

Limitations to Plant Analysis

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What is an essential plant nutrient

- omission of the element will result in abnormal growth, failure to complete the life cycle, or premature death
- element must be specific and not replaceable by another element
- the elements effect must be direct and not indirect

Which of these is not a plant essential nutrient?

- ★ 1. Na
- 2. Cl
- 3. Cu
- 4. Mo

Plant Essential Nutrients

C	H	O
N	P	K
Ca	Mg	S
B	Mn	Zn
Cu	Fe	Mo
Cl	Ni	

Element	Form taken up by plants	Major Source	Conc. in plants
Nitrogen	NO_3^- , NH_4^+	OM, Atmosphere	1-6%
Phosphorus	H_2PO_4^- , HPO_4^-	Soil Minerals, OM	0.05-1.0%
Potassium	K^+	Soil Minerals	0.3-6.0%
Calcium	Ca^{++}	Soil Minerals	0.1-3.0%
Magnesium	Mg^{++}	Soil Minerals	0.05-1.0%
Sulfur	$\text{SO}_4^{=}$	OM, Precip.	0.05-1.5%

Element	Form taken up by plants	Major Source	Conc. in plants
Boron	H_2BO_3^-	OM	2-75 ppm
Manganese	Mn^{++}	Soil Minerals	5-500 ppm
Zinc	Zn^{++}	Soil Minerals, OM	5-100 ppm
Copper	Cu^{++}	Soil Minerals, OM	2-50 ppm
Iron	$\text{Fe}^{++}, \text{Fe}^{+++}$	Soil Minerals, OM	10-1000 ppm
Molybdenum	MoO_4^-	Soil Minerals	0.01-10 ppm
Chlorine	Cl^-	Precipitation	0.05-3%
Nickel	Ni^{++}	Soil Minerals	0.01-10 ppm

What is a non-essential element

- Can increase crop yield, but
- Absence will not cause the plant to die

Enhancing/Beneficial non-essential elements

- Can compensate for toxic effects of other elements
- May replace mineral nutrients in some other function
- May be essential to some plants, but not all
- Co – essential for N fixation in legumes
- Si – deposited in cell walls, can improve heat and drought tolerance as well as insect and disease resistance

Non-Essential Elements

Al	Cd	Co	Pb
Hg	Se	Si	Na

Key Uses of Plant Analysis

- evaluation of fertilizer efficiency
- determination of availability of elements for which reliable soil tests are not available
- the ability to evaluate the interaction among plant nutrients

Interpretation of Tissue Test Results

- Sufficiency range approach (SR)
- Diagnosis and Recommendation Integrated System approach (DRIS)
- Plant analysis with standardized scores (PASS) system

Sufficiency Range

Advantages

- Simple
- Values are independent – level of one element does not influence the interpretation of another

Disadvantages

- Too few categories to aid in interpretation
- Does not rank low to high
- Sensitive to maturity and part sampled

DRIS

Advantages

- Scale is continuous and easy to interpret
- Nutrients are ranked from most deficient to most excessive

Disadvantages

- Computations are complicated
- Indices are not independent of each other

PASS

Advantages

- Combines the features of both SR and DRIS

Disadvantages

- Interpretations available for only 3 crops

Do not take plant tissue samples from plants that:

- are dead or insect damaged
- are mechanically or chemically injured
- have been stressed by too much or too little moisture
- have been stressed by abnormally high or low temperatures

Handling Tissue Samples Do's:

- remove roots and foreign matter attached to the sample
- dust off the sample to remove any soil particles
- air dry if delivery to a lab will be delayed
- place sample in a paper bag

Handling Tissue Samples Don'ts:

- wash the sample with water
- place sample in a plastic or plastic lined bag
- mail or ship at the end of the week

Which of these is not a mobile nutrient in plants?

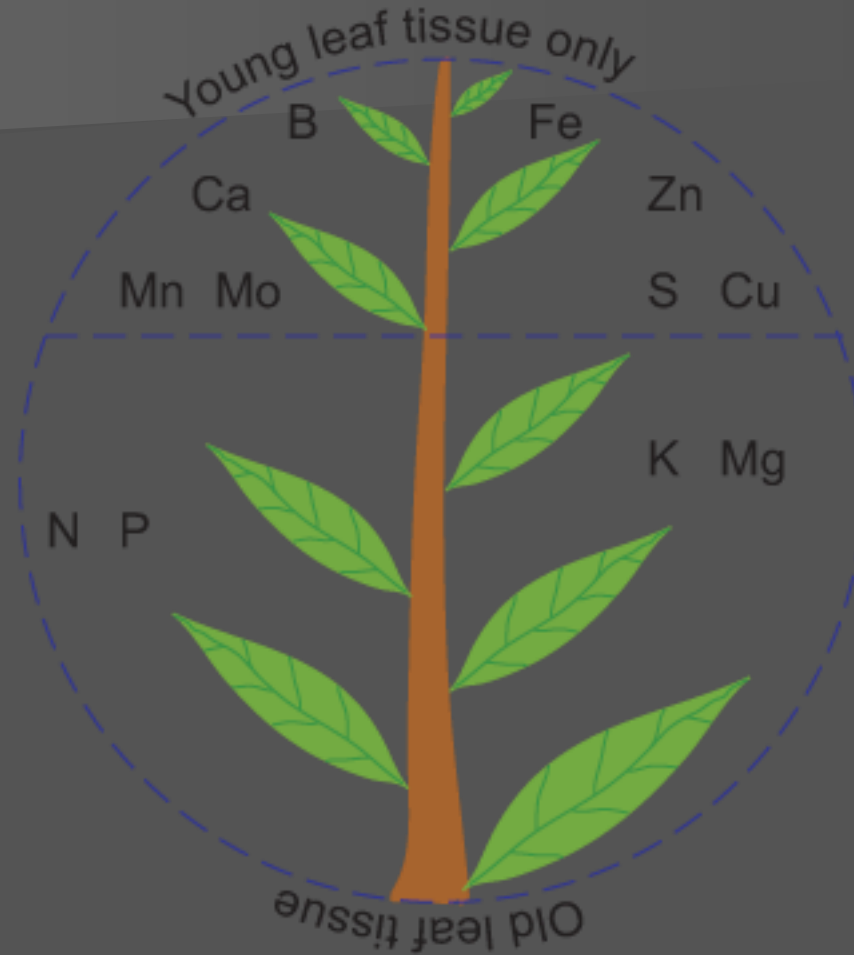
1. N

★ 2. B

3. K

4. Mg

Mobile vs. Immobile Nutrients



What deficiency is shown in these photos?

1. K
2. Ca
3. Mg
4. P
5. N
- ★ 6. S





Sulfur

- Deficiency can often be confused with N deficiency. Plants are light yellow green, with symptoms first seen in the new growth
- Significantly reduced atmospheric contribution in recent years
- More pronounced on lighter textured soils and low OM soils

What deficiency is shown in this photo?

1. K
- ★ 2. B
3. Mg
4. P
5. S



Boron

- Symptoms of abnormal growth first appearing on new growth. Example - rosetting/terminal bud dieback in alfalfa
- Low OM, light textured soils, hot, cold or dry weather all factors. Dry weather also reduces root activity causing B shortage in summer alfalfa crops

What deficiency is shown in these photos?

1. K
2. Ca
3. Mg
- ★ 4. P
5. N
6. S



Phosphorus

- Promotes early root formation and growth. Symptoms include overall stunting of plants and dark green/purple coloring on leaves. Older leaves most affected.
- Cold, wet soils early in the season can lead to P shortage in corn

An early season (12" sample) plant analysis result for P that is interpreted as "low" for corn results in a UW recommendation for:

1. 50% more P than what was recommended for the field based on the soil test result
2. 25% more P than what was recommended for the field based on the soil test result
3. 100% more P than what was recommended for the field based on the soil test result
4. a recommendation for no P to be applied
5. no fertilizer recommendation will be given ★

What deficiency is shown in these photos?

- ★ 1. K
- 2. Ca
- 3. Mg
- 4. P
- 5. N
- 6. S



Potassium

- Symptoms include scorching or firing along leaf margins appearing on the older leaves first. Other symptoms include weak stalks, poor root systems, small grain size, and general reduced plant vigor.
- Low soil test K, low CEC soils

What deficiency is shown in this photo?

1. K
2. Ca
3. Mg
4. P
- ★ 5. Zn
6. S



Zinc

- Chlorosis in the interveinal areas of new leaves, which can result in a banding appearance
- Stunting of plants as a result of shortage of growth regulators due to Zn deficiency
- More pronounced on lighter textured, low OM soils and high pH soils

What deficiency is shown in these photos?

1. K
2. Ca
- ★ 3. Mg
4. P
5. N
6. S



Magnesium

- Symptoms of yellowing or interveinal chlorosis appear first on the older leaves.
- Low OM, light textured soils
- Soil reserves become depleted due to continued cropping with low-Mg containing fertilizers or minimal use of dolomitic limestone

Which one is not a possible cause of the deficiency?

1. Low pH
2. Liming with calcitic lime only
- ★ 3. No-till
4. Large applications of potash or excessively high soil test K levels

Limitations to Plant Analysis Include:

- limited ability to remediate a nutrient deficiency identified by plant analysis
- the deficiency may have already caused a yield loss
- the crop may not respond to additional nutrients at the growth stage tested
- the crop may be too large to allow an application
- the weather may be unfavorable

Summary

- Plant analysis is an excellent tool for high value, perennial horticultural crops such as cranberries and apples where soil testing is of limited value
- In agronomic crops, tissue testing can help diagnose crop production problems when used in conjunction with other information such as soil test results and detailed crop history

Acknowledgement

Some photos taken from the IPNI image collection



Questions & Discussion