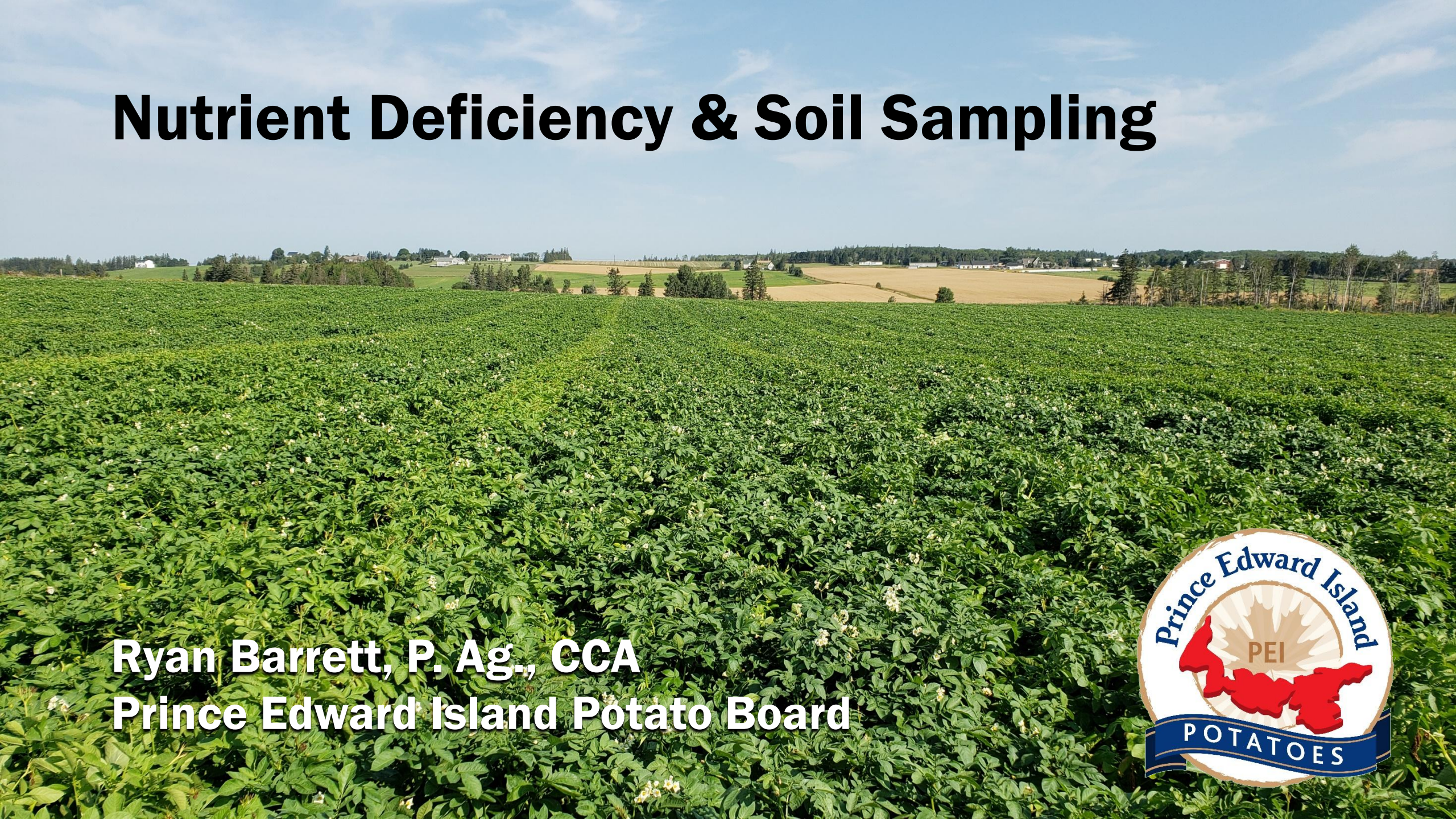
Nutrient Deficiency & Soil Sampling



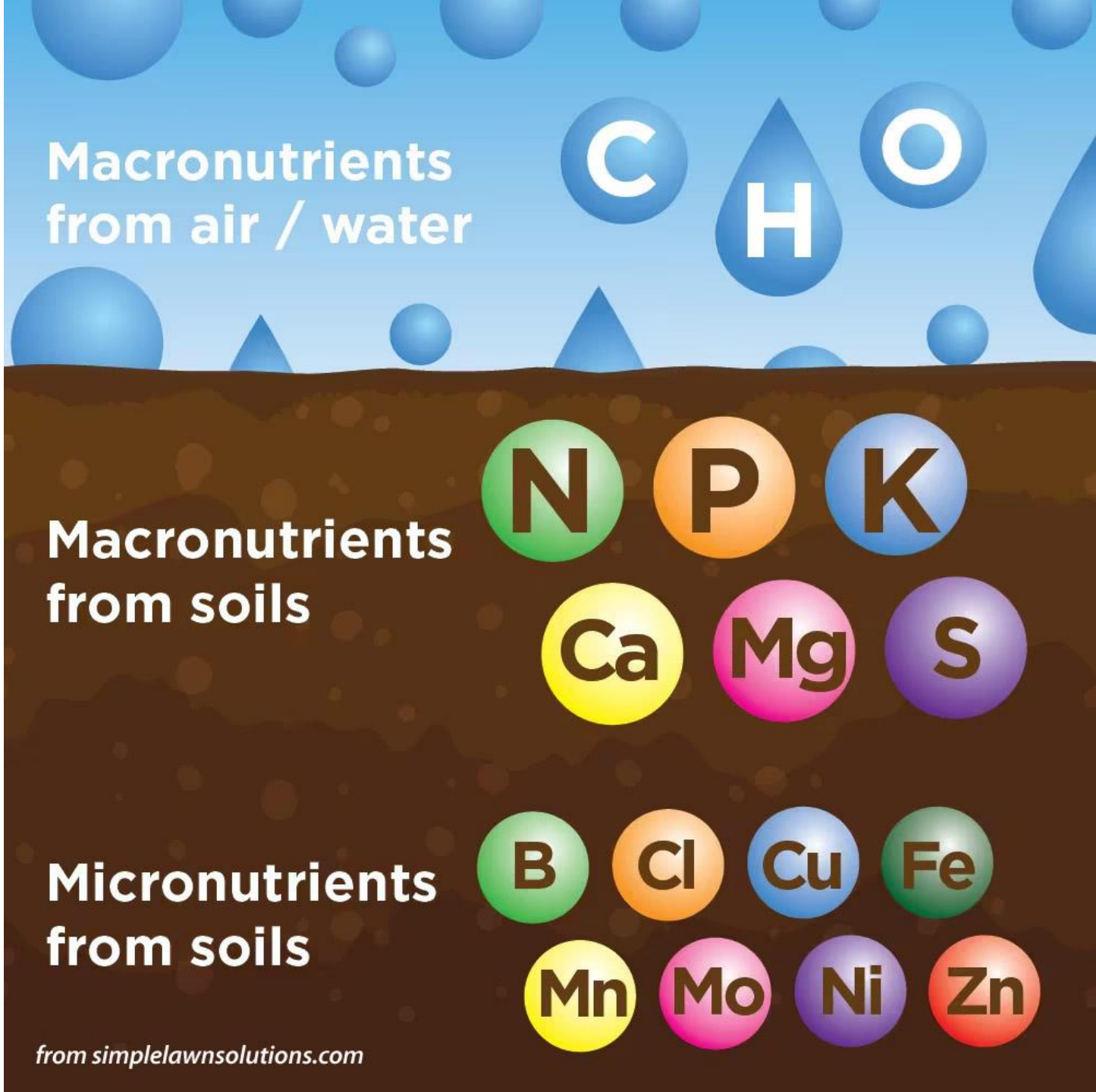
Ryan Barrett, P. Ag., CCA
Prince Edward Island Potato Board

Nutrient Deficiencies:

- We don’t frequently see many nutrient deficiencies in potato fields.
- Potatoes are a high value crop, so producers will rarely skimp on fertility!
- Most likely to see deficiencies in micronutrients during dry weather (reduced water uptake) or in new fields (low pH) that haven’t been in potatoes.

Macronutrients Needed for Plants

- Nitrogen (N)
- Phosphorus (P)
- Potassium (K)
- Sulfur (S)
- Magnesium (Mg)
- Calcium (Ca)



Nitrogen: What does it do?

- Major component of chlorophyll
- Essential component in amino acids, which form proteins
- Component of energy-transfer compounds ATP/ADP
- Component of DNA and RNA, the building blocks of life

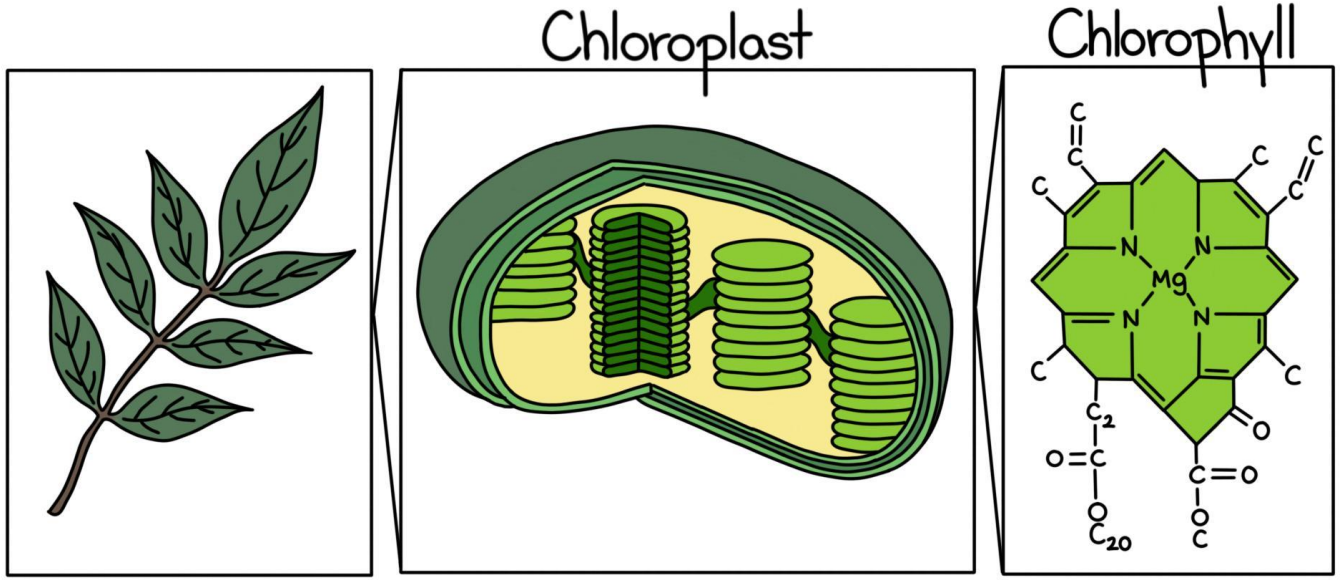
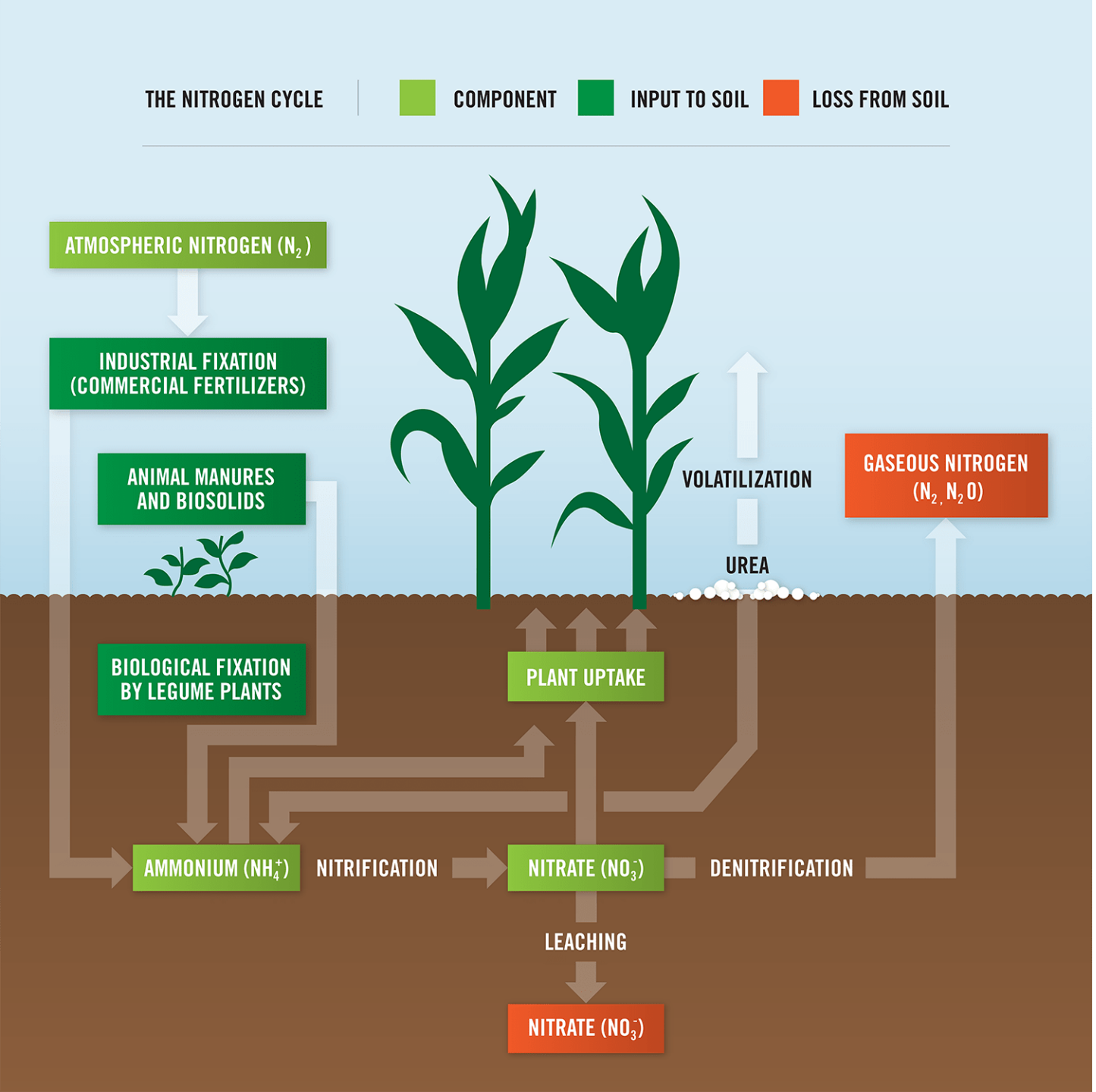


Image from futureengineers.org



Nitrogen

- Nitrogen is possibly the most complex nutrient to understand in plant nutrition, as it comes in many forms, and is the easiest nutrient to be lost from the system
- Too much and too little can both be a problem!

Image: https://kochagronomicservices.com/

What are the N fertilizer options?

- Urea (46-0-0) with or without inhibitor (Agrotain)
- AXAN or CAN (27-0-0) – ammonium nitrate stabilized by Ca
- Super U (46-0-0) – urea with dual inhibitors
- ESN/PurYield (45-0-0) urea with coating
- Ammonium Sulphate (21-0-0-24 S)
- Amidas (40-0-0-5.5S) urea/ammonium sulphate
- Calcium Nitrate Tropicote (15.5-0-0-19% Ca)
- Nitrabor (15.4-0-0 with 18% Ca and 0.3% B)
- Foliar N products (Last N (25%), Length N (28%), etc)

Nitrogen Deficiency Symptoms

- Chlorosis (lighter shade of green)
- Stunted growth
- Most evident on older leaves
- Look for "lines" in the field that could be evidence of under-application of fertilizer
- Wet spots – nitrate leaching

Images from www.yara.co.uk

Sulfur: What does it do?

- Formation of 2 essential amino acids, which make proteins
- Necessary for chlorophyll formation
- Nodulation in legumes, glucosinalates in brassicas (mustard)
- Develop/activate certain enzymes/vitamins
- Highly linked with N.
- Less mobile in plants than N
- Deficiency more likely on sandy, low OM soil

What are the S fertilizer options?

- SOP (0-0-50 18S)
- Polysulphate (0-0-14 with 18S 6Mg 17Ca)
- K-Mag (0-0-22 with 11Mg 22S
- Ammonium Sulphate (21-0-0-24 S)
- Amidas (40-0-0-5.5S) urea/ammonium sulphate
- Gypsum (18.6% S, 23.3% Ca)
- Manure!

Sulfur Deficiency

- Can be confused with N deficiency
- Leaves are smaller than normal
- Symptoms often appear first on younger leaves.
- Can be upward cupping on leaves

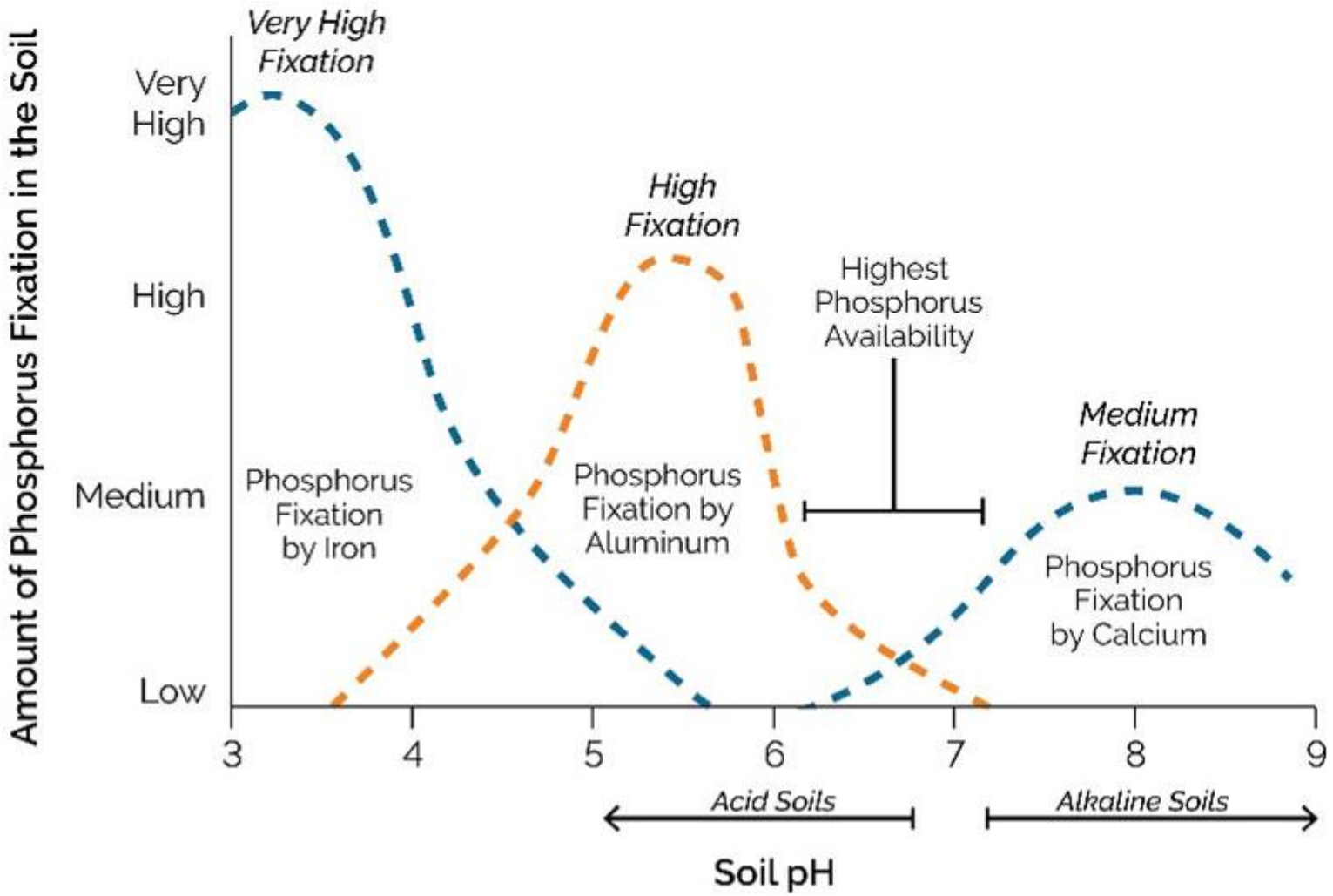
Images from www.yara.co.uk, www.powerag.com

Phosphorus: What does it do?

- Key component in DNA and RNA, building blocks of life
- Key component of ATP and ADP (energy transfer system)
- Stimulates root development
- Increased stalk/stem strength
- Needed in smaller amount by the plant, but not always plant available in soil
- Mobile in plants

DAP
(Diammonium phosphate)

Phosphorus: Finding the right rate



- Historically, we went higher with applied P rates because most fields were at pH < 6.0
- P is much more available at pH > 6.0
- Seeing soil tests now with >500 ppm P_2O_5. Building up in soil due to over-application.

What are the P fertilizer options?

- MAP (11-52-0)
- DAP (18-46-0)
- TSP (0-45-0 with 15% Ca)
- ManZinPhos Max in-furrow (6-20-5)
- TruPhos Advanced in-furrow (5-18-5)
- HydroPhos foliar (0-29-5)
- Alpine G24 in-furrow (6-24-6)

Phosphorus Deficiency

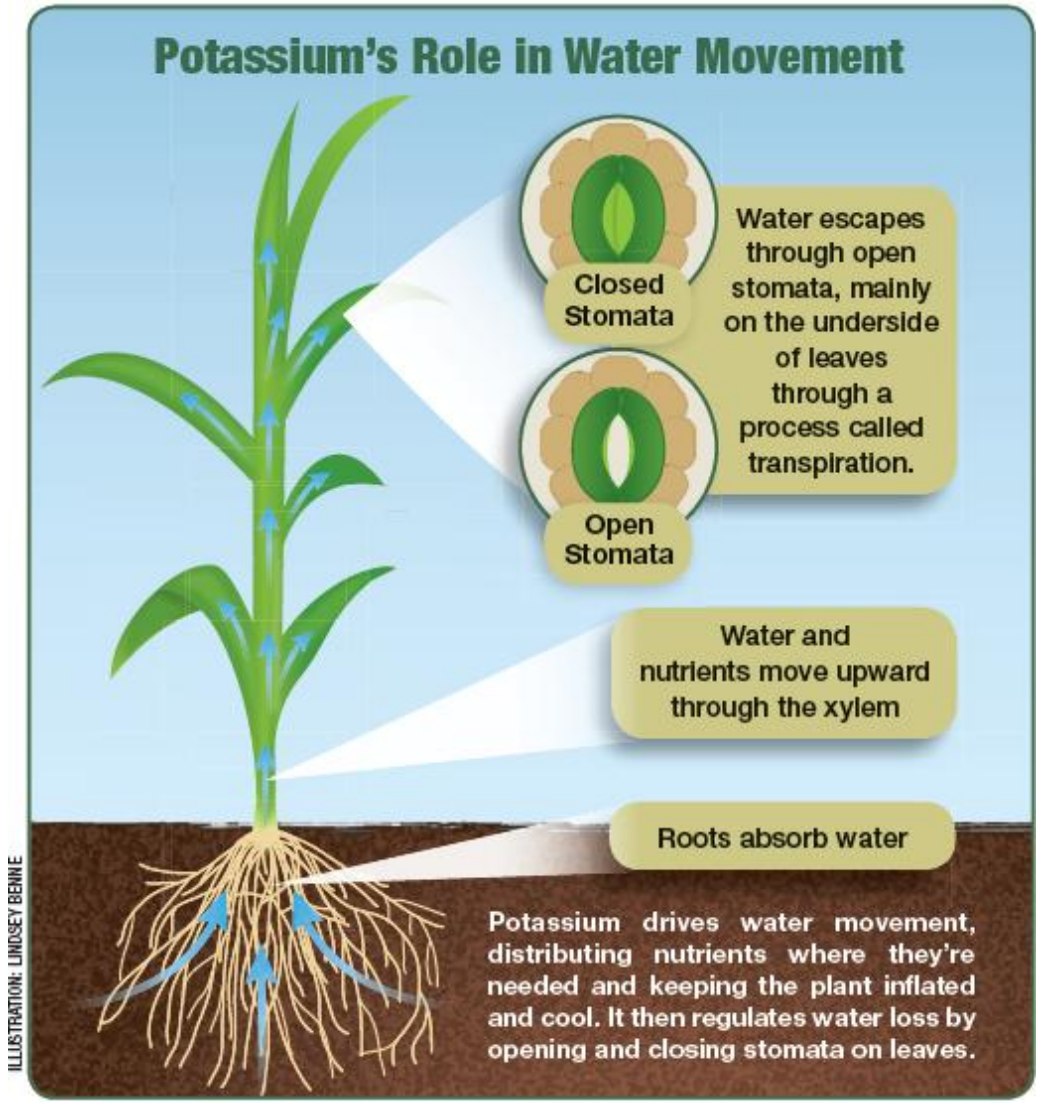
- Early growth stages – purpling of leaves/stems
- Later growth stages – stunted growth, dark-green or reddish/purple foliage, reduced root and tuber development
- Upward cupping of leaf margins

Images from nbsystems.co.za, PEI Potato Board

Potassium: What does it do?

- Potassium (K) is essential for nearly all processes needed to sustain plant growth and reproduction
- Helps fortify plants, making them more resistant to pests, diseases, drought, etc.
- Highly correlated with “quality” parameters
- Key in structural components like cellulose for building cell walls.
- Key in starch synthesis and deposition
- Mobile in plants

Image: AgWeb



What are the K fertilizer options?

- KCl/MOP (0-0-60)
- Potassium sulphate/SOP (0-0-50 18S)
- Polysulphate (0-0-14 with 18S 6Mg 17Ca)
- K-Mag (0-0-22 with 11Mg 22S
- AgriPotash liquid (0-5-32)
- K Max liquid (0-0-24)
- Manure!

Image: Nutrien eKonomics

Potassium Deficiency

- Edges/tips of lower leaves first affected.
- Curling of leaf margins, bluish tinge on leaflets
- Stunted growth
- May be confused for some fungal diseases

Images: Science Photo Library, www.protassiumplus.com

Magnesium: What does it do?

- Every molecule of chlorophyll has an atom of Mg
- Carrier of P, key for root development
- Associated with K. Excess K can impact Mg uptake
- Mobile in the plant

What are the Mg fertilizer options?

- Polysulphate (0-0-14 with 18S 6Mg 17Ca)
- K-Mag (0-0-22 with 11Mg 22S
- Lime (High Mg, Dolomitic)
- Foliar Mg products

Magnesium Deficiency

- Deficiencies show first in the lower leaves
- Reddish pigments at leaf margins, Necrotic areas on leaves
- Stunted growth Interveinal chlorosis
- Can be confused for *Alternaria* symptoms

Images: www.ephytia.inra.fr

Calcium: What does it do?

- Essential structural component in building cell walls.
  - Key for healthy plants
  - Associated with tubers that are more resistant to bruise and soft-rot
- Regulates many growth and development processes
- Removal rate is highest for forage crops. Removal in grains/potatoes is pretty low.
- PEI soils are naturally low in Ca.
- Immobile in plants

What are the Ca fertilizer options?

- Polysulphate (0-0-14 with 18S 6Mg 17Ca)
- Lime (calcitic) – slow breakdown and availability
- AXAN/CAN
- Calcium Nitrate/Nitrabor
- Gypsum

Calcium Deficiency

- Black on sprouts (deficiency in tuber)
- Young shoots are poorly developed
- Young leaf tips look burnt
- Symptoms mostly on apical parts of leaves, stems, sprouts (immobile)
- Internal necrosis of tubers

Images: www.ephytia.inra.fr

Micronutrients:

- **Pay attention to your soil test results**. If soil test amounts are adequate, need for much supplementary micros will be minor.
- **Boron (B) and Zinc (Zn) are notoriously lacking in PEI soils**
- **Use of coatings to add B and Zn** is an excellent way to ensure that these nutrients are available throughout the fertilizer band, not just one particle here and there
- B, Zn, Mn are often used as foliar products. Micronutrients are less able to be taken up through the above ground plant than through the roots.

Zinc

- Immobile

- Interveinal chlorosis/necrosis in new leaves
- Whitish spots with brown necrotic tissue
- Striping/banding
- Leaf/plant stunting
- Upward cupping of leaves
- Laves can fold inward (“fern leaf”)

Images from www.yara.co.uk

Copper

- Immobile

- Leaf roll, similar to PLRV symptoms, especially young leaves
- Permanent wilting of plants
- Not frequently seen in potatoes (or in PEI)

Images from www.yara.co.uk

Nutrient Deficiencies: Tips

- Look for strips/regions of the field that show similar symptoms
- Take samples to rule out virus/fungal diseases
- Petiole samples can be used to identify nutrient levels and possible deficiencies.
- Some deficiencies can be corrected through in-season application (N, K, Mg, B, Zn). Others may be harder to reverse later in the season (P, Ca)

Petiole Sampling

- Clean hands, clean petioles!
- Collect 30-40 petioles (4th leaf from top of plant)
- Remove leaflets from petiole
- Bundle and place in paper bag
- Keep cool and dry until submitting to lab.
- Submit to lab ASAP

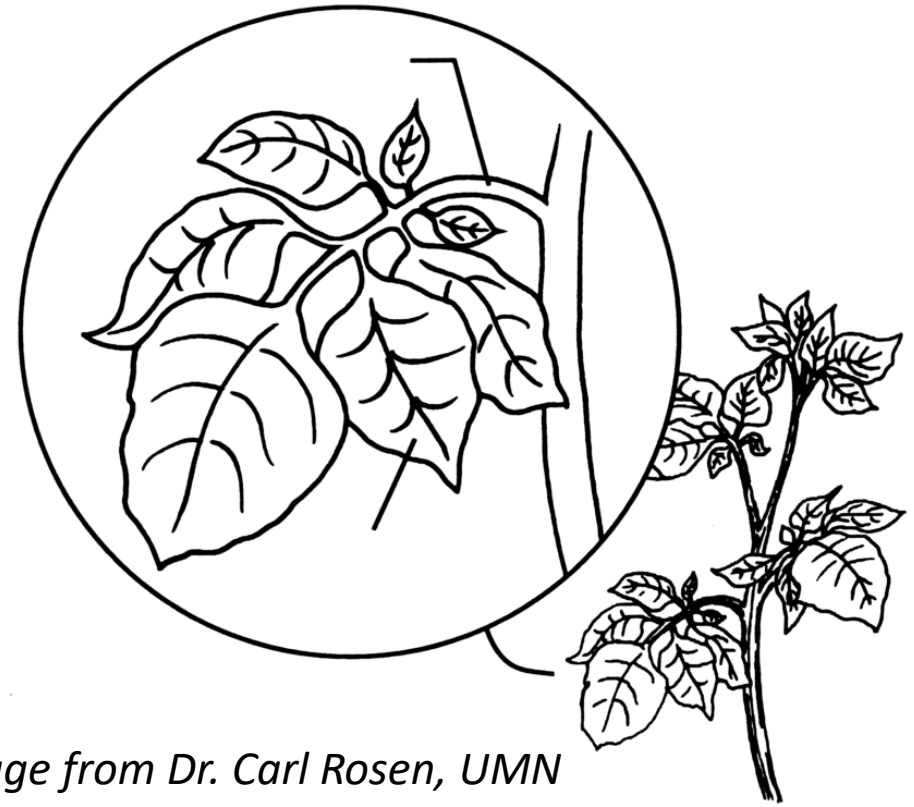


Image from Dr. Carl Rosen, UMN

Image from www.yara.co.uk

English

Plant Tissue Report

02-Aug-2024

PEI Analytical Laboratories
Department of Agriculture
23 Innovation Way
PO Box 2000, Charlottetwon, PE, C1A 7N8
Fax: (902) 368-6299
Tel: (902) 620-3300

Client:

Accession No:

Samples Received: 24-Jul-2024

Samples Reported: 01-Aug-2024

ANALYSIS PERFORMED*	**Lab #:** **Sample ID** **Type:** Potato	**Lab #:** **Sample ID** **Type:** Potato	**Lab #:** **Sample ID** **Type:**	**Lab #:** **Sample ID** **Type:**
Nitrate-N %	1.99	1.59		
Phosphorus %	0.34	0.41		
Potassium %	10.68	10.36		
Calcium %	0.57	0.61		
Magnesium %	0.24	0.21		
Boron ppm	28.54	28.57		
Copper ppm	7.03	6.92		
Zinc ppm	30.84	34.61		

***Results reported on a dry matter basis**

Soil Sampling: Tips

- Consistent soil depth each year
- Probe or dutch auger (keep consistent)
- Ensure you are taking clean equipment into the field. Clean between fields.
- Label bags before you head to the field!
- Avoid sampling in very dry or very wet soil conditions
- Keep samples cool before submitting

Soil Sampling: Tips

- Grid/Zone Sampling: Take 10-12 cores or 3-4 augers around one point/zone.
- Sampling whole field or region of field: Take 30-40 cores or 12-15 augers from random locations across the field in a zig-zag or random pattern
- Avoid non-representative areas for field scale samples
  - Wet spots/depressions
  - Eroded knolls
  - Where manure piles were!

Soil Analysis Report

23-Nov-2022

PEI Analytical Laboratories
Department of Agriculture & Land
23 Innovation Way
PO Box 2000, Charlottetown, PE, C1A 7N8
Fax: (902) 368-6299
Tel: (902) 620-3300

This is an amended version of the report printed on 11/23/2022
Details of amendment available upon request.

Client:
Accession No:
Samples Reported: 23-Nov-2022
Samples Received: 15-Nov-2022

Sample Information		Soil Test Values and Ratings								
Lab Sample #	Field Number	Organic Matter (%)*	pH*	Phosphate P_2O_5 (ppm)*	Potassium K_2O (ppm)*	Calcium Ca (ppm)*	Magnesium Mg (ppm)*	Boron B (ppm)*	Copper Cu (ppm)*	Salt (mS/cm)
1	#50PFWoodpile	3.0	6.1	383 H+	276 H+	1234 M	98 M	0.4 L	1.7 M+	
2	#51PFRacetrac	3.0	6.1	209 M	156 H	1128 M	114 M	0.5 M	1.0 M	
3	#52 PF Centre	2.9	5.5	260 M+	52 L	754 L	81 M	0.4 L	1.4 M	
4	#9 Arnie Sq	3.0	6.3	274 H	154 H	1139 H+	117 H	0.5 M	2.0 M+	
5	#11Bhnd Pond	3.4	6.4	70 L-	99 M+	1278 M	102 M	0.7 M	0.6 L	

Lab Sample #	Field Number	Zinc Zn (ppm)*	Sulfur S (ppm)*	Manganese Mn (ppm)*	Iron Fe (ppm)*	Sodium Na (ppm)*	Aluminum Al (ppm)*	Lime Index*	Nitrogen N (%)	Nitrate-N NO_3-N (ppm)
1	#50PFWoodpile	1.5 L	39 H+	36 M+	145 H+	38	1514	6.6		
2	#51PFRacetrac	0.9 L-	28 H+	19 M	122 H	29	1515	6.6		
3	#52 PF Centre	1.4 L	18 M+	20 M	120 H	32	1568	6.3		
4	#9 Arnie Sq	1.3 L	14 M+	43 H	113 H	34	1436	6.7		
5	#11Bhnd Pond	0.9 L-	15 M+	29 M	205 H+	38	1229	6.8		

L-: Low L: Low M: Medium M+: Above Medium H: High H+: Very High

To convert HECTARES into ACRES multiply by 2.47				To convert T/HECTARE into T/ACRE mulitply by 0.45			To convert kg/Ha to lbs/acre multiply by 0.9		
Sample Information				Limestone application (T/Ha) to achieve			Recommended Applications (kg/Ha)		
Lab Sample #	Field Number	Field Size (Ha)	Crop to be Grown	pH 5.5	pH 6.0	pH 6.5	Nitrogen N	Phosphate P_2O_5	Potash K_2O
1	#50PFWoodpile	5.3	Corn			3	120		
2	#51PFRacetrac	4.9	Barley			3	40	40	
3	#52 PF Centre	4.7	Corn		3	5	100	45	150
4	#9 Arnie Sq	6.9	Mixed Hay (30 - 60% Legume)				30	15	40
5	#11Bhnd Pond	4.2	Corn : Silage				110	120	75

Lab Sample #	Field Number	% P/Al	Ratio Ca/Mg	Man	Sod	CEC (Meq/100g)	Base Saturation					Total % Base Saturation
							% K	% Mg	% Ca	% H	% Na	
1	#50PFWoodpile	11.05	13:1	0	0	13	4.7	6.5	49.2	36.9	1.3	60.4
2	#51PFRacetrac	6.02	10:1	1	0	12	2.8	8.0	47.6	40.0	1.1	58.4
3	#52 PF Centre	7.24	9:1	0	2	13	0.8	5.2	28.8	64.6	1.1	34.8
4	#9 Arnie Sq	8.33	10:1	0	2	11	3.1	9.1	53.0	32.7	1.4	65.2
5	#11Bhnd Pond	2.49	13:1	0	1	10	2.1	8.5	63.8	24.0	1.6	74.4

The Soil Analysis Report result(s) relate only to the actual submitted and tested sample(s). Dates of analysis are available in Appendix A of this report. Please take a moment to complete our client satisfaction survey at **https://peial.questionpro.ca**

Comments: All fertilizer recommendations are based on a pH of 6.0.
To convert P2O5 to P, divide by 2.29. To convert K2O to K, divide by 1.2.

Copies To:

Approved By:

Laboratory Manager

Methods: SFL_22M - pH*
SFL_23M - Organic Matter*
SFL_24M - Nutrients*
SFL_30M - Nitrogen*

*Accredited Methods & Parameters

Soil Health Testing

- Use spade/shovel or auger
- Mix soil gently, ideally not with tools (just hands)
- Wear gloves
- Need more soil than you would submit for S3 chemical analysis
- Forms available on PEI Analytical Lab website
- Currently free for producers!

Soil Health #: SH240516001-22	**Soil #:** S240516001-4	**Sample ID:** Sky Check 4
Tillage Depth: 7 - 9 inch	**Cropping System:** Root Crops	**Amendments Applied (manure, etc):** ☐ Yes ☒ No
Yield: Average		

Soil Texture:

Sand (%)
Silt (%)
Clay (%) **Soil Texture Class:**

Test	Results	Score (out of 100)	Rating
Organic Matter	2.8 %	46	L+
Active Carbon	415 µg/g	32	L+
Soil Respiration	0.41 mg/g	14	L
Aggregate Stability	49.6 %	55	M
Biological Nitrogen Availability	25.3 mg/kg	55	M
pH	6.9		
Phosphorous Index (P/Al)	8.58 %		
C:N Ratio	11.57		
Total Carbon	1.62 %		
Total Nitrogen	0.14 %		

http://www.princeedwardisland.ca/labservices

Dates of analysis available upon request.
Organic Matter is calculated from Total Carbon.

ND** - CN ratio could not be accurately calculated due to Total Nitrogen or Total Carbon being below detection limit

Helpful resources:

- **PEI Potato Agronomy Site:** www.peipotatoagronomy.com
- **OMAFRA IPM Site:** https://cropipm.omafra.gov.on.ca/en-ca/crops/potatoes
- **OMAFRA Crop Protection Hub:** https://cropprotectionhub.omafra.gov.on.ca/
- **Ephytia (France) – Images of nutrient deficiency:** https://ephytia.inra.fr/en/C/21155/Potato-Deficiency-or-phytotoxicity-of-mineral-elements
- **PEI Analytical Lab:** https://www.princeedwardisland.ca/en/information/agriculture/pei-analytical-laboratories-peial

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www.peipotatoagronomy.com