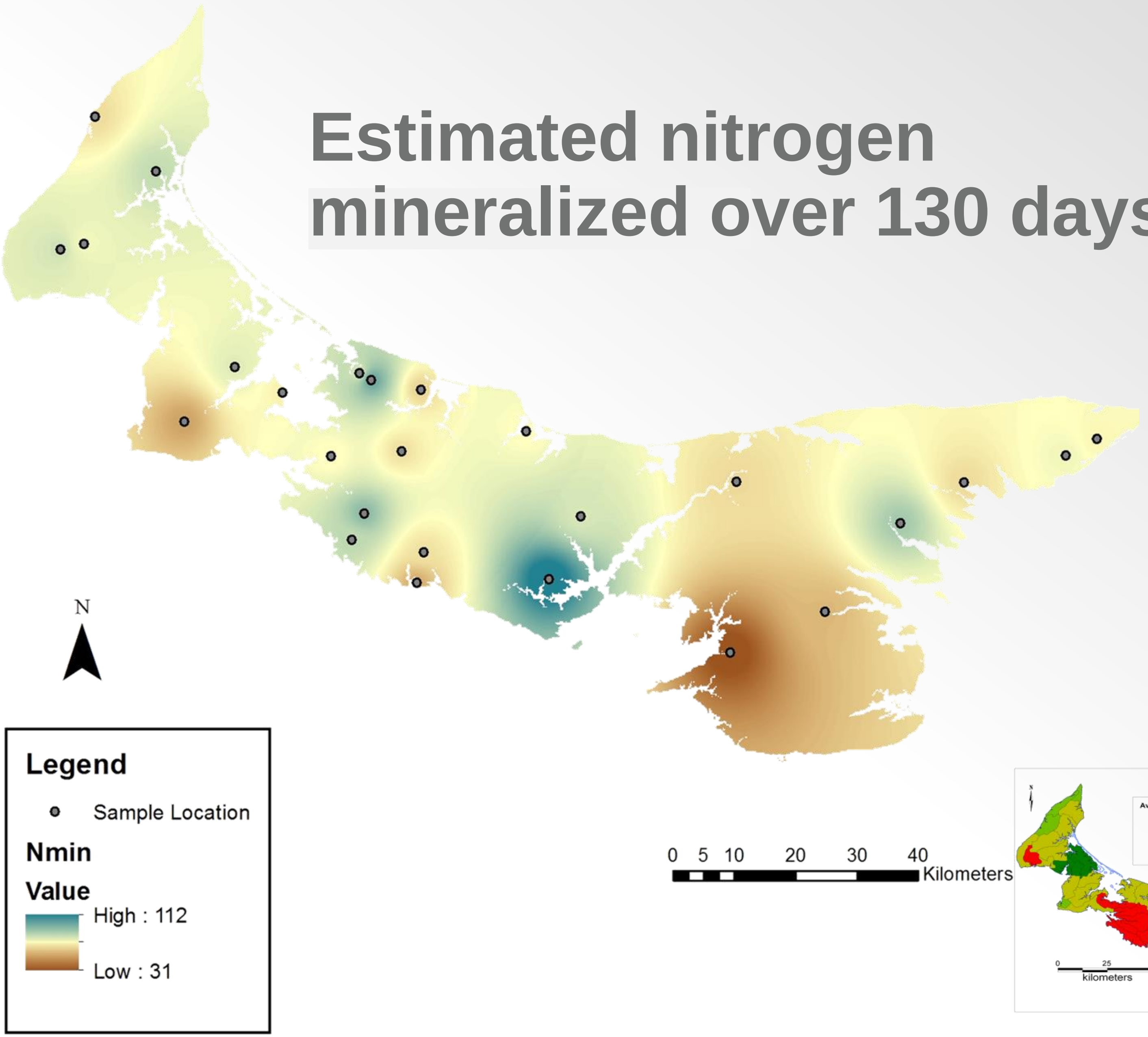
Soil organic matter greater than or equal to 3.5%	15
Soil organic matter less than 3.5%	0
S in kg N/ha = (enter appropriate value from above) = _________	(5)

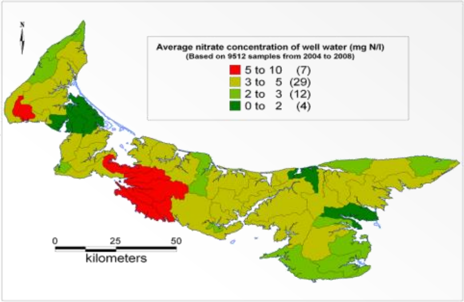


Estimated nitrogen mineralized over 130 days



Estimated nitrogen mineralized over 130 days





Reducing Environmental Nitrogen Impacts

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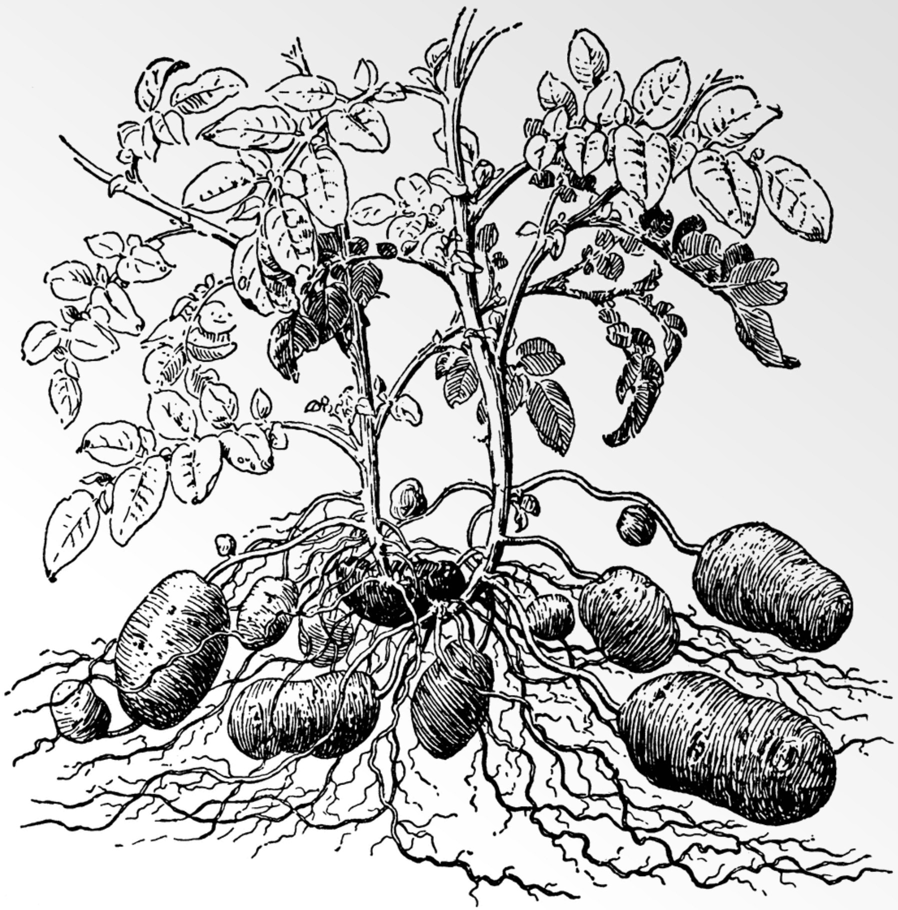
Partial Nitrogen Balance for Potato

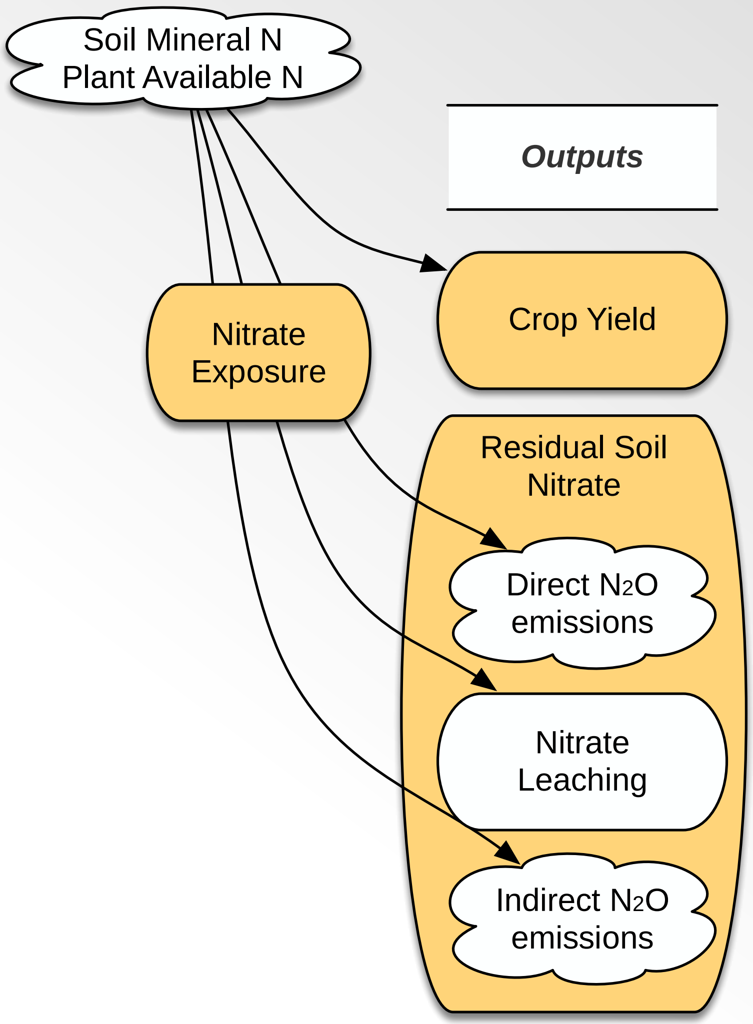
	Yield Goal (300 cwt/acre)
N Fertilizer (lb N/acre)	185
Crop N Removal (lb N/acre)	90
Partial N Balance (lb N/acre)	105
Fertilizer N Use Efficiency (%)	49%

	Yield Goal (300 cwt/acre)
N Fertilizer (lb N/acre)	+ 185
Soil Nitrogen Supply (lb N/acre)	+ 60
Crop N Removal (lb N/acre)	- 90
Residue and Root N return (lb N/acre)	- 40
Partial N Balance (lb N/acre)	115
Nitrogen Use Efficiency (%)	37%

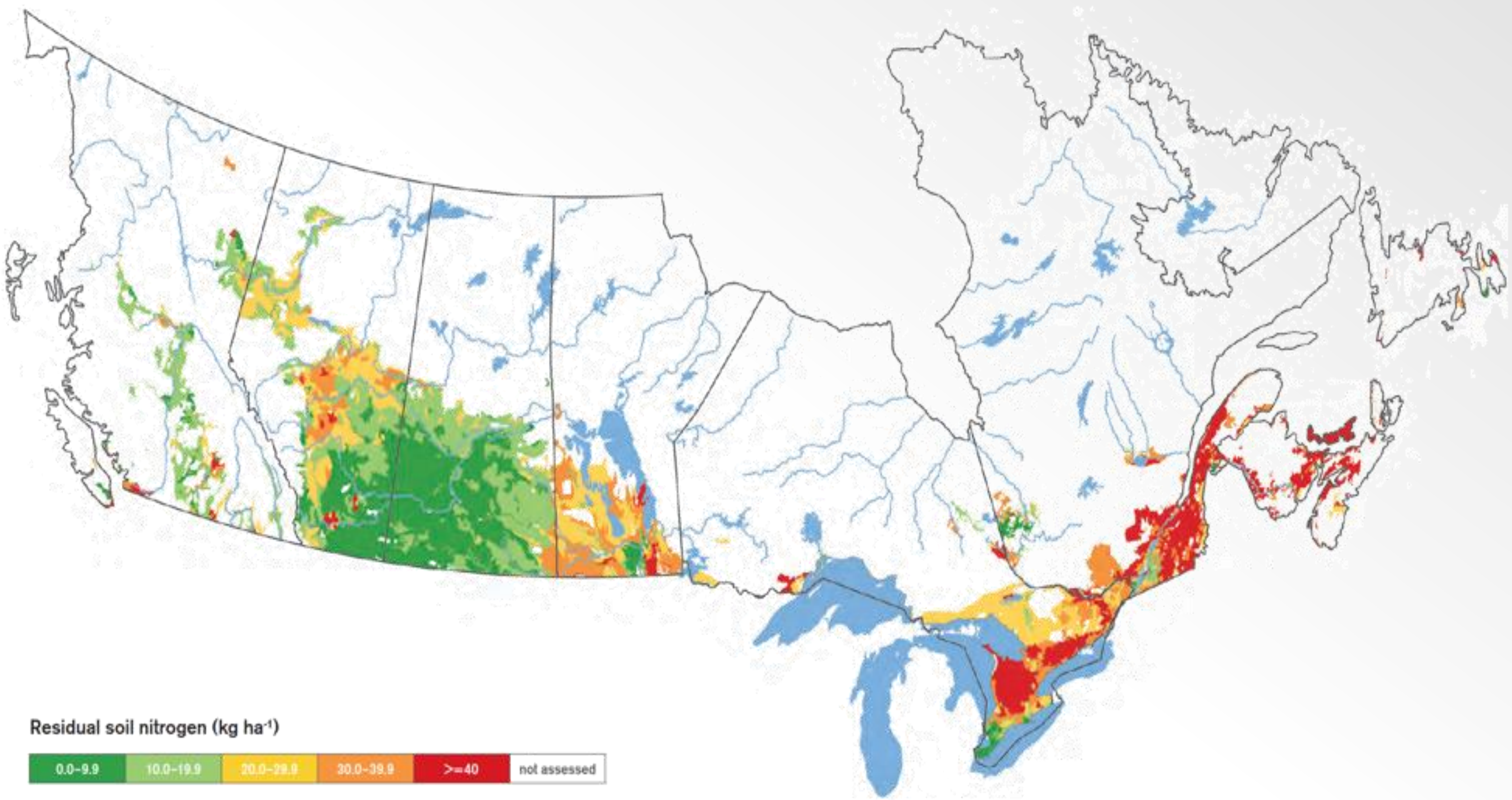


Monitoring the Potential for N Loss

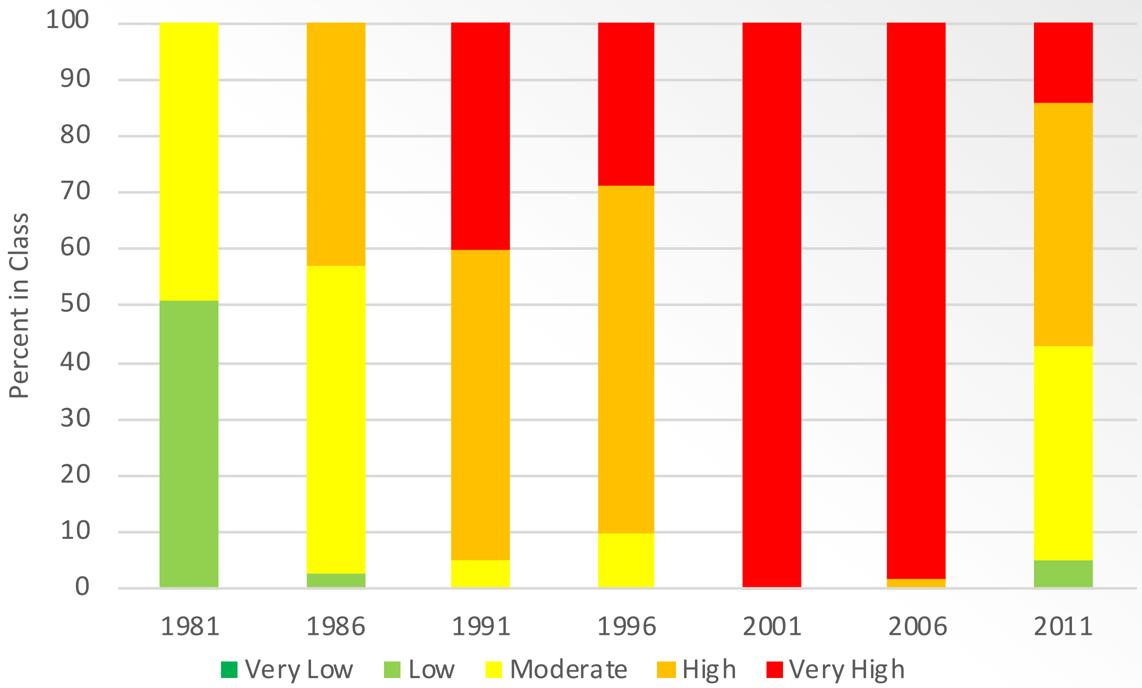
- Need a means of practically measuring the potential for N loss
  - N_2O emissions
  - Nitrate leaching
- Can assess how well management is doing in reducing nitrate accumulation
  - Feedback to producer
  - Documentation of success of mitigation strategies



Agri-Environmental Indicators
Residual Soil Nitrogen



Trends in RSN



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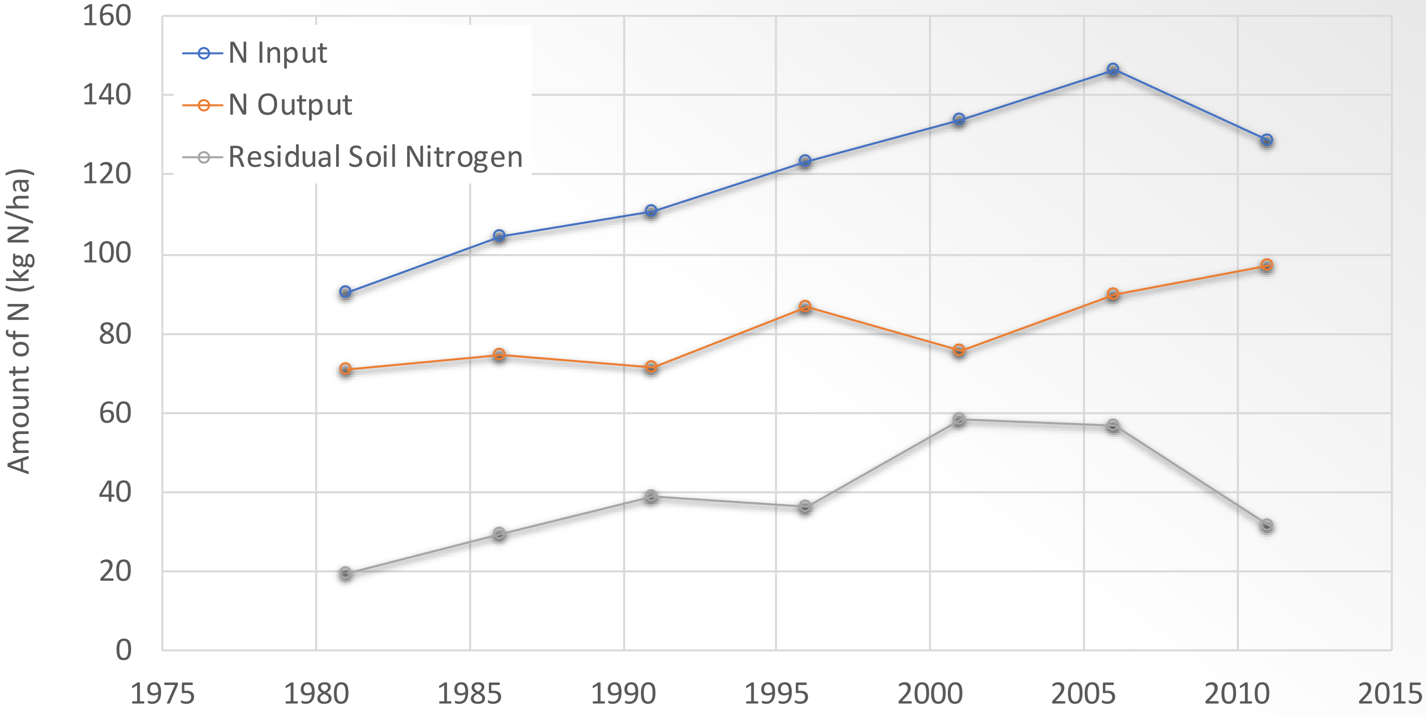
RSN for PEI



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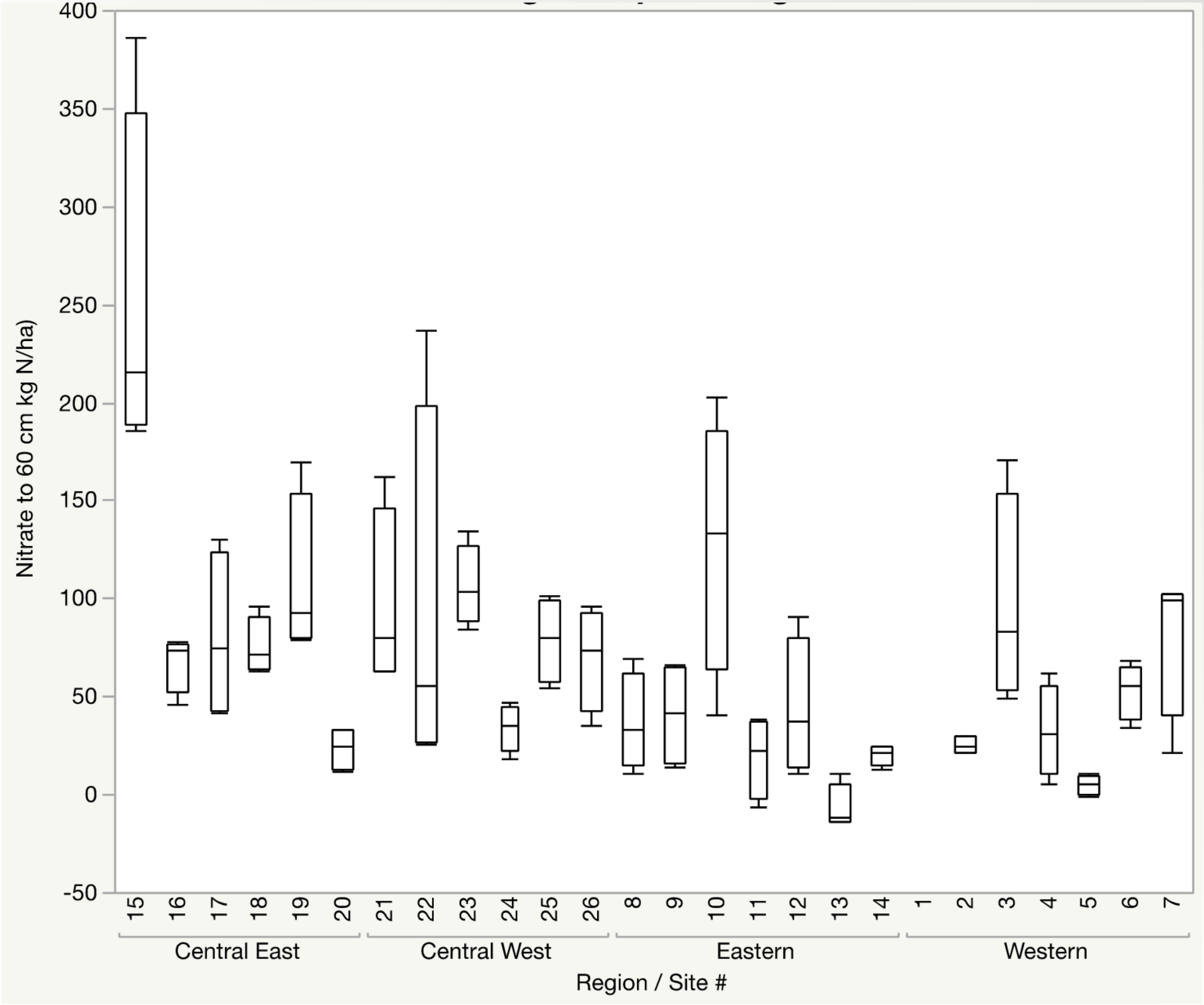
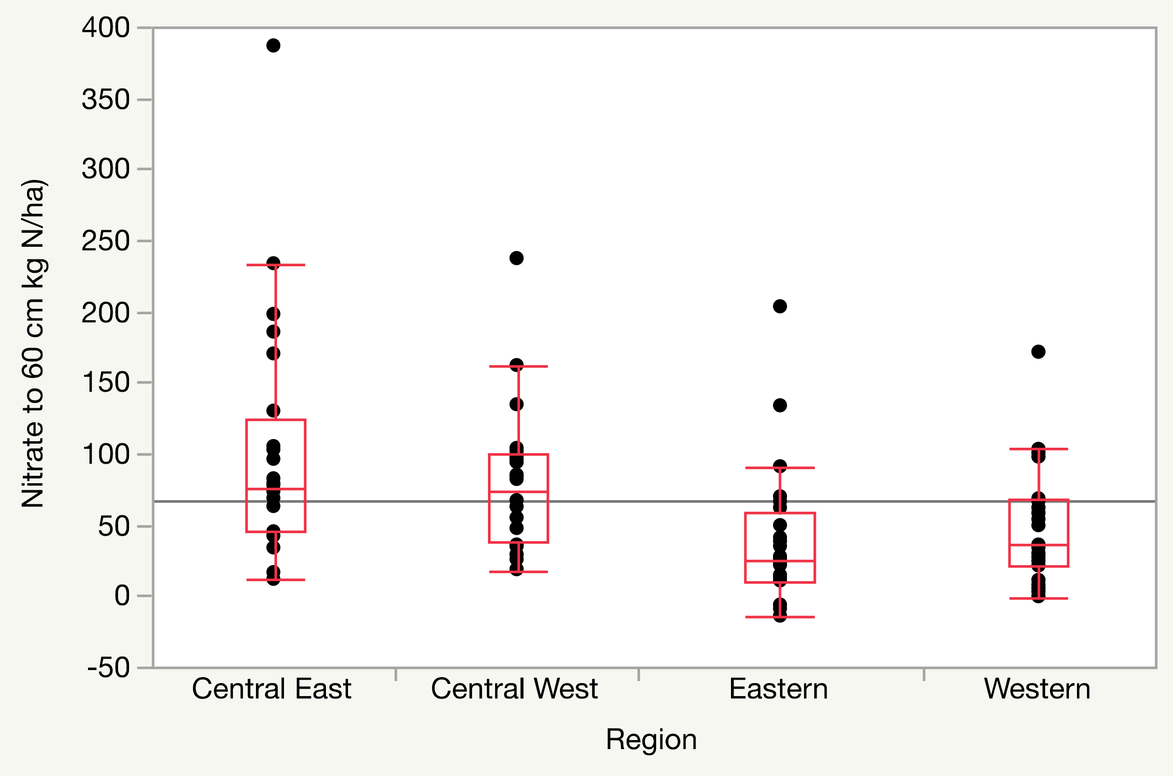
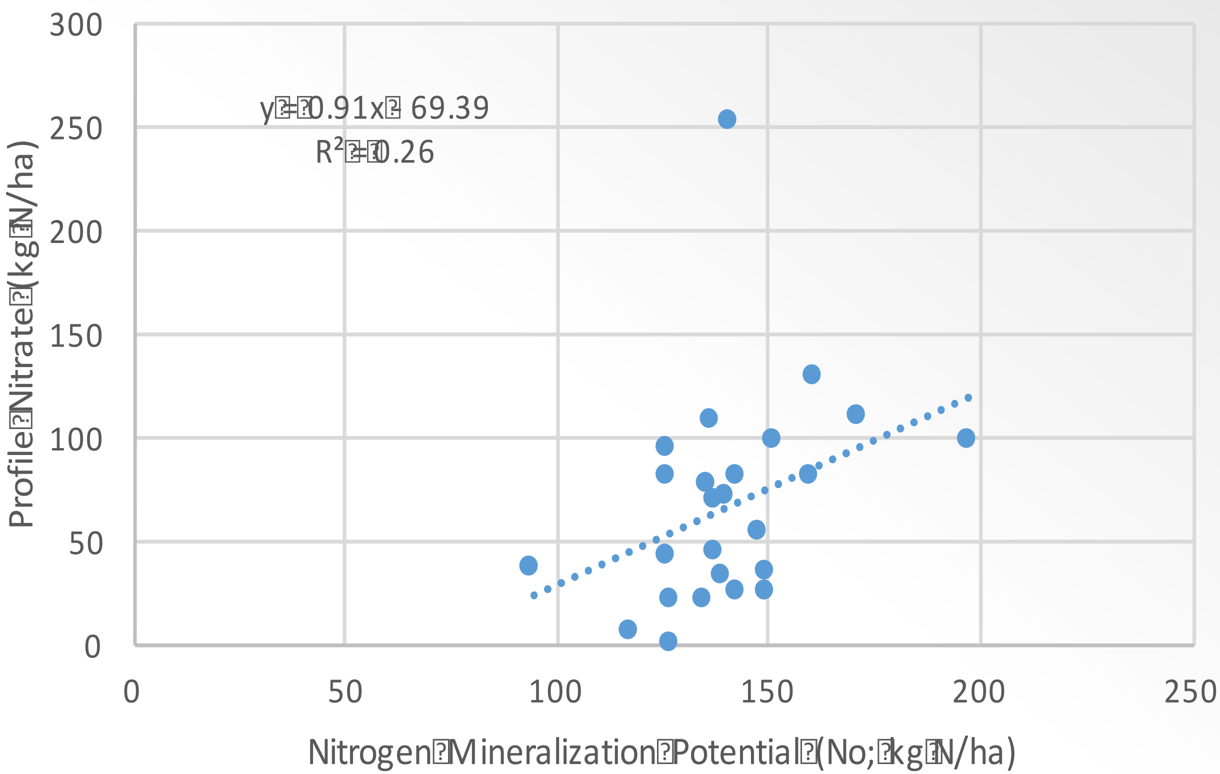


Nitrate to 60 cm kg N/ha)
400
350
300
250
200
150
100
50
0
-50
15
16
17
18
19
20
21
22
23
24
25
26
8
9
10
11
12
13
14
1
2
3
4
5
6
7
Central East
Central West
Eastern
Western
Region / Site #

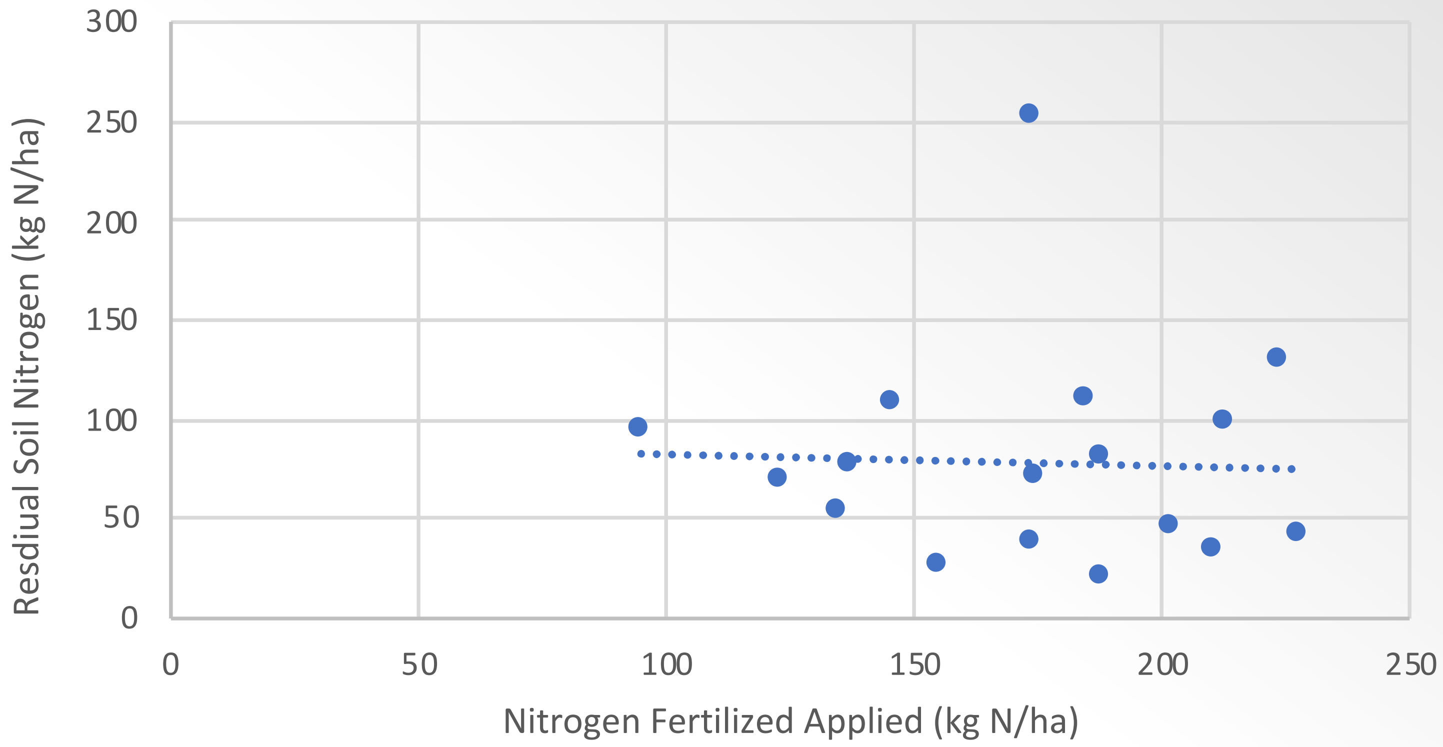


400
350
300
250
200
150
100
50
0
-50
Nitrate to 60 cm kg N/ha)
Central East
Central West
Eastern
Western
Region

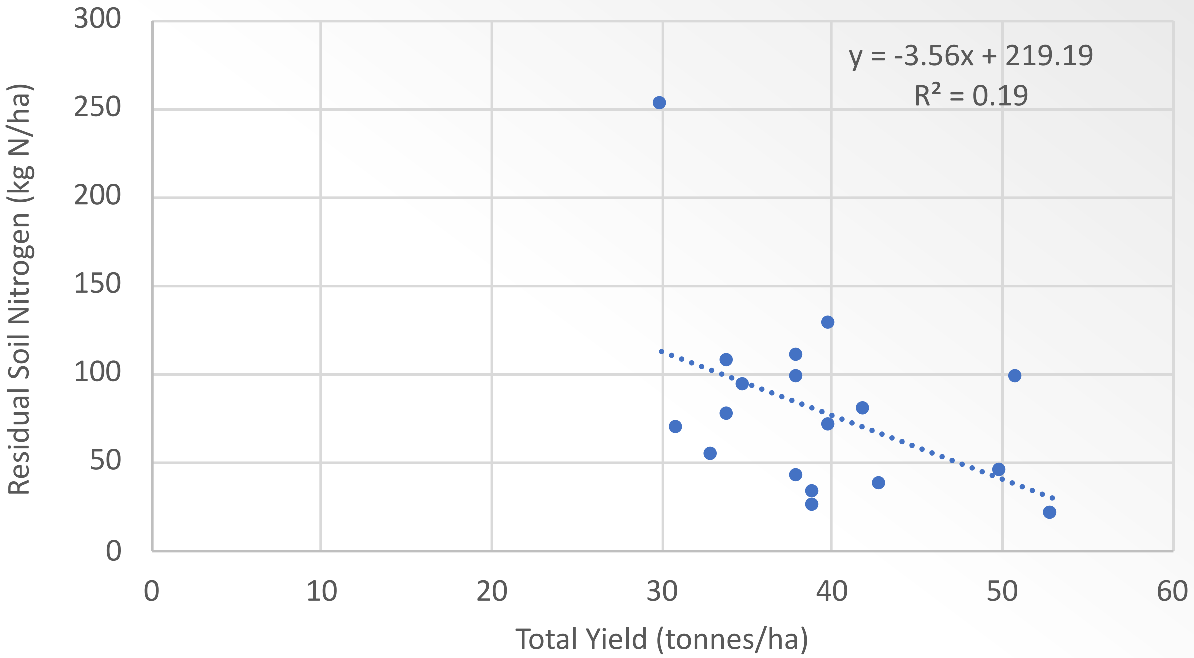
Profile nitrate and N mineralization potential



RSN not a function of N application…



RSN is inversely related to total yield



Split application of N, either through delayed application or use of slow-release products

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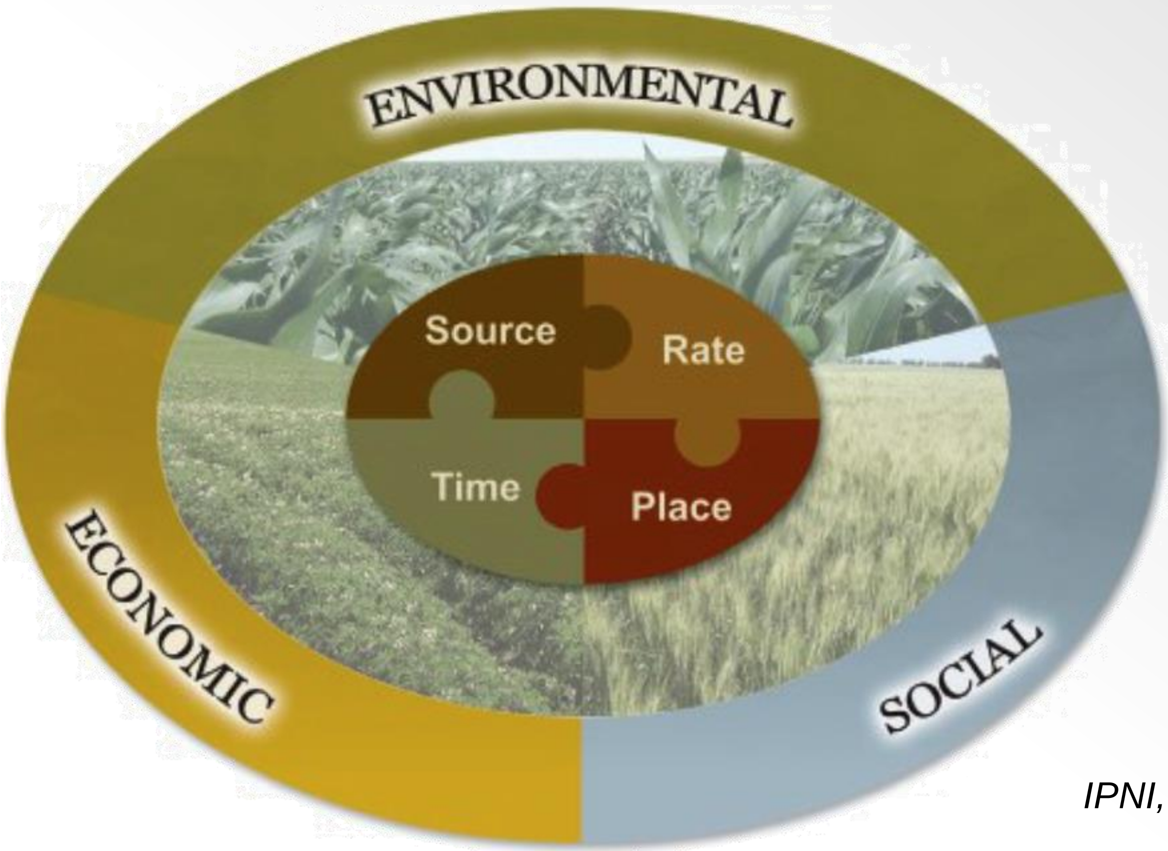
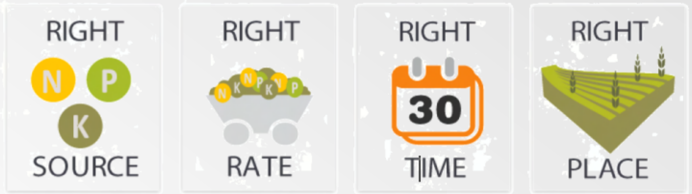
To improve nutrient management the fertilizer industry has developed the framework of 4R management



IPNI, 2015

4R Frame work builds on science and offers practical solutions

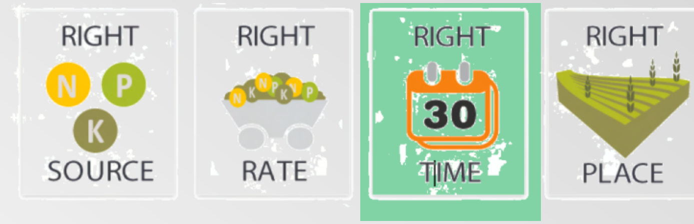


	The Four Rights (4Rs)			
	Source	**Rate**	**Time**	**Place**
Examples of Key Scientific Principles	◆ Ensure balanced supply of nutrients ◆ Suit soil properties	◆ Assess nutrient supply from all sources ◆ Assess plant demand	◆ Assess dynamics of crop uptake and soil supply ◆ Determine timing of loss risk	◆ Recognize crop rooting patterns ◆ Manage spatial variability
Examples of Practical Choices	◆ Commercial fertilizer ◆ Livestock manure ◆ Compost ◆ Crop residue	◆ Test soils for nutrients ◆ Calculate economics ◆ Balance crop removal	◆ Pre-plant ◆ At planting ◆ At flowering ◆ At fruiting	◆ Broadcast ◆ Band/drill/inject ◆ Variable-rate application

IPNI, 2015

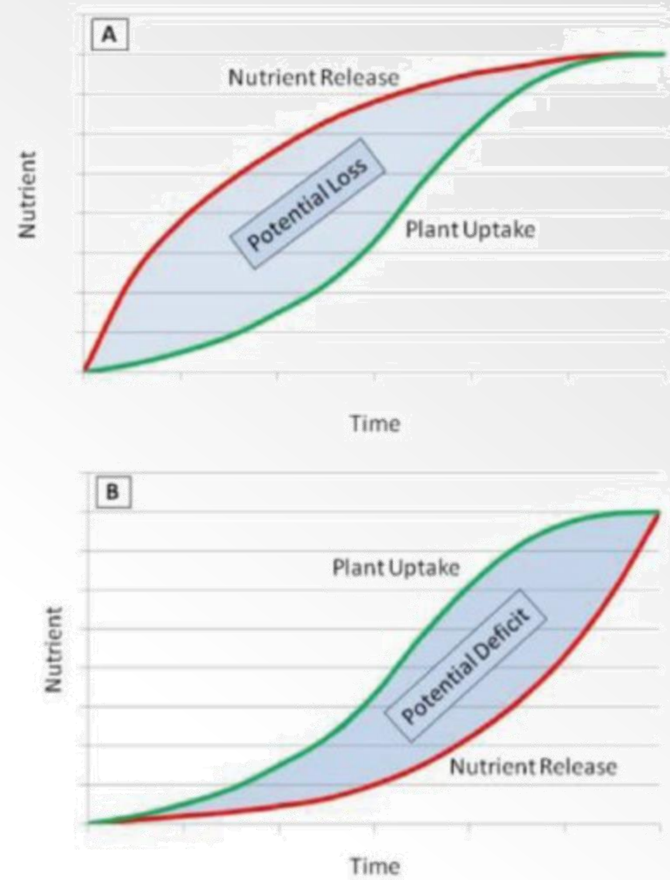
Right Source

- Balanced supply of nutrients and recognize synergies
- Use of sources that are (or will become) plant available
- Ammonium (NH_4^+) based sources are less likely to be lost than nitrate (NO_3^-)
- Use of enhanced efficiency fertilizer products
  - Urease and nitrification inhibitors
  - Coated N sources
- Account for organic N sources – legumes, animal manures, biosolids, composts

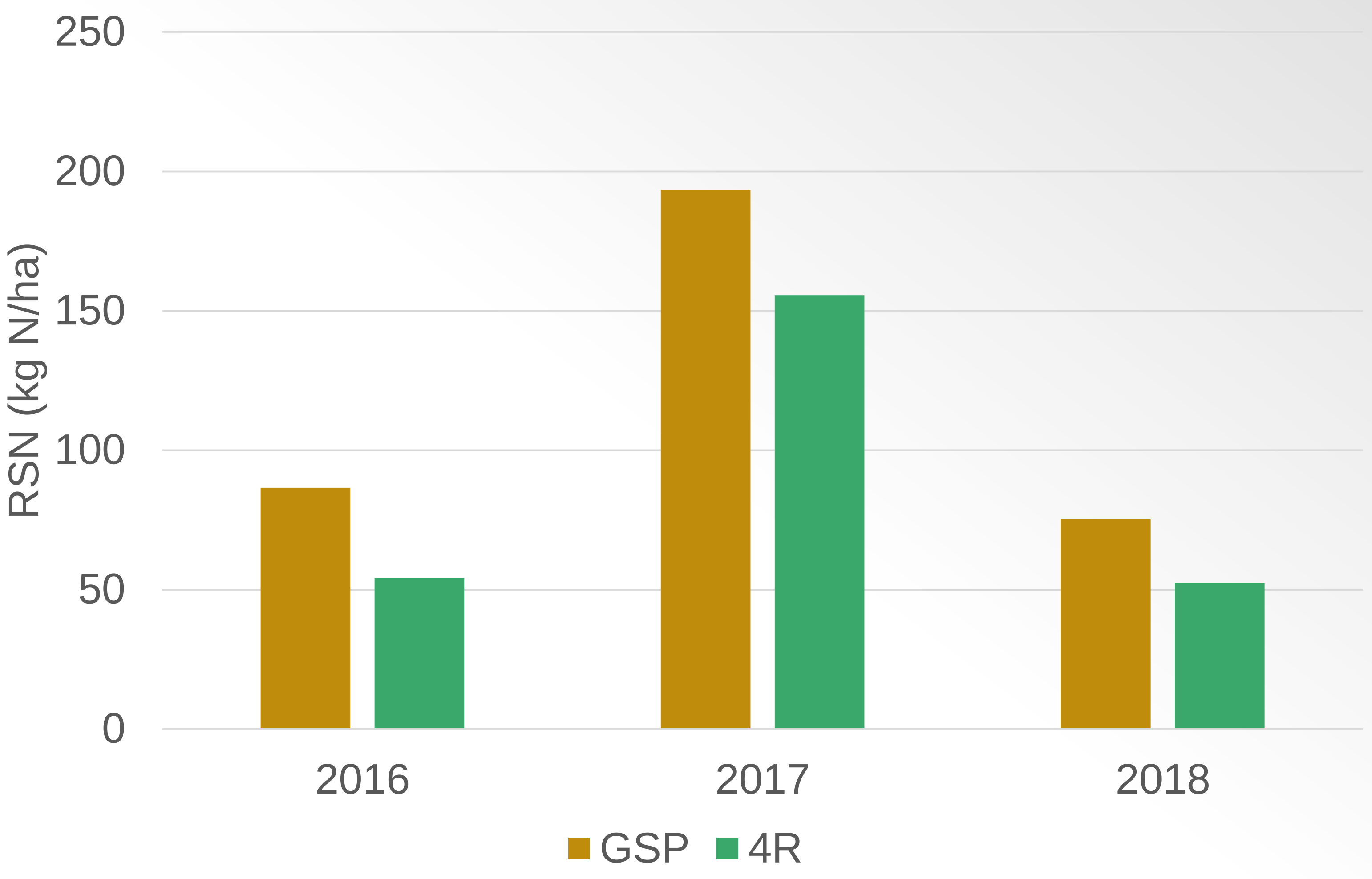


Right Time

- Attempt to synchronize N availability with plant N demand
- Applying all at or before planting increases risk of N loss
- Can improve synchrony of N supply by
  - Delaying nitrification – NH_4^+ less likely to be lost than NO_3^-
    - Using urease or nitrification inhibitors
    - Banding of N fertilizer to inhibit nitrification
    - Coated products
    - Application of N to cold soils delays nitrification
  - Split applications of N
    - Side-dress applications
    - Foliar applications & fertigation



Can 4R management reduce Residual Soil Nitrogen?



Can the use of in-season foliar urea increase the efficiency of N use and reduce nitrous oxide emissions and nitrate leaching in potato production in Atlantic Canada?

- There was no N response to N fertilizer applications greater that 120 kg N/ha
- The addition of 60 kg N/ha at planting, followed by 30 kg N/ha as foliar resulted in yields that were not difference that 180 kg N/ha.

Constructing a Fertilizer N Recommendation

1. Calculate N Requirement
2. Credit for manure ammonium
3. Credit for manure organic N
4. Credit for previous crop
5. Credit for soil organic matter
6. Calculate fertilizer N recommendation
7. Apply 4R principles
   - We have calculated the right rate
   - What product should we use?
     - If we are using a enhanced efficiency product the rate should be adjusted
   - When should it be applied?
   - Where should it be placed?

Nitrogen Management for Potatoes: General Fertilizer Recommendations

NBSCIA AASCNB · PEISCIA · Prince Edward Island

GHG Taking Charge Team Factsheet

Why do we need good nitrogen management?

Sound nitrogen management for potatoes makes good economic sense. Optimal nitrogen fertilization is essential for achieving commercial tuber yield and size requirements and results in maximum economic return. Excessive nitrogen inputs can reduce tuber specific gravity and can delay maturity, making vines difficult to kill.

Good nitrogen management also makes good environmental sense. Excess fertilizer nitrogen application increases environmental losses of nitrogen, including nitrate leaching to groundwater and emissions of nitrous oxide, a greenhouse gas. Good nitrogen management represents an effective and practical means for producers to reduce greenhouse gas emissions.

Optimizing nitrogen management for potatoes

Our goal in optimizing crop nitrogen management is to match the nitrogen supply to the crop nitrogen demand. The amount of nitrogen required by the crop is determined by the level of crop growth – the greater the growth, the higher the crop demand for nitrogen. Crop growth is influenced by management practices such as variety selection and planting date, and also by soil and climatic conditions.

The nitrogen supply for a potato crop comes from fertilizer, but also from manure and mineralization. Mineralization is the release of plant available nitrogen from soil organic matter and crop residues as a result of soil microbial activity. The optimal fertilizer nitrogen rate for a potato crop varies from field-to-field and from year-to-year due to variation in both crop nitrogen demand and soil nitrogen supply.

General nitrogen recommendations for potatoes

This factsheet provides general fertilizer nitrogen recommendations for potatoes. These recommendations require a soil test for organic matter content and a manure or compost analysis. If no manure or compost analysis is available, typical values for different types of manure or compost can be used.

How much fertilizer nitrogen to apply?

The general recommendation for fertilizer nitrogen rate (F_N) in kg N/ha is estimated by:

$$F_N = R - M_{AMM} - M_{ORG} - C - S$$

where R is the crop N requirement based on potato variety and planting date, M_{AMM} is a credit for ammonium in manure or compost, M_{ORG} is a credit for organic nitrogen in manure or compost, C is a credit for the crop grown in the previous year, and S is a credit based on soil organic matter content.

This factsheet provides a series of six steps to calculate the fertilizer nitrogen recommendation using the General Nitrogen Recommendation Worksheet (page 3). Complete Table 2 to calculate the information you need from your manure or compost analysis before you begin. The worksheet considers manure applied in the spring before planting, and manure applied in the previous fall. Complete steps 2 and 3 for each manure or compost application.

Cautionary note: According to CHC On-Farm Food Safety Guidelines, the time between application of liquid or solid manure and potato harvest should be a minimum of four months.

Step 1: Calculate crop N requirement (R)

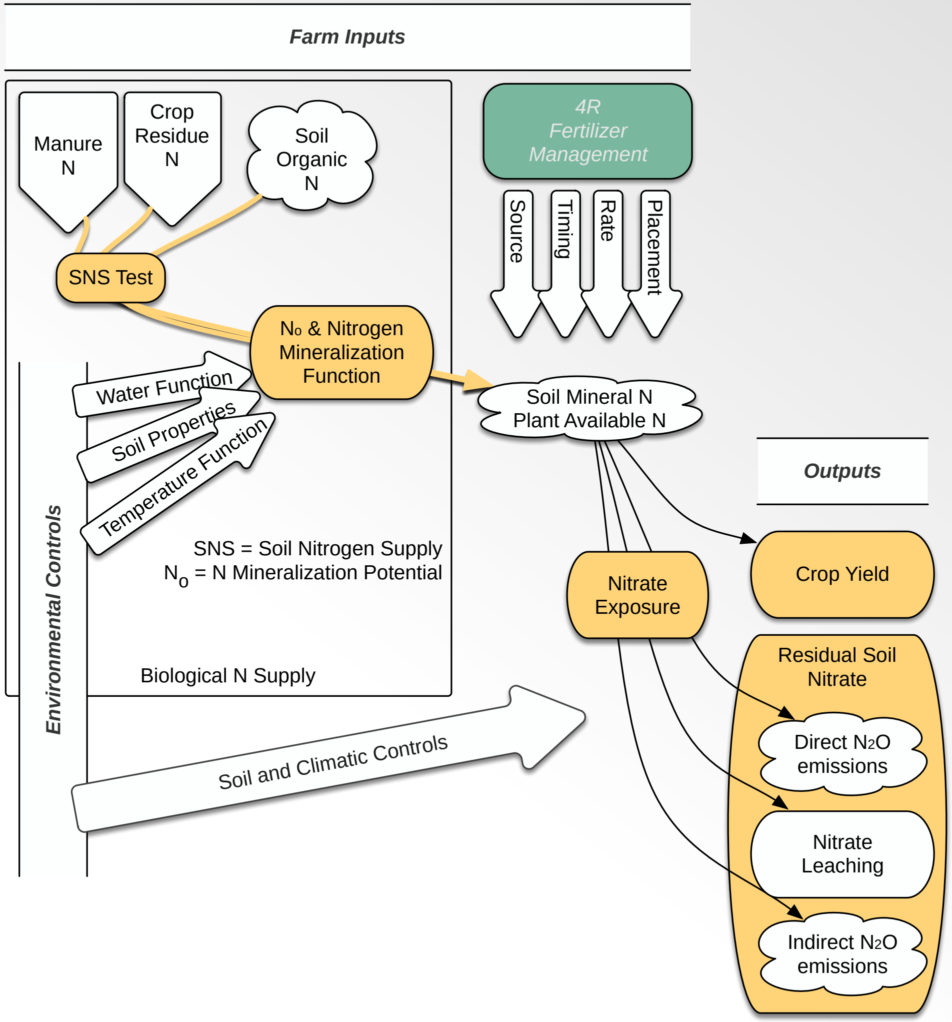
Choose the base value for calculating crop nitrogen requirement from Table 1. These values represent our best guess as to the maximum fertilizer N application rate which may be required for these varieties. The base value is the same for irrigated and non-irrigated crops.

A shorter crop growth period results in a lower crop demand for N. The base value is decreased by 10% for seed crops or for crops that will be harvested early. The base value is also decreased for planting dates after May 25 by 11 kg N/ha (10 lb N/ac) for each week that planting is delayed.

Using Carbon to increase N use efficiency in Atlantic Canada

Need tools to:

- measure soil N supply (SNS),
- predict climate impacts on N mineralization,
- measure potential for N losses
  - Nitrate exposure
  - Residual soil nitrogen
- Recognize and value increased NUE



Carbon Farming

Can we manage our agricultural landscapes so they can efficiently deliver food as well as ecological services?


Willow Project
Demonstration an agroforestry an best management practice that can reduce nutrient impacts and mitigate greenhouse gas emissions while maintaining overall crop production on farms.
EAST PRINCE AGRI-ENVIRONMENT ASSOCIATION INC
SOURIS AND AREA BRANCH PEI WILDLIFE FEDERATION
KENSINGTON NORTH WATERSHEDS ASSOCIATION

Reducing Nutrient Impacts

Planting Willow Riparian Buffers on Agriculture Land

Demonstrating an Agroforestry Best Management Practice that can reduce Nutrient Impacts and mitigate Greenhouse Gas Emissions (GHG) while maintaining overall crop production on farms

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

East Prince Agri-Environment Association Inc

Souris and Area Branch PEI Wildlife Federation

Kensington North Watersheds Association

Dalhousie University
Faculty of Agriculture

Project Objectives

The specific objectives are to use science-based data and operational experience from pilot willow riparian buffer systems on multiple sites in Prince Edward Island to determine:

1. Above and below ground carbon storage;
2. Biomass production potential of willow riparian buffers relative to conventional short rotation willow systems;
3. Economic cost-benefits of willow riparian buffer establishment and operation;
4. Opportunities for wood chip utilization as an alternative energy source or soil organic matter amendment;
5. Operational constraints and efficiencies of implementing willow riparian buffer systems within the PEI riparian buffer regulatory framework.


9 8 7 6 5 4 3 2 1
4
S. viminalis Coppiced
S. viminalis coppiced plots at 26.0 meters long X .75 m spacing (35 plants/ro
@ 4 rows = 140 plants/plot
S. viminalis
S. viminalis not coppiced plots 26.0 meters long at .75m spacing (35 plants/r
@ 4 rows = 140 plants/plot
Total # of Willows
= 840 plants
Grass
8 meters X 10 meters
Oyster Cove Rd
104
© 2017 Google
Image © 2017 DigitalGlobe
Google Eart
2012
Grass
26 m
S. viminalis
S. viminalis
S. viminalis
S. viminalis
Grass
8 m
Grass
Grass
26 m
S. viminalis Coppiced
S. viminalis Coppiced
S. viminalis Coppiced
S. viminalis Coppiced
Grass
26 m
S. viminalis
S. viminalis
S. viminalis
S. viminalis
Plot 6
Grass
8 m
Grass
Plot 5
Grass
26 m
S. viminalis Coppiced
S. viminalis Coppiced
S. viminalis Coppiced
S. viminalis Coppiced
Plot 4
Grass
8 m
Waterway
Grass
26 m
S. viminalis
S. viminalis
S. viminalis
S. viminalis
Plot 3
Grass
8 m
Grass
Plot 2
Grass
26 m
S. viminalis Coppiced
S. viminalis Coppiced
S. viminalis Coppiced
S. viminalis Coppiced
Plot 1

Grass	Grass	Grass	Grass	Grass	Grass	Grass	Gra
16 m	10 m	16 m	10 m	16 m	16 m	16 m	10
S. viminalis	Grass	S. viminalis Coppiced	Grass	S. viminalis	S. viminalis Coppiced	S. viminalis	Gra
S. viminalis		S. viminalis Coppiced		S. viminalis	S. viminalis Coppiced	S. viminalis	
S. viminalis		S. viminalis Coppiced		S. viminalis	S. viminalis Coppiced	S. viminalis	
S. viminalis		S. viminalis Coppiced		S. viminalis	S. viminalis Coppiced	S. viminalis	
Grass		Grass		Grass	Grass	Grass	
	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plo

AAFC – Yefang Jiang - Improving crop production resiliency using innovative BMPs

BMP 1 – Addition of willow wood chips as a soil amendment
BMP 2 – Planting of buckwheat in year prior to potato

- ❑ Reduce N leaching and greenhouse gas emissions
- ❑ Build soil organic matter – carbon storage
- ❑ Soil Health – microbial diversity
- ❑ Control soil-borne disease

This research has been supported by...

Canadian Water Network

Fertilizer Canada

Prince Edward Island Canada

Prince Edward Island PEI Potatoes

East Prince Agri-Environment Association Inc

Souris and Area Branch PEI Wildlife Federation

Kensington North Watersheds Association

NSERC CRSNG

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