Perennia
Nova Scotia's Food Development Agency

Grape Nutrition: Making Sense of Soil and Tissue Analyses

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PART 1: Soil Test Interpretation for Grape Growers

March 11, 2024

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Overview

- Go through the elements of the soil test report
  - What is it?
  - Why is it important?
  - Where you want to be?
- Considerations for Management

Soil Sampling

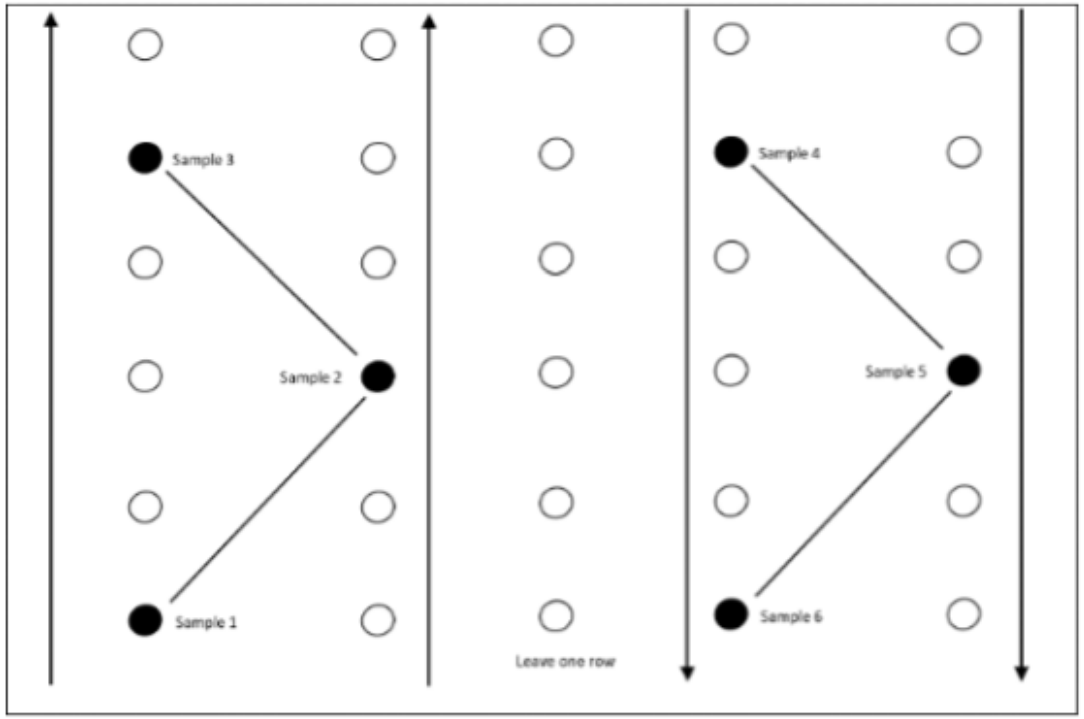
Why Sample?

Soil sampling helps make informed decisions on:

- Inputs required for economical and efficient crop production
- Fertilizer and lime requirements
- Diagnose problem areas

Soil Sampling

- Take a composite sample (15-20 samples combined) after dividing your property into reasonable blocks.
- Walking in a zigzag pattern throughout your field.
- Sampling back and forth between rows and skipping one.
- Depth in vineyards is 0-15/20cm



Soil Sampling

- Sample at least every three years, more if required.
- Set up appropriate sampling zones/areas.
  - You want to take a new sample when there is a change in topography, soil type, management history, crop variety, and drainage.
- Develop a long-term sampling plan and maintain records.
- Sample around the same time of year – mid August to mid September for grape production.

Soil Test Interpretation

- pH
- Soil Organic Matter
- Macronutrients
- Micronutrients
- Cation Exchange Capacity
- Lime Recommendation

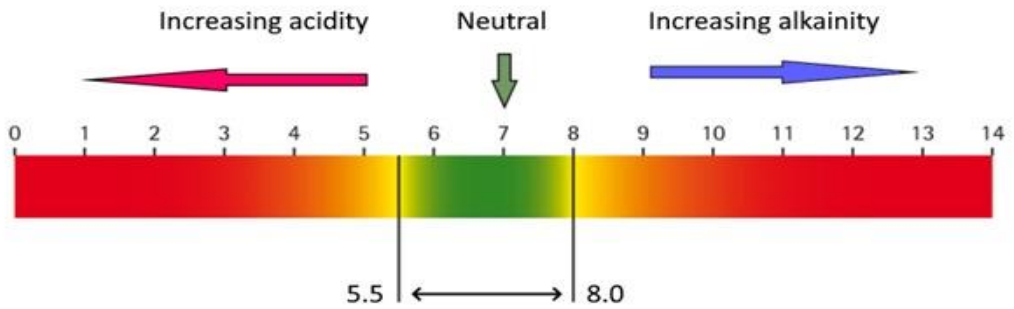
PARAMETER	ANALYSIS	RATING	ANALYSIS	RATING
pH (pH Units)	5.14		5.70	
Buffer pH (pH Units)	7.37		7.62	
Organic Matter (%)	3.6		4.2	
P205 (kg/ha)	277	L+	2093	E
K20 (kg/ha)	151	L+	1191	E
Calcium (kg/ha)	327	L-	2226	M-
Magnesium (kg/ha)	60	L-	363	M+
Sodium (kg/ha)	23		47	
Sulfur (kg/ha)	42		40	
Aluminum (ppm)	1569		1160	
Boron (ppm)	< 0.50		0.56	
Copper (ppm)	1.75		2.79	
Iron (ppm)	169		264	
Manganese (ppm)	149		294	
Zinc (ppm)	3.72		26.97	
CEC (meq/100g)	6.3		11.5	
Base sat. K (%)	2.5		11.0	
Base sat. Ca (%)	12.9		48.5	
Base sat. Mg (%)	3.9		13.2	
Base sat. Na (%)	0.8		0.9	
Base sat. H (%)	79.8		26.5	
LR CaCO3 (t/ha to pH 6.5)	8		4	

Required Nutrient (kg/ha)	N	P205	K20	N	P205	K20
	140	225	130	140	0	0

pH

What is it?

- A measure of soil acidity.
- Measures the active hydrogen ions in the soil solution.
- pH is on a scale of 1-14, where below 7 is acidic, 7 is neutral, and above 7 is alkaline.
- pH is on an inverse logarithmic scale– for every one unit increase in pH, there is a 10-fold decrease in hydrogen ion activity.



	Ontario	Northeast US
pH	6.0 – 7.4	5.5 – 6.0 Labrusca (American) 6.0 – 6.5 Hybrids 6.5 – 7.5 Vinifera > 7.5 TOO HIGH

pH

Why is it important?

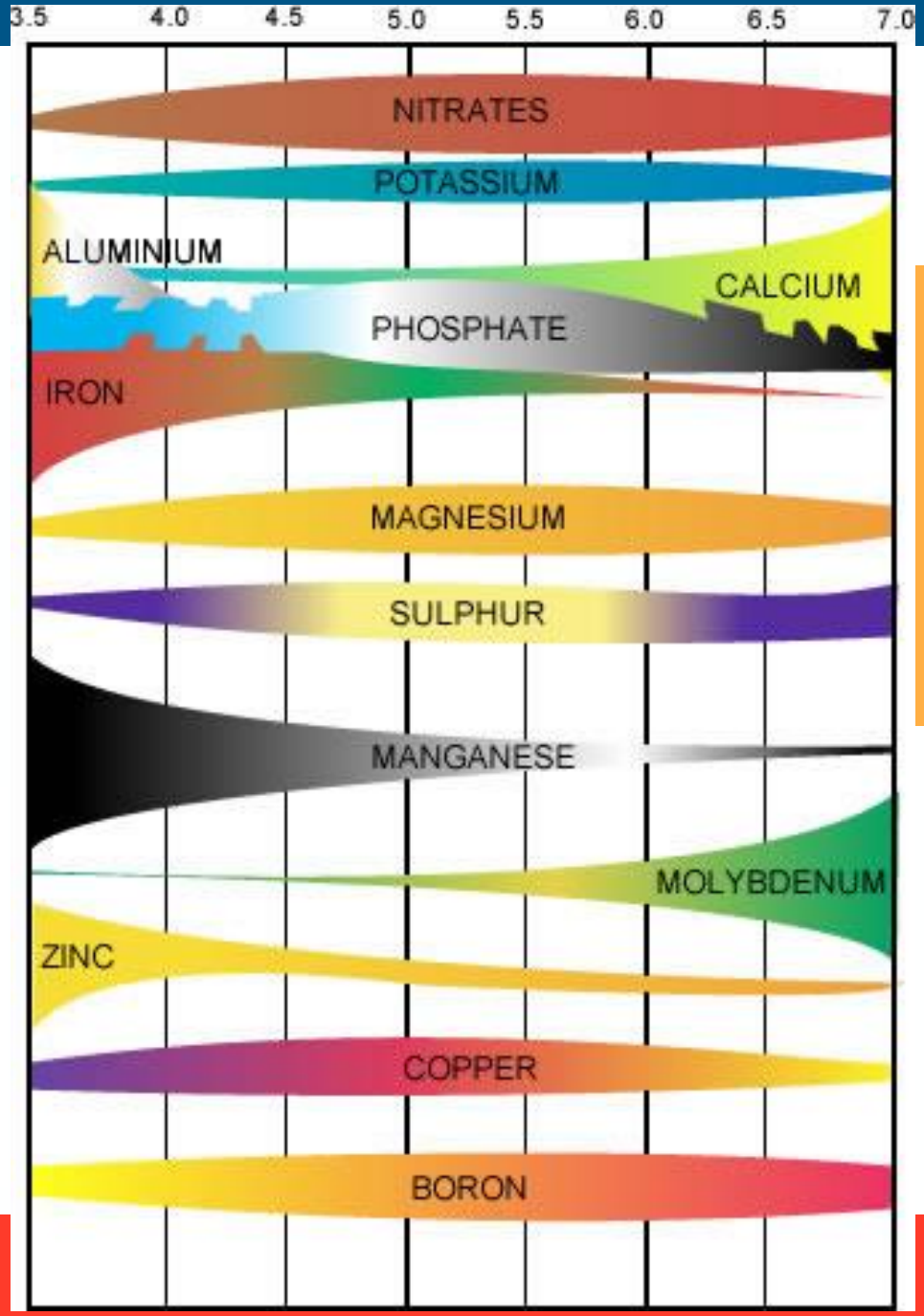
- Impacts the solubility of nutrients. Acidic soils can lead to nutrient deficiencies.
- Important for microbial productivity.
- Fertilizer use efficiency.

Table 1. Fertilizer efficiency rates of different nutrients at different soil pH values.

Soil pH	Nitrogen Efficiency	Phosphorous Efficiency	Potassium Efficiency	Overall Fertilizer Efficiency
6.5	95%	63%	100%	86%
6	89%	52%	100%	80%
5.5	77%	48%	77%	67%
5	53%	34%	52%	46%

Modified from Pub 534-84; Atlantic Soils Need Lime

pH



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Soil solution pH: Measure of the active hydrogen ions in the soil solution.

Buffer pH: the residual acidity neutralized by lime (mainly used by the lab for lime recommendations)

Lime Recommendation: The amount of lime required to increase your pH to 6.5

Crop to be Grown	Grapes		Grapes	
Parameter	Analysis	Rating	Analysis	Rating
pH (pH Units)	4.95		5.34	
Buffer pH (pH Units)	7.35		7.36	
Organic Matter (%)	3.9		4.3	
P2O5 (kg/ha)	63	L-	70	L-
K2O (kg/ha)	180	M	152	M-
Calcium (kg/ha)	1019	L+	2441	M
Magnesium (kg/ha)	143	M-	252	M
Sodium (kg/ha)	36		57	
Sulfur (kg/ha)	17		14	
Aluminum (ppm)	1144		1139	
Boron (ppm)	< 0.50		< 0.50	
Copper (ppm)	0.72		1.01	
Iron (ppm)	291		359	
Manganese (ppm)	39		79	
Zinc (ppm)	2.25		1.58	
CEC (meq/100 g)	8.6		12.6	
Base sat. K (%)	2.2		1.3	
Base sat. Ca (%)	29.6		48.6	
Base sat. Mg (%)	6.9		8.4	
Base sat. Na (%)	0.9		1.0	
Base sat. H (%)	60.4		40.8	
LR CaCO3 (t/ha to pH 6.5)	9		7	
Required Nutrient (kg/ha)	N 40	P2O5 500	K20 130	N 40	P2O5 500	K20 160

pH

What you need to know?

- The pH on the soil test report measures the active acidity in soil (in soil solution).
  - Indicates if your soils need lime.
- The buffer pH measures the reserve acidity and is an indicator of the buffer capacity.
  - Helps determines how much lime is needed.
  - Used by the lab to determine the lime requirement.
- The amount of $CaCO_3$ is required to increase the pH to 6.5.
  - The amount may need to be adjusted based on the type of liming agent, and the application method.

pH

Liming

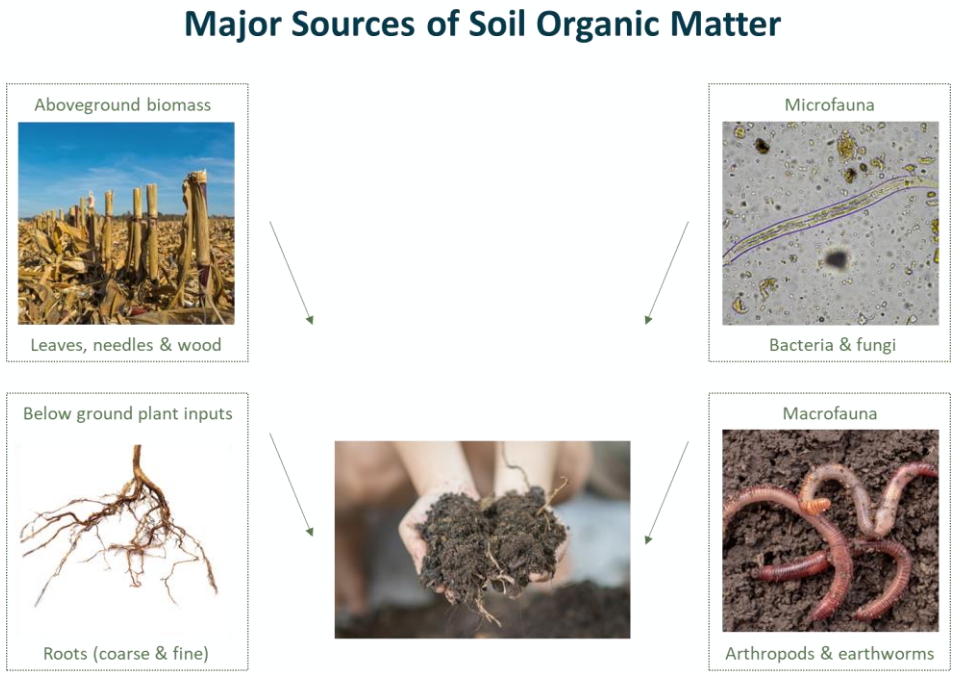
- Do I need lime by seeing if the pH is below the suitable range for your variety.
- What type of lime by assessing the amount needed, and other nutrients.
  - Types of Lime:
    - $CaCO_3$ Calcite
    - $CaMgCO_3$ Dolomite
    - Wood ash and composts and other amendments
- The amount of lime from the lime recommendations.
- Lime is slow acting. Incorporating lime increase the speed at which it is effective, but disturbs the soil.
- Sandier soils with low organic matter will react quicker to lime, but also become acidic quicker.
- If your lime recommendation is above 5 t/ha consider split applying.

Soil Organic Matter

What is it? Why is it important?

Combination of living and dead plant and animal matter in soil.

- Provides nutrients
- Adds structure
- Increase water-holding capacity
- Reduce risk of erosion
- Increases biodiversity
- Organic matter contains negatively charged binding sites for nutrient retention.



Soil Organic Matter: Often an indicator of soil health

	Ontario	Northeast US
OM %	1.7 – 4.3 %	3 – 5 %

Crop to be Grown	Grapes		Grapes	
Parameter	Analysis	Rating	Analysis	Rating
pH (pH Units)	4.95		5.34	
Buffer pH (pH Units)	7.35		7.36	
Organic Matter (%)	3.9		4.3	
P2O5 (kg/ha)	63	L-	70	L-
K2O (kg/ha)	180	M	152	M-
Calcium (kg/ha)	1019	L+	2441	M
Magnesium (kg/ha)	143	M-	252	M
Sodium (kg/ha)	36		57	
Sulfur (kg/ha)	17		14	
Aluminum (ppm)	1144		1139	
Boron (ppm)	< 0.50		< 0.50	
Copper (ppm)	0.72		1.01	
Iron (ppm)	291		359	
Manganese (ppm)	39		79	
Zinc (ppm)	2.25		1.58	
CEC (meq/100 g)	8.6		12.6	
Base sat. K (%)	2.2		1.3	
Base sat. Ca (%)	29.6		48.6	
Base sat. Mg (%)	6.9		8.4	
Base sat. Na (%)	0.9		1.0	
Base sat. H (%)	60.4		40.8	
LR CaCO3 (t/ha to pH 6.5)	9		7	
Required Nutrient (kg/ha)	N: 40	P2O5: 500	K20: 130	N: 40	P2O5: 500	K20: 160

Nitrogen

- Low N can lead to low vigor, poor shoot growth, and discoloured leaves.
- **Not on a soil test, but a N recommendation is!**
- Nitrogen availability is biological
- Consider your application method before applying.
- The recommendations are guidelines.
- Available forms of nitrogen are NO3- and NH4+

Crop to be Grown	Grapes		Grapes	
Parameter	Analysis	Rating	Analysis	Rating
pH (pH Units)	6.66		6.42	
Buffer pH (pH Units)	7.95		7.89	
Organic Matter (%)	2.9		2.5	
P2O5 (kg/ha)	365	H-	275	M
K2O (kg/ha)	313	H	239	H-
Calcium (kg/ha)	3598	H-	3301	H-
Magnesium (kg/ha)	398	H	422	H
Sodium (kg/ha)	35		43	
Sulfur (kg/ha)	17		16	
Aluminum (ppm)	699		731	
Boron (ppm)	0.61		< 0.50	
Copper (ppm)	15.61		11.54	
Iron (ppm)	297		295	
Manganese (ppm)	51		55	
Zinc (ppm)	5.06		4.09	
CEC (meq/100 g)	11.5		11.2	
Base sat. K (%)	2.9		2.3	
Base sat. Ca (%)	78.5		73.4	
Base sat. Mg (%)	14.5		15.6	
Base sat. Na (%)	0.7		0.8	
Base sat. H (%)	3.5		7.8	
LR CaCO3 (t/ha to pH 6.5)				
Required Nutrient	N	P2O5	K20	N	P2O5	K20
(kg/ha)	40	140	40	40	260	70

Phosphorous

- Phosphorous can be present in the soil, but not available in large amounts.
- Immobile in soil, P uptake is largely dependent on the root system.
- P is mostly in unavailable forms.
- P_2O_5 = 2.29 X P
- To convert kg/ha to PPM divide by 2.

	Ontario	Northeast US
Phosphorus (P)	21 – 108 PPM	20 – 50 PPM

Crop to be Grown	Grapes			Grapes		
Parameter	Analysis	Rating		Analysis	Rating	
pH (pH Units)	6.66			6.42		
Buffer pH (pH Units)	7.95			7.89		
Organic Matter (%)	2.9			2.5		
P2O5 (kg/ha)	365	H-		275	M	
K2O (kg/ha)	313	H		239	H-	
Calcium (kg/ha)	3598	H-		3301	H-	
Magnesium (kg/ha)	398	H		422	H	
Sodium (kg/ha)	35			43		
Sulfur (kg/ha)	17			16		
Aluminum (ppm)	699			731		
Boron (ppm)	0.61			< 0.50		
Copper (ppm)	15.61			11.54		
Iron (ppm)	297			295		
Manganese (ppm)	51			55		
Zinc (ppm)	5.06			4.09		
CEC (meq/100 g)	11.5			11.2		
Base sat. K (%)	2.9			2.3		
Base sat. Ca (%)	78.5			73.4		
Base sat. Mg (%)	14.5			15.6		
Base sat. Na (%)	0.7			0.8		
Base sat. H (%)	3.5			7.8		
LR CaCO3 (t/ha to pH 6.5)						
Required Nutrient (kg/ha)	N	P2O5	K20	N	P2O5	K20
	40	140	40	40	260	70

Potassium

- K is mobile in the soil, therefore will move with **water.**
- Poor aeration reduces root K uptake
- Organic matter is not a major source, but high OM increases CEC and helps soils retain K
- $K_2O = 1.2 \times K$

	Ontario	Northeast US
Potassium (K)	3.6 – 6.4 % 20 – 109 PPM	75 – 100 PPM

Crop to be Grown	Grapes			Grapes		
Parameter	Analysis		Rating	Analysis		Rating
pH (pH Units)	6.66			6.42		
Buffer pH (pH Units)	7.95			7.89		
Organic Matter (%)	2.9			2.5		
P2O5 (kg/ha)	365		H-	275		M
K2O (kg/ha)	313		H	239		H-
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Base sat. Na (%)	0.7			0.8		
Base sat. H (%)	3.5			7.8		
LR CaCO3 (t/ha to pH 6.5)						
Required Nutrient (kg/ha)	N	P2O5	K20	N	P2O5	K20
	40	140	40	40	260	70

Calcium and Magnesium

- Helps with cell nutrition, stress response, and important for photosynthesis.
- Can be added with liming.

	Ontario	Northeast US
Calcium (Ca)	66 – 84 % 1,000 – 2000 PPM	1,000 – 2,000 PPM
Magnesium (Mg)	11 – 18 % 50 – 100 PPM	100 – 250 PPM

Crop to be Grown	Grapes			Grapes		
Parameter	Analysis	Rating		Analysis	Rating	
pH (pH Units)	6.66			6.42		
Buffer pH (pH Units)	7.95			7.89		
Organic Matter (%)	2.9			2.5		
P2O5 (kg/ha)	365	H-		275	M	
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Required Nutrient (kg/ha)	N	P2O5	K20	N	P2O5	K20
	40	140	40	40	260	70

Nutrient Ratings

- Only available if you input the crop.

TABLE 1.
AVAILABLE PHOSPHORUS (P_2O_5) SOIL INTERPRETATION RATINGS FOR NOVA SCOTIA CROPS.

SOIL RATING	SOIL TEST LEVELS (kg/ha)					
	Forages	Grain	Vegetables	Small Fruits	Tree Fruits	Turf
Low (L-, L, L+)	0-141	0-141	0-336	0-231	0-239	0-336
Medium (M-, M, M+)	142-215	142-215	337-582	232-360	240-383	337-582
High (H-, H, H+)	216–411	216–411	583–1144	361–558	383–598	583–1144
Excessive (E)	411+	411+	1145+	559+	599+	1145+

TABLE 2.
AVAILABLE POTASSIUM (K_2O) SOIL INTERPRETATION RATINGS FOR NOVA SCOTIA CROPS

SOIL RATING	SOIL TEST LEVELS (kg/ha)					
	Forages	Grain	Vegetables	Small Fruits	Tree Fruits	Turf
Low (L-, L, L+)	0–121	0–121	0–179	0–121	0–179	0–179
Medium (M-, M, M+)	122–236	122–236	180–330	122–236	180–330	180–330
High (H-, H, H+)	237–514	237–514	331–703	237–514	331–703	331–703
Excessive (E)	515+	515+	704+	515+	704+	704+

Crop to be Grown	Grapes		Grapes	
Parameter	Analysis	Rating	Analysis	Rating
pH (pH Units)	6.66		6.42	
Buffer pH (pH Units)	7.95		7.89	
Organic Matter (%)	2.9		2.5	
P2O5 (kg/ha)	365	H-	275	M
K2O (kg/ha)	313	H	239	H-
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Sodium (kg/ha)	35		43	
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Base sat. Mg (%)	14.5		15.6	
Base sat. Na (%)	0.7		0.8	
Base sat. H (%)	3.5		7.8	
LR CaCO3 (t/ha to pH 6.5)				
Required Nutrient (kg/ha)	N 40	P2O5 140	K2O 40	N 40 / P2O5 260 / K2O 70

Micronutrients

- Iron (Fe) – Most soils in Nova Scotia have plenty
- Manganese (Mn) – Most soils in Nova Scotia have plenty
- Zinc (Zn) – Can be made unavailable by high P
- Copper (Cu) – Sandy or low OM soils might see a response to a Cu application
- Boron (B) – More available in acidic soils, organic matter stores B

	Ontario	Northeast US
Boron (B)	0.3 – 0.7 PPM	0.3 – 2.0 PPM
Copper (Cu)	1.1 – 21.8 PPM	0.5 PPM
Iron (Fe)	20 – 55 PPM	20 PPM
Manganese (Mn)	4.1 – 21.8 PPM	20 PPM
Zinc (Zn)	1.1 – 1.9 PPM	2 PPM

Crop to be Grown	Grapes			Grapes		
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Base sat. H (%)	3.5			7.8		
LR CaCO3 (t/ha to pH 6.5)						
Required Nutrient (kg/ha)	N	P2O5	K2O	N	P2O5	K2O
	40	140	40	40	260	70

Cation Exchange Capacity

"Total amount of exchangeable cations that a soil can adsorb"

- **Ability of the soil to retain important nutrients**
- Indication of the buffering capacity of the soil
- Dependent on the number of negative exchange sites found on soil organic matter and clay particles
- May be difficult to alter

Crop to be Grown	Grapes			Grapes		
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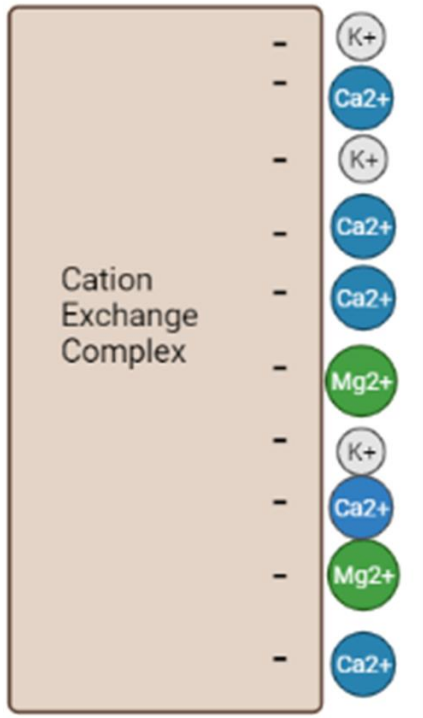
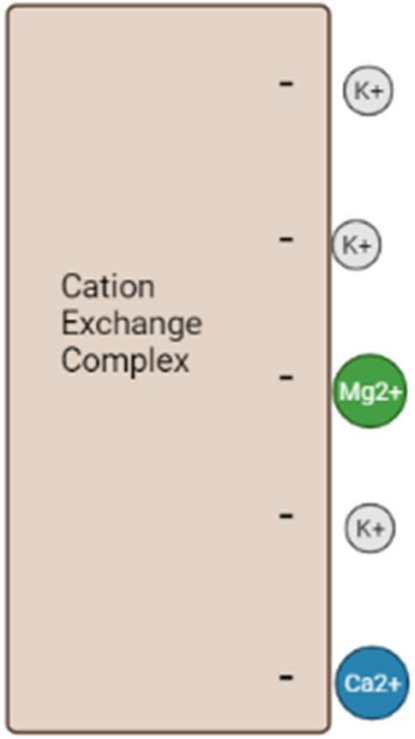
Base sat. H (%)	3.5			7.8		
LR CaCO3 (t/ha to pH 6.5)						
Required Nutrient	N	P2O5	K20	N	P2O5	K20
(kg/ha)	40	140	40	40	260	70

Clay Dominated Soil (High CEC)



Sand Dominated Soil (Low CEC)



Soil Texture	*CEC (meq/100g)*
Sand	1-5
Fine Sandy Loam	5-10
Loam	5-15
Clay Loam	15-30
Clay	>30
Organic Matter	200-400

Base Saturation

- The ratio of Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}, and H^{+} on the cation exchange complex.
- Used as an indicator of soil acidification.
- Fertility recommendations should not be made solely on base saturation.
- Does not represent total amount of nutrients, only amounts relative to each other.

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Parameter	Analysis	Rating	Analysis	Rating
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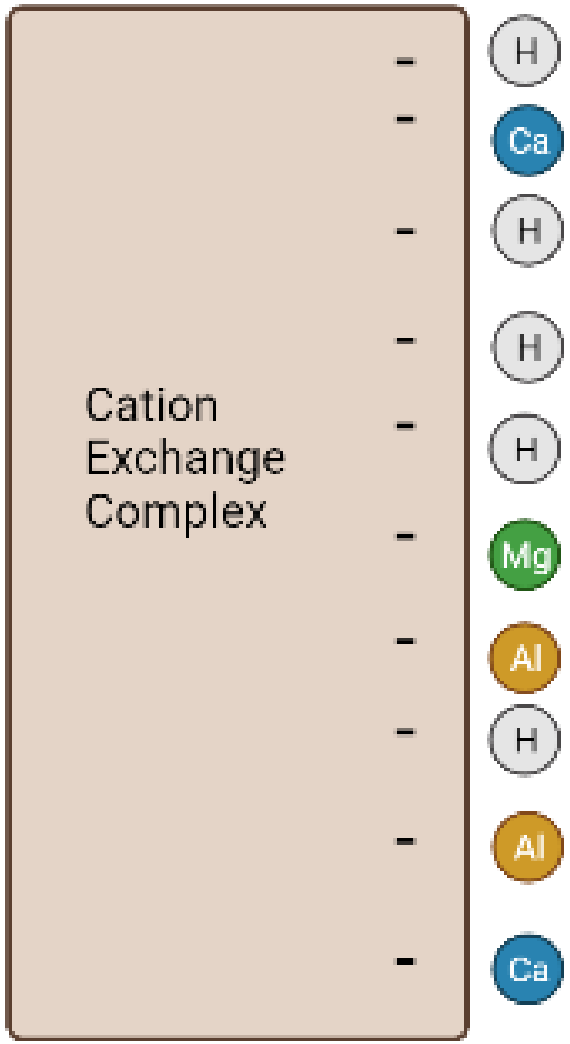
Manganese (ppm)	51		55	
Zinc (ppm)	5.06		4.09	
CEC (meq/100 g)	11.5		11.2	
Base sat. K (%)	2.9		2.3	
Base sat. Ca (%)	78.5		73.4	
Base sat. Mg (%)	14.5		15.6	
Base sat. Na (%)	0.7		0.8	
Base sat. H (%)	3.5		7.8	
LR CaCO3 (t/ha to pH 6.5)				
Required Nutrient (kg/ha)	N: 40	P2O5: 140	K2O: 40	N: 40	P2O5: 260	K2O: 70


Cation
Exchange
Complex
H
Ca
H
H
H
Mg
Al
H
Al
Ca

Recap

- Take soil samples at least every three years, and more frequently for problem areas.
- Understand your soil pH and how to amend it.
- Increase organic matter if necessary.
- Critically evaluate macro and micronutrient needs.
- Understand CEC and base saturation.

Thank you!

Questions PART 1?

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Nova Scotia's Food Development Agency

PART 2: Grape Nutrition: Making Sense of Tissue Analyses

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There is no “ONE SIZE FITS ALL” approach to vineyard nutrition

Need to think like Sherlock Holmes and Dr. Watson

- Observe the patients in the field (vine)
- Understand the patients' lifestyle (crop load, pruning, training, environment, etc)
- Check the patients' diet (soil)
- Physically check over the patients (tissue)

Why do people take soil and tissue samples?

- Observations of poor vine growth or fruit quality
- Poor yields
- Want higher yields than what they are currently getting
- Correct issues before they become a problem (prevention versus treatment!)
- Understand need to develop personal and site specific vineyard data

Factors that Influence Nutrient Availability

- Water and nutrients limit vine growth and productivity
- Frequency of precipitation to enable mineral elements to be taken up by roots
- Evaporation (temperature) and transpiration demands – more transpiration more nutrient uptake
- Mineral element balance (competition for space on soil particles and uptake by vine roots)
- Cultivar, clone, rootstock and interactions

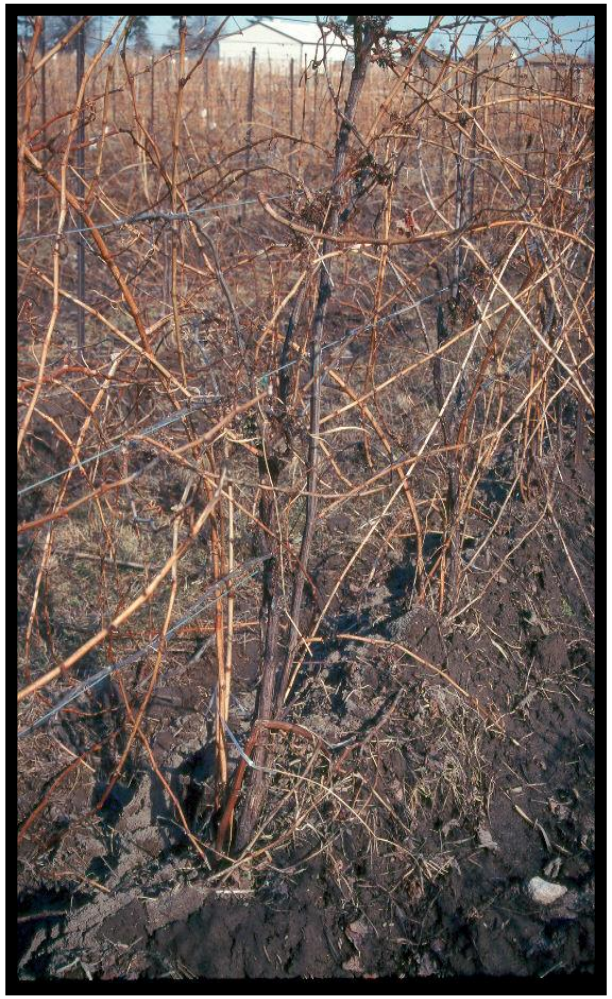
Critical Elements for Vine Development

Macro Nutrients

Nitrogen, Phosphorus, Potassium, Magnesium, Calcium, Sulphur

Micro Nutrients

Iron, Manganese, Boron, Copper, Zinc, Chlorine

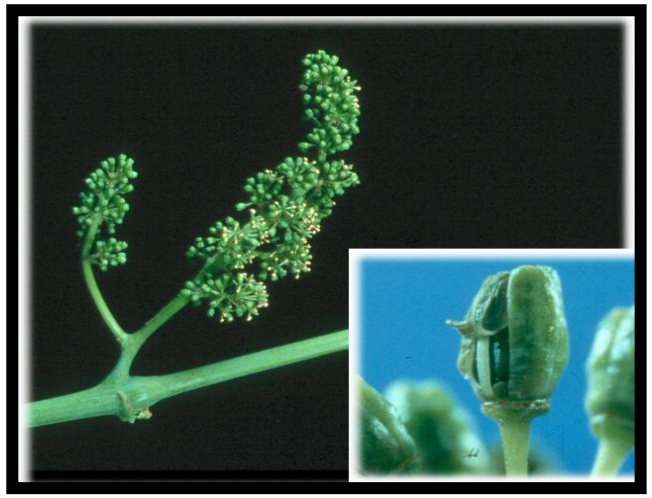


Nitrogen

Nitrogen deficiency

- Root growth
  - Drought susceptibility
- Shoot growth ↓
- Photosynthesis ↓
  - Chlorophyll ↓ Carbohydrates ↑ Anthocyanins ↑
- Premature Leaf senescence
  - Nutrient recycling

Phosphorus

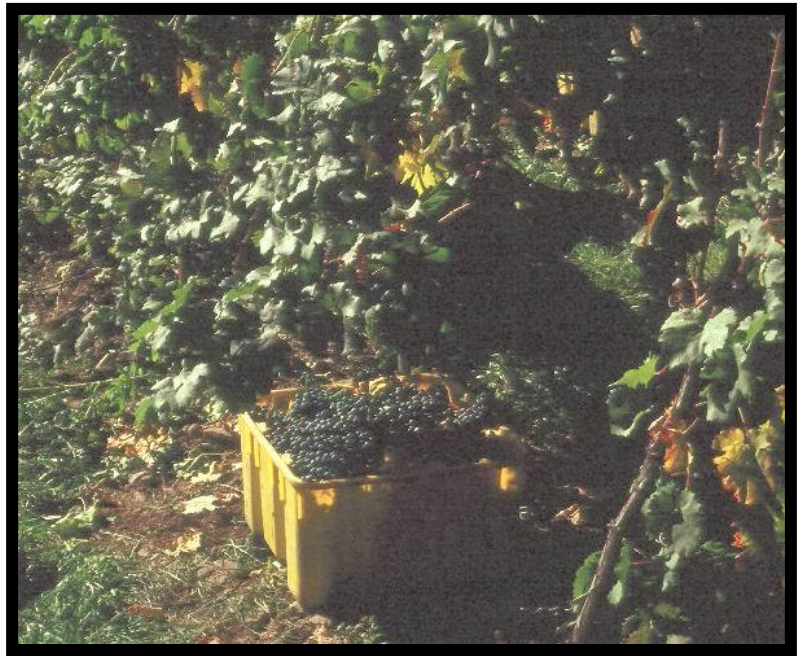


Phosphorus deficiency

- Root Growth - more shallow and less at depth
  - Increase drought susceptibility
- Shoot Growth ↓
- Carbohydrates ↑
- Photosynthesis ↓
- Mg transport ↓ leads to Mg deficiency symptoms
- Premature Leaf Senescence
  - Nutrient recycling

P deficiency, Merlot

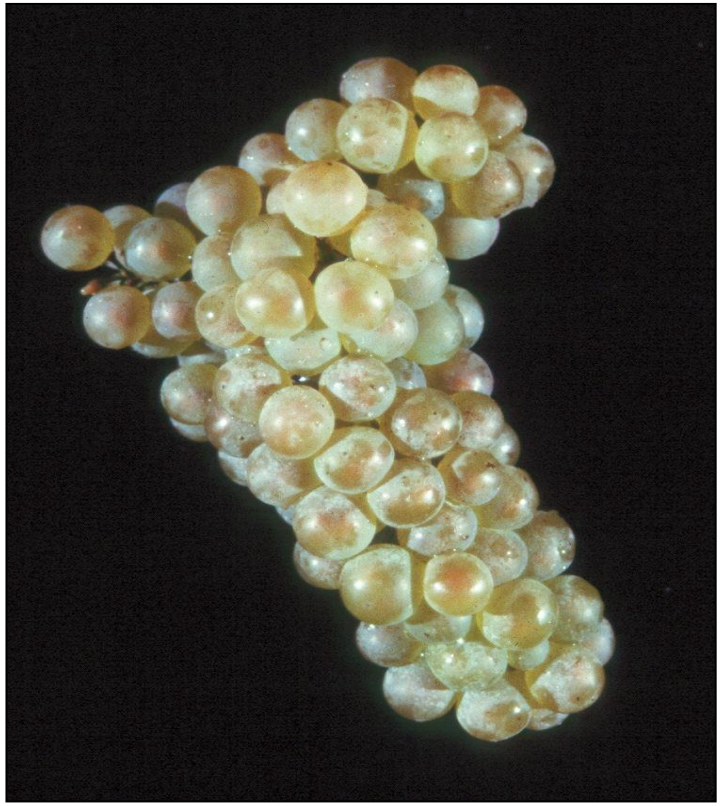
Potassium



Potassium deficiency

- Root growth – more lateral
- Shoot Growth
- Photosynthesis
- Sugar export
  - Ripening and overwintering reserves
- Xylem flow
- Premature Leaf Senescence
  - Nutrient recycling
- **Be aware of Cultivar/Clone Demand and Rootstock Interaction*

Magnesium



Magnesium deficiency

- Root growth
- Photosynthesis ⬇
  - Sugar and starch in leaves ⬆
  - Light sensitive leaves
  - Anthocyanins in leaves ⬆
- Shoot growth ⬇
- Berry development
  - Late season bunch stem necrosis
  - Shatter

Role of Micro Nutrients

Iron	Chlorophyll, shoot growth and elongation, fruit set, shatter
Manganese	Photosynthesis, chlorophyll, enzyme activation
Boron	Pollen germination and fruit set, shoot development, root growth
Copper	Root growth, leaf formation, shoot elongation, crop load
Zinc	Plant growth and seed formation, chlorophyll, bud hardiness, stem integrity
Chlorine	Cell division, nitrogen metabolism

Macro Nutrients

	Mobility in Soil	Plant Available Form	Mobility in Plant
Nitrogen	Med – High	NH_4^+, NO_3^-	High
Phosphorus	Low	$HPO4^{-2}$, $H_2PO_4^-$	High
Potassium	Low – Med	K^+	High
Calcium	Low	Ca^{+2}	Low
Magnesium	Low	Mg^{+2}	High
Sulphur	Medium	SO_4^{-2}	High

Micronutrient Mobility

	Mobility in Soil	Plant Available Form	Mobility in Plant
Boron	High	$B(OH)_3$, $H_2BO_3^-$	Low-med
Copper	Low	Cu^{+2}	Med
Iron	Low	Fe^{+2}, Fe^{+3}	Low
Manganese	Low	Mn^{+2}	Low
Molybdenum	Low-med	MoO_4^{-2}	Low-med
Zinc	Low	Zn^{+2}, $Zn(OH)_2^0$	Low
Chlorine	High	Cl^-	High

Why do people use fertilizers?

Habit

Good Salesman

Laboratory Recommendation

How should I decide what nutrients are REALLY needed?

Soil and Tissue Sampling

- Establish base levels of nutrients
- Diagnose problem areas
- Monitor nutrient levels
- Assist in establishing fertilizer and lime requirements

- What do I have available? (Soil)
- What is the vine taking up? (Tissue)
- What do I change? (Fertilization)

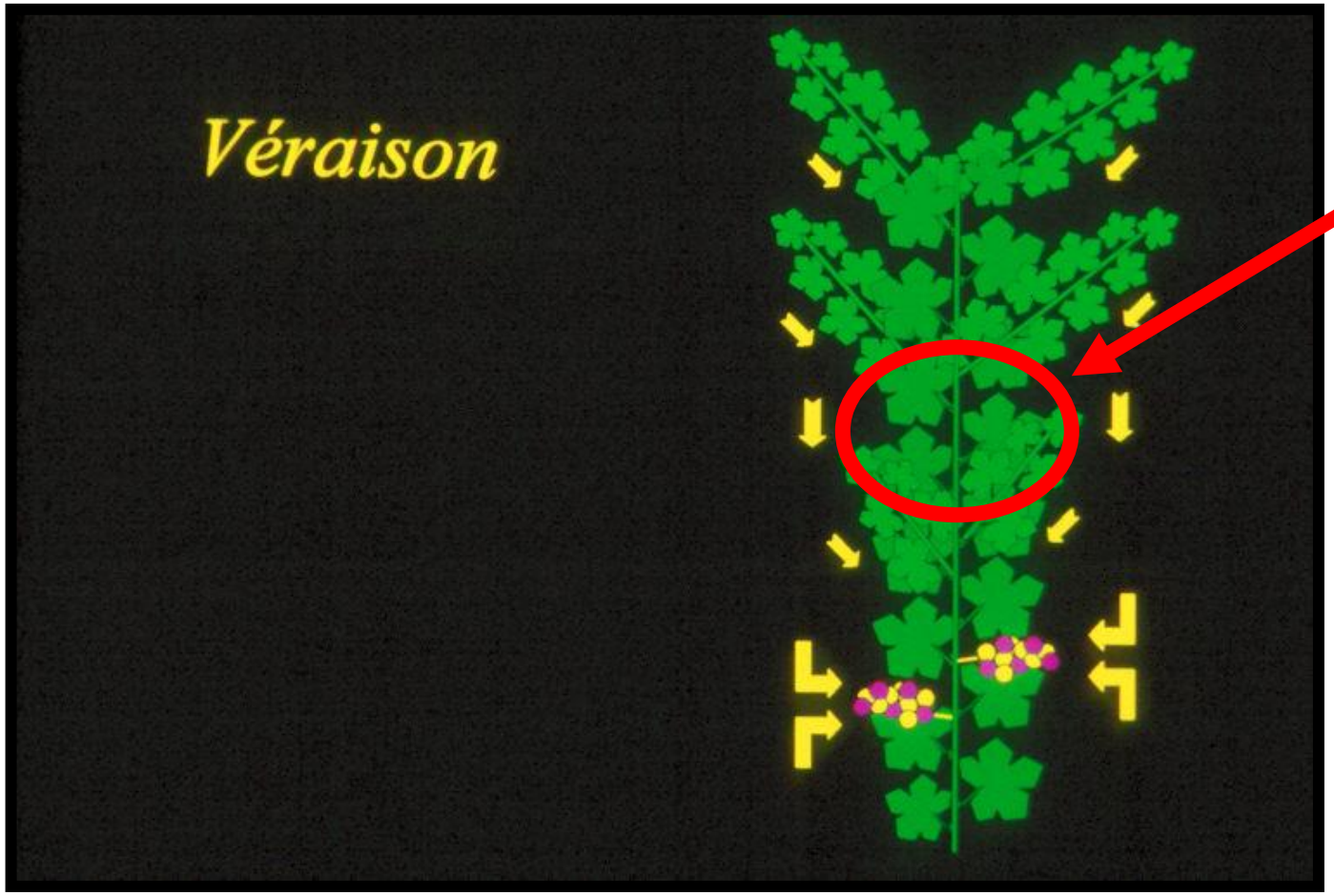
What a Tissue Analysis provides

- General concentration in tissue
- Results will be variable with tissue selected and time of season selected
- Nitrogen content will fluctuate over season
- Plant stresses not taken into consideration – e.g. drought, excessive crop level, recent pruning, shading
- Does NOT tell you what is available in the soil

Sample Tissue Just Before Bloom

Leaf opposite
primary fruit cluster

Veraison Tissue Sampling



Petiole sampling area

Getting Laboratory Results

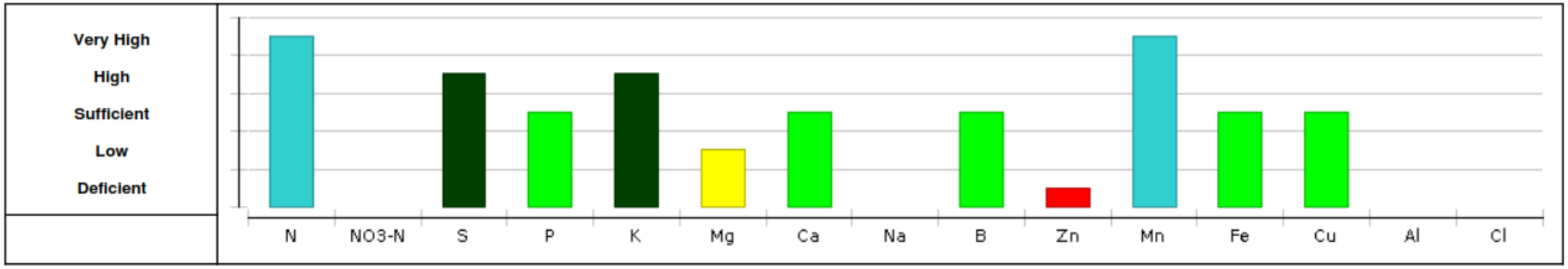
- Tissue results will vary
  - with the age of the vines
  - cultivars
  - time of the year sampled
  - plant part sampled
  - representativeness of the sample for the area
  - vine ***stress*** – water, heat, crop load, competition, injury from pests
  - pesticide use – some have trace elements or active (e.g. Cu and S)

Plant Type: Grape
Growth Stage: Bloom-Post Bloom
Plant Part: Blade

Date Sampled	Lab Number	Nitrogen (%)	Nitrate Nitrogen (%)	Sulfur (%)	Phosphorus (%)	Potassium (%)	Magnesium (%)	Calcium (%)	Sodium (%)	Boron (ppm)	Zinc (ppm)	Manganese (ppm)	Iron (ppm)	Copper (ppm)	Aluminum (ppm)	Chloride (%)
2022-06-29		4.26		0.53	0.31	1.91	0.23	1.03	0.02	83.71	23	280	86	16.16	26	
Normal Range		2.30 2.80		0.35 0.50	0.25 0.45	1.20 1.60	0.25 0.80	1.00 3.00		35 100	34 70	30 100	40 300	6 20		

	N/S	N/K	P/S	P/Zn	K/Mg	K/Mn	Fe/Mn	Ca/B
Actual Ratio	8.1	2.2	0.6	134	8.5	68	0.3	123
Expected Ratio	6.2	1.9	0.8	70	3.3	175	1.3	416

Nutrient Sufficiency Ratings



Laboratory Recommendations

- These plants are low in Magnesium . This **condition may be due to low soil Mg, excess soil potassium, low soil pH or poor drainage**
- These plants are deficient in Zinc. **Possible causes may be low soil Zinc availability, high soil pH or excess soil phosphorus**. XXX Lab recommends foliar zinc application following manufacturers directions.
- The very High levels of Manganese **may be from contamination from a spray or dust**
- XXX Lab **recommends an application when Mg, B, P, Zn, or Mn are deficient at this stage**
- XXX Lab **recommends a follow up sample 14 days after foliar treatment**

Element	Bloom	Veraison Deficient	Veraison Adequate	Veraison High/Excess
Nitrogen N	1.2 – 2.2 %	< 0.6 %	**0.8 – 1.3 %**	> 1.4 %
Calcium Ca	1 – 3 %	< 0.7 %	**0.8 – 3.0 %**	> 3.1 %
Potassium K	1.5 – 2.5 %	< 0.7 %	**0.8 – 2.5 %**	> 2.6 %
Magnesium Mg	0.3 – 0.5 %	< 0.4 %	**0.35 – 1.5 %**	> 1.6 %
Phosphorus P	0.17 – 0.30 %	< 0.14 %	**0.15 – 0.4 %**	> 0.5 %
Boron B	25 – 50 PPM	< 20 PPM	**20 – 60 PPM**	> 61 PPM > 100 PPM toxic
Copper Cu	5 – 15 PPM	< 1.9 PPM	**2.0 – 16 PPM**	> 17 PPM
Iron Fe	30 – 100 PPM	< 15 PPM	**15 – 100 PPM**	> 101 PPM
Manganese Mn	25 – 100 PPM	< 20 PPM	**20 – 200 PPM**	> 201 PPM
Zinc Zn	30 – 60 PPM	< 15 PPM	**15 – 100 PPM**	> 101 PPM

Revised Petiole Values Chart for Perennia Grape Production Guide 2022
Page 35,Sec 4.2.3 Grapevine Nutrients Figure 2

Grape Petiole Ranges

Element	Bloom	Veraison Deficient	Veraison Adequate	Veraison High/Excess
Nitrogen N	**1.2 – 2.2 %**	< 0.6 %	**0.8 – 1.3 %**	> 1.4 %
Calcium Ca	**1 – 3 %**	< 0.7 %	**0.8 – 3.0 %**	> 3.1 %
Potassium K	**1.5 – 2.5 %**	< 0.7 %	**0.8 – 2.5 %**	> 2.6 %
Magnesium Mg	**0.3 – 0.5 %**	< 0.4 %	**0.35 – 1.5 %**	> 1.6 %
Phosphorus P	**0.17 – 0.30 %**	< 0.14 %	**0.15 – 0.4 %**	> 0.5 %
Boron B	**25 – 50 PPM**	< 20 PPM	**20 – 60 PPM**	> 61 PPM > 100 PPM toxic
Copper Cu	**5 – 15 PPM**	< 1.9 PPM	**2.0 – 16 PPM**	> 17 PPM
Iron Fe	**30 – 100 PPM**	< 15 PPM	**15 – 100 PPM**	> 101 PPM
Manganese Mn	**25 – 100 PPM**	< 20 PPM	**20 – 200 PPM**	> 201 PPM
Zinc Zn	**30 – 60 PPM**	< 15 PPM	**15 – 100 PPM**	> 101 PPM

This is an updated version of the guideline for petiole interpretation in the Perennia Grape Production Guide 2022 (Page 35, Section 4.2.3 Grapevine Nutrients, Figure 2)

Now I have some numbers so…….?

- General assumption that 50% of nutrients taken up by the vine are assimilated in roots/leaves/shoots or lost

- Crop removal in fruit is estimated at:

	N	P	K	Ca	Mg	Mn	Fe	Zn	Cu	B
Lb/t	4.5	1.5	6.75	0.5	0.4	.005	.01	.02	.002	.005
Kg/t	2.25	0.8	3.5	0.25	0.20	7 g	15 g	30 g	2.5 g	6.0 g

Now I have some numbers so…….?

- Must remember that the elements all work in concert with one another – No single element performs alone!

Nutrition 101 – Top Ten

1. Make a good site map for you and others to follow

2. Collect data over time for YOUR site – no two locations are the same

3. Compare your results with ONSITE observations of vine performance

Nutrition 101 – Top Ten

4. Sample from GOOD and POOR areas on same site to develop your own target values for results

5. Be consistent - create a 5-year plan of sampling - same time of year and general locations

6. Before applying any fertilizers be sure it to meet a REAL need **not a guess** of need

Nutrition 101 – Top Ten

7. Nutrient applications are not cheap and costs skyrocket if you blend in micronutrients (are they really needed?)

8. Foliar fertilizers good when symptoms visible but a luxury expense when not needed

9. All purpose foliar products often have you paying for what is not needed

Nutrition 101 – Top Ten

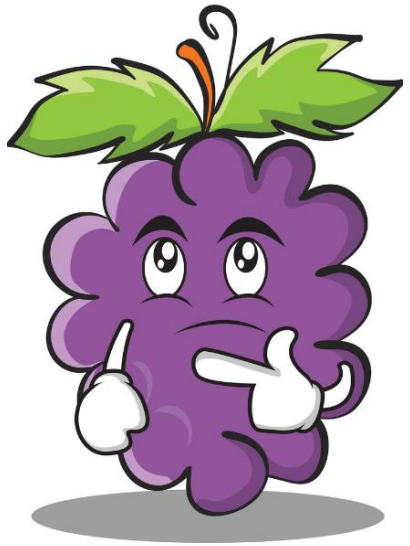
10. Walk your vineyard regularly –

    Using your own experience and knowledge along with your senses (sight, touch, taste, smell) can tell you a lot more than paper results!

Additional Information Sources

- Wine Grape Production Guide for Eastern North America (2008) – T.K. Wolf, Editor
- Oregon Viticulture (2003) – E. W. Hellman, Editor
- Grapevine Nutrition into Practice (2005) CCRV Australia
- Mineral Nutrition of Higher Plants 2Nd Ed. (2003) – H. Marschner
- The Science of Grapevines: Anatomy and Physiology (2010) – M. Keller WSU

Questions?



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