

Nutrient Deficiency & Soil Sampling

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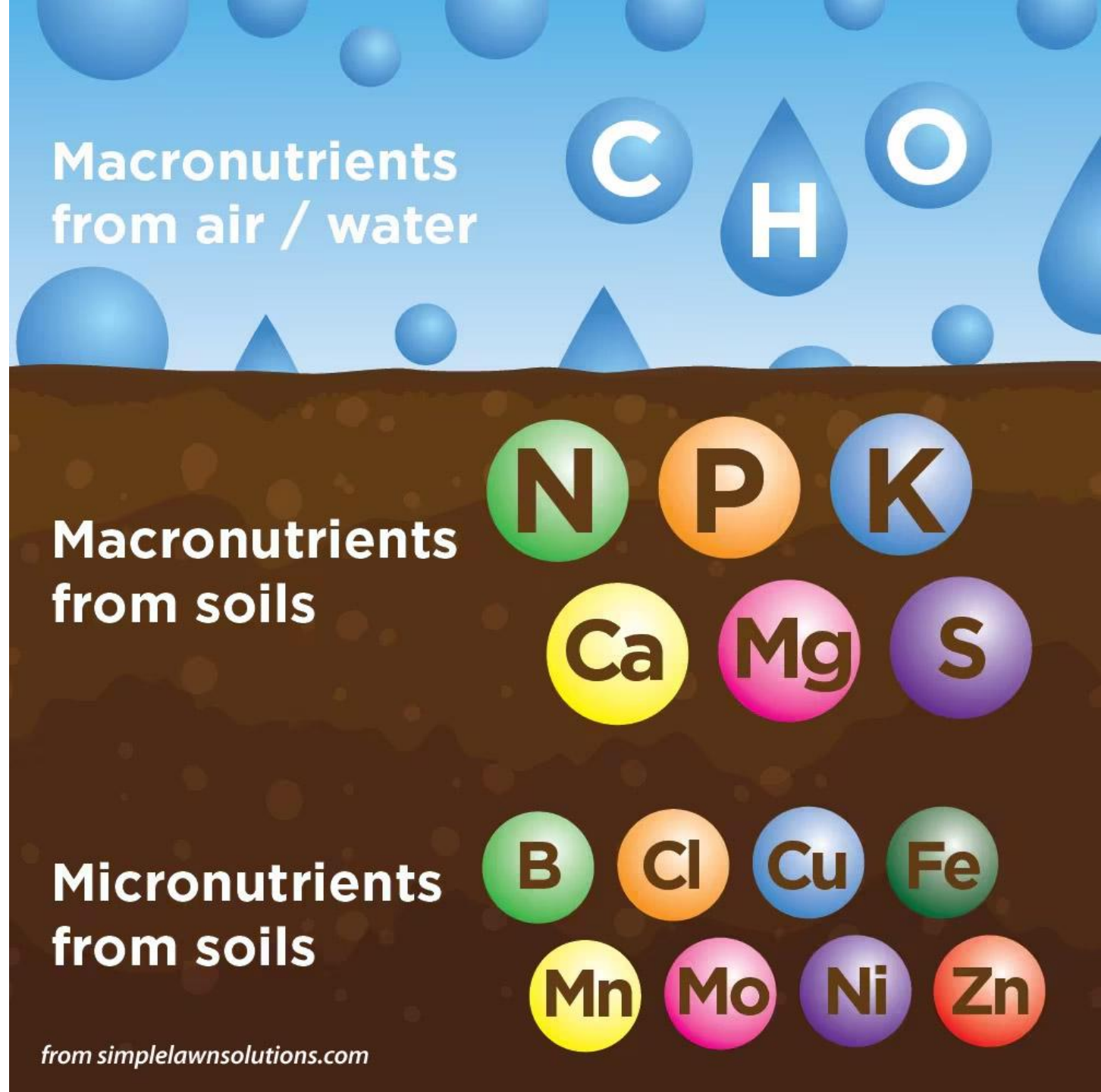


Nutrient Deficiencies:

- 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

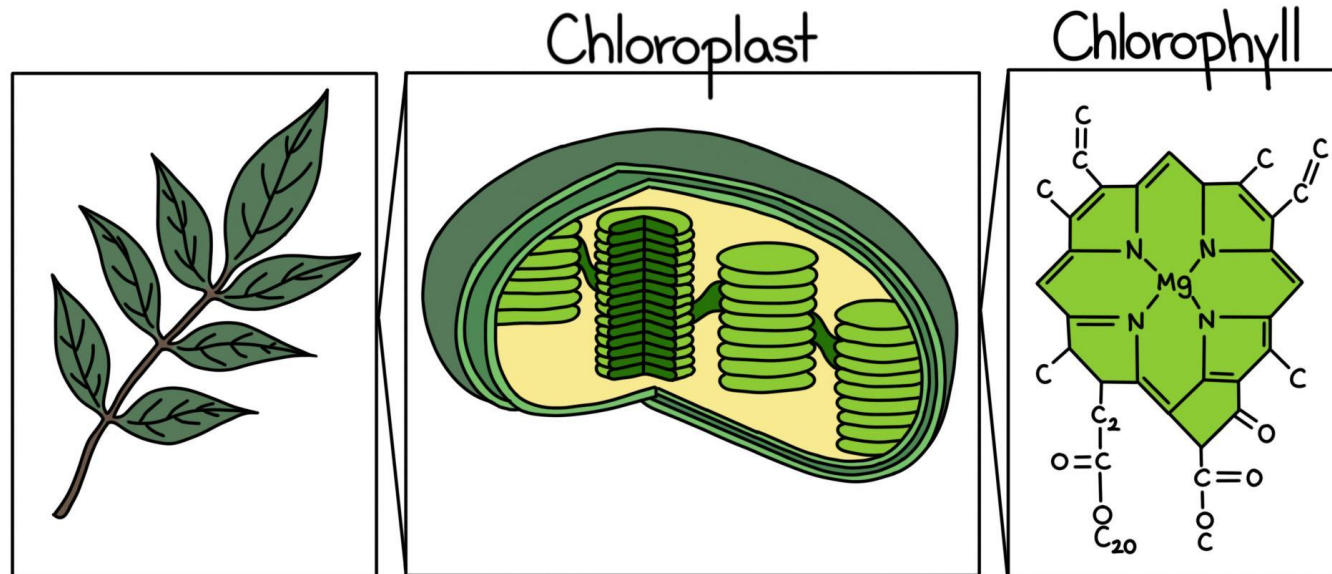
- Nitrogen (N)
- Phosphorus (P)
- Potassium (K)
- Sulfur (S)
- Magnesium (Mg)
- Calcium (Ca)



Nitrogen: What does it do?

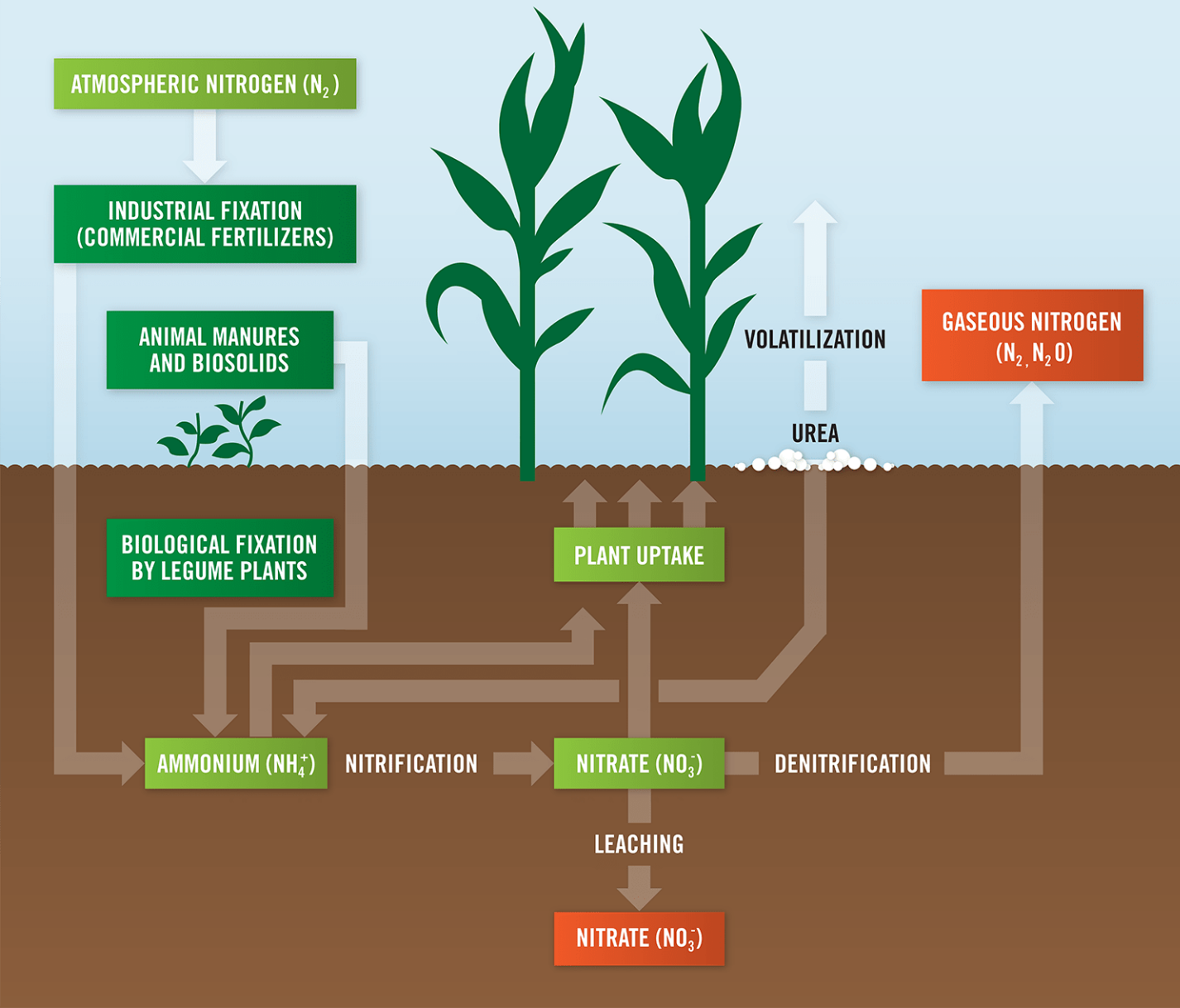
- Major component of chlorophyll
- Essential component in amino acids, which form proteins
- Component of energy-transfer compounds ATP/ADP
- Component of DNA and RNA, the building blocks of life

Image from futureengineers.org



THE NITROGEN CYCLE

■ COMPONENT
 ■ INPUT TO SOIL
 ■ LOSS FROM SOIL



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/>

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



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

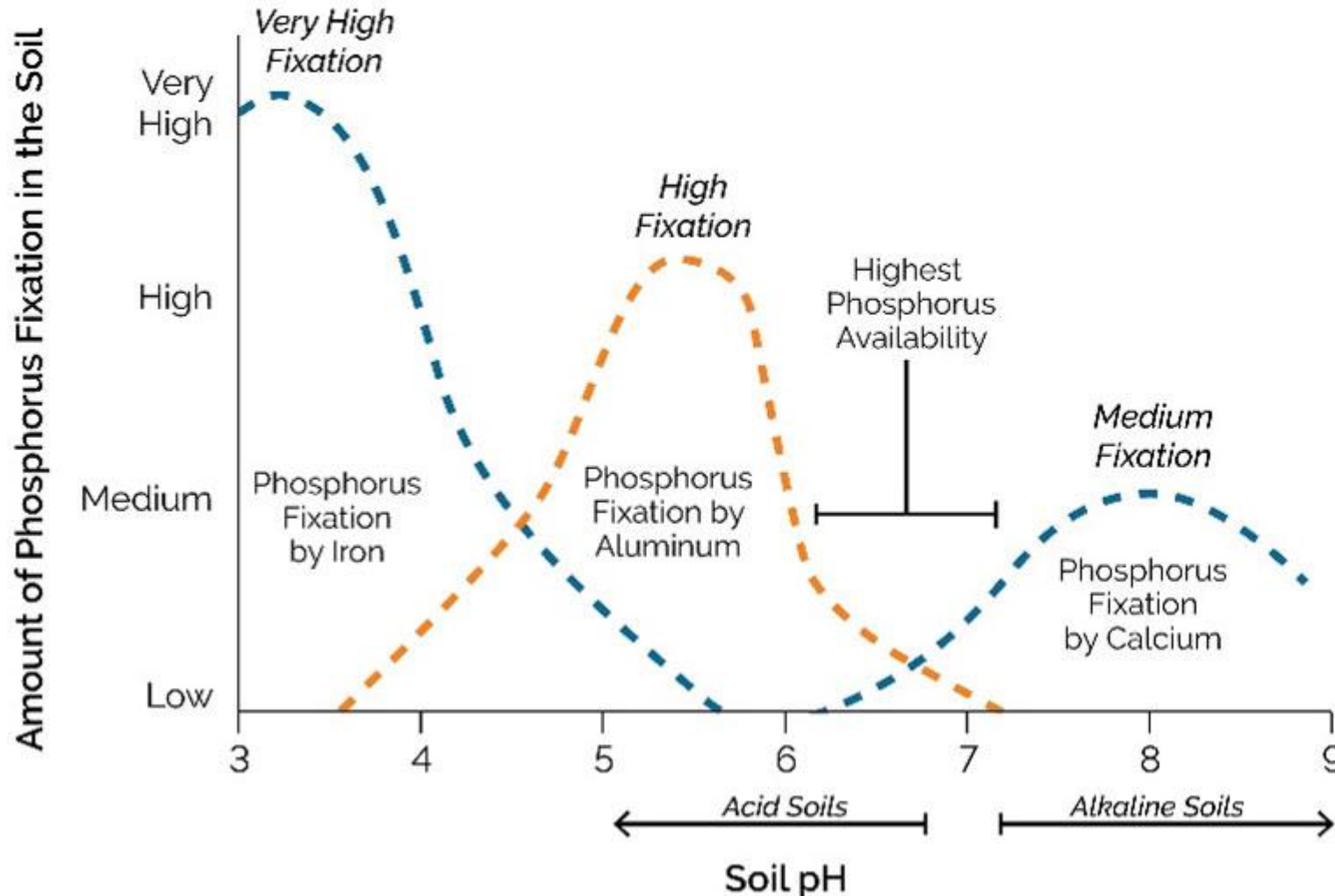
Phosphorus: What does it do?

- 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.

Phosphorus Deficiency



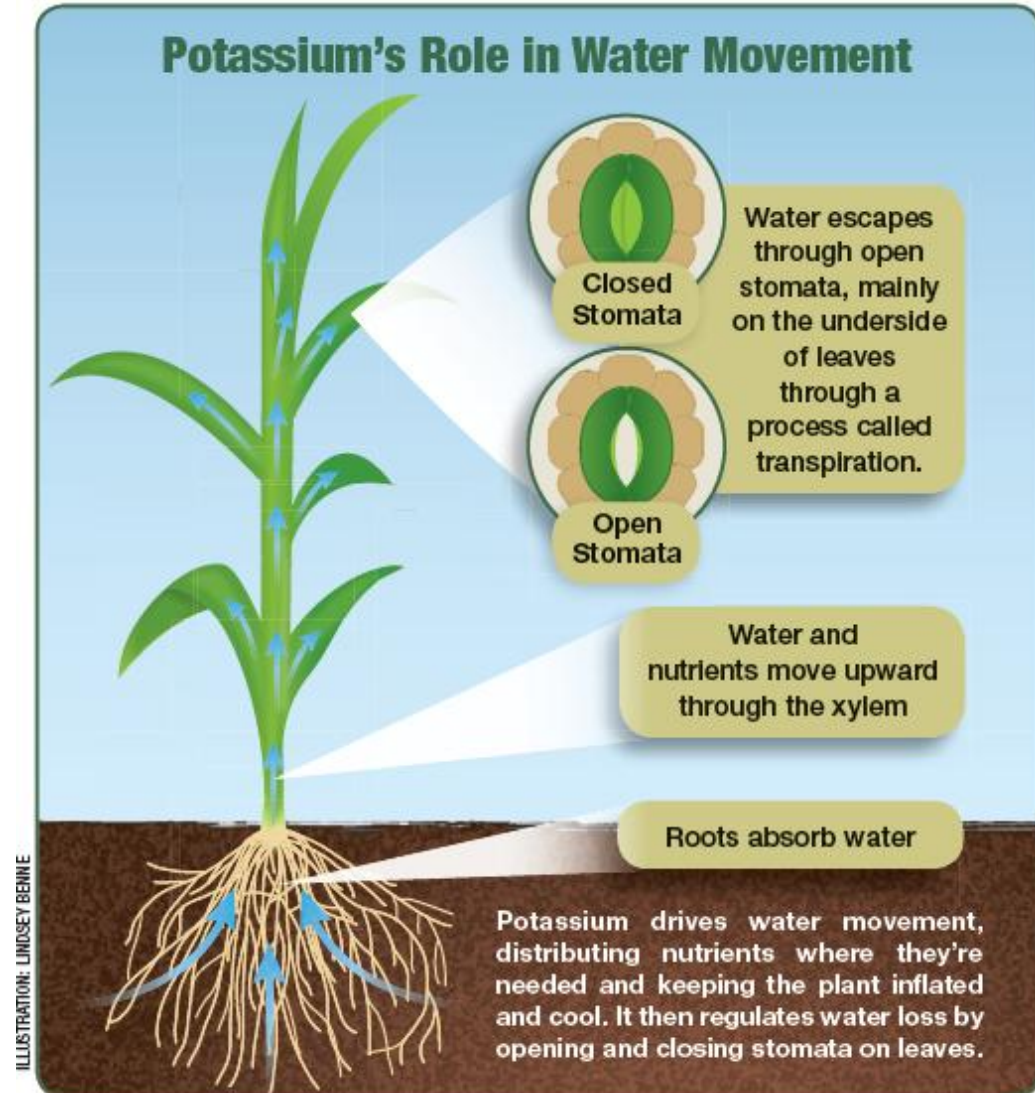
- Early growth stages – purpling of leaves/stems
- Later growth stages – stunted growth, dark-green or reddish/purple foliage, reduced root and tuber development
- Upward cupping of leaf margins

Images from nbsystems.co.za, PEI Potato Board

Potassium: What does it do?

Image: AgWeb

- 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



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

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

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

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.

Boron

- **Mostly Immobile**
- Young leaves are thickened, crinkled, and bordered by light brown tissue.
- Growing points and shoot tips die off.
- In severe deficiency, leaf margins are cupped upward.
- Low boron has been associated with hollow heart in tubers.
- PEI soils generally low in B.



Zinc



- **Immobile**
- Interveinal chlorosis/necrosis in new leaves
- Whitish spots with brown necrotic tissue
- Striping/banding
- Leaf/plant stunting
- Upward cupping of leaves
- Leaves 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)



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

**Plant Tissue Report**

02-Aug-2024

PEI Analytical Laboratories
 Department of Agriculture
 23 Innovation Way
 PO Box 2000, Charlottetown, 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 #:	Lab #:	Lab #:	Lab #:
	Sample ID	Sample ID	Sample ID	Sample ID
	Type: Potato	Type: Potato	Type:	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				

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>



Thank You!

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www.peipotatoagronomy.com