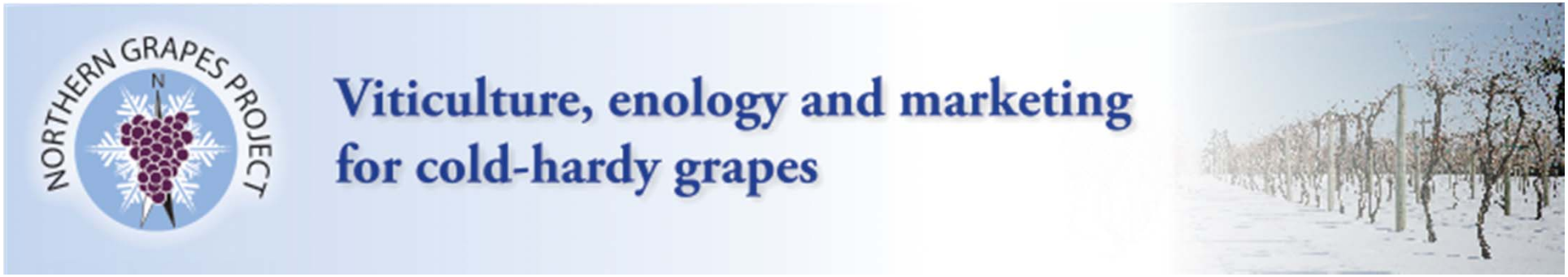

Vine Nutrition

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&

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Iowa State University

The Northern Grapes Project Webinar Series
March 12, 2013

General Topics

- Soil testing and basic nutrient management for vineyards **before** planting
- Petiole analysis - how and when to use it
- Interpretations – nutrient management based on petiole analysis

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Determining the Need for Fertilizer

- Vine vigor
- Visual symptoms
  - Yield and quality already affected
- Soil testing
- Petiole analysis

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Essential Plant Nutrients

14 nutrients derived from the soil and/or fertilizer

Macronutrients

- Primary
  - N - Nitrogen
  - P – Phosphorus
  - K – Potassium
- Secondary
  - S – Sulfur
  - Mg – Magnesium
  - Ca – Calcium

Micronutrients

- Zn – Zinc
- B – Boron
- Fe – Iron
- Mn – Manganese
- Cu – Copper
- Mo – Molybdenum
- Ni – Nickel
- Cl – Chlorine

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Soil vs. Petiole Analysis

Soil

Pre-plant:

- Adjust pH, bring P & K to optimum.
- Not an accurate test for many nutrients.

2nd year & beyond:

- Monitor pH.
- Basis for K rate if petiole analysis indicates a short supply.

Petiole

1st year:

- Not accurate
- Reflects growing conditions in the nursery.

2nd year & beyond:

- Accurate measure of most essential nutrients.
- Sampling time is important.
- Annual analysis allows for fine-tuning of the fertilizer program, & correcting shortages before they become a problem.

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Availability of Essential Mineral Nutrients

- Composition of the soil parent material
- Soil pH
- Soil Texture
  - Soil weathering / leaching
  - Internal drainage characteristics of the soil
- Soil organic matter content
- Competition between nutrients for uptake by the plant
- Previous fertilizer history

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Soil Testing

- Soil test before planting
- Test every 4 to 5 years after planting...
  - or when a problem is suspected
- Supplements petiole testing in established vineyards

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Soil Testing

- pH, P, and K
  - Soil tests very well calibrated for adjusting these properties
- Ca, Mg, Zn, B, S
  - Soil tests also useful for detecting deficiencies (or excesses) of these nutrients
- Organic Matter
  - Used to adjust N rates

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Soil Sampling

- Collect representative samples
  - Soil tests are only as accurate as the samples you submit
  - Sampling is often the weakest link in a soil testing program

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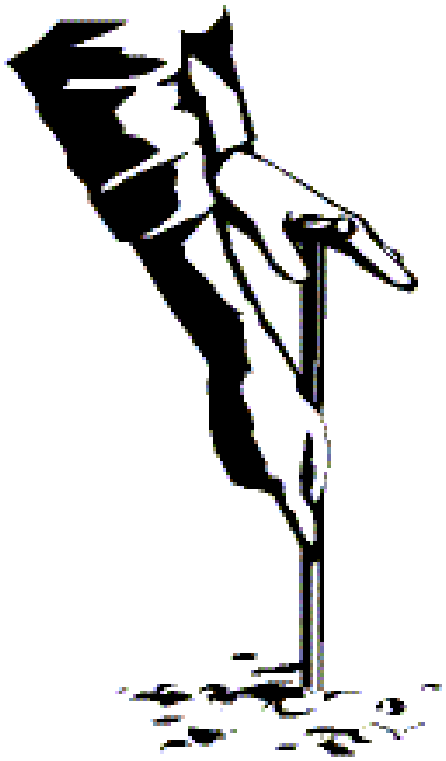
Sampling Guidelines

- Divide fields into uniform areas
  - Soil type, slope, crop history, previous lime, fertilizer, manure applications
  - < 20 acres for a single sample
  - < 2-3 acres on uneven land



- Collect 15-20 soil cores per sample
  - Random, zig-zag pattern across the field

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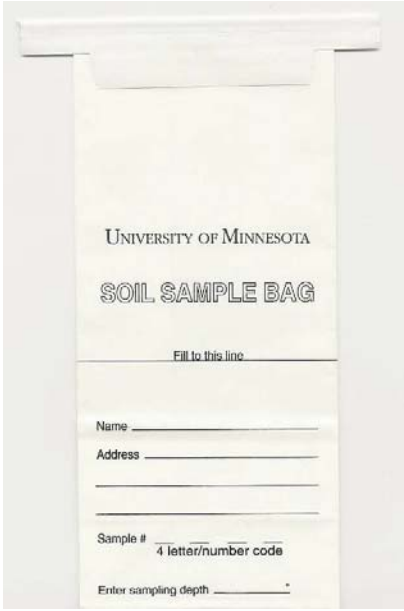
Soil Sampling

- Sample to a depth of 0 to 8”
- A second sample, 8 to 16” can also be submitted
- Thoroughly mix sub-samples in a clean, plastic container
  - Submit about a pint of composite sample to testing lab
- If soil is wet
  - Air dry
  - Oven dry at <97° F



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UNIVERSITY OF MINNESOTA
Soil Testing Laboratory
Instructions for filling out this form are given on the back side

FARM/FIELD CROPS and COMMERCIAL HORTICULTURAL CROPS

SOIL SAMPLE INFORMATION SHEET

Report No.

LOCATION REFERENCE

Name Pine Hill Vineyard
Address 123 Needle Lane
City, State, Zip Big Lake, MN 55309
Phone

Soil location: County Sherburne
Township
Check for $ 48 enclosed
Customer Number
(pre-arranged accounts only)

MAIL REPORT TO:

Name
Address
City, State, Zip
Phone

Sample Identification			1 Crop History				2 Proposed Crops						3 CHECK TESTS REQUESTED (plow layer sample)								
			Crop Grown Before Last		Last Crop Grown		Option 1		Option 2		Option 3										Nitrate Before selecting this test please read section on nitrate on the BACK SIDE. Sampling to 24" is required for this test.
Laboratory Number (Lab Use Only)	Field or Sample No. or Letter	Check If Irrigated	Crop Code No.	If Alfalfa check plants per sq ft	Crop Code No.	If Alfalfa check plants per sq ft	Crop Code No.	Expected Yield	Crop Code No.	Expected Yield	Crop Code No.	Expected Yield	* Regular Series P, K, pH, %OM $9	Sulfur ** $4	Zinc $4	Zinc, Copper, Iron, Manganese $10	Boron $6	Calcium and Magnesium $6	Nutrient Management P $5	Soluble Salts $5	
	1			☐ 4+ ☐ 2-3 ☐ 0-1	57	☐ 4+ ☐ 2-3 ☐ 0-1	57						X		X			X			Nitrate ☐ 0-6"/6-24" sample $5.00 ☐ 0-24" sample $5.00
	2			☐ 4+ ☐ 2-3 ☐ 0-1	25	☐ 4+ ☐ 2-3 ☐ 0-1	57						X	X	X		X	X			Nitrate ☐ 0-6"/6-24" sample $5.00 ☐ 0-24" sample $5.00
				☐ 4+ ☐ 2-3 ☐ 0-1		☐ 4+ ☐ 2-3 ☐ 0-1															Nitrate ☐ 0-6"/6-24" sample $5.00 ☐ 0-24" sample $5.00
				☐ 4+ ☐ 2-3 ☐ 0-1		☐ 4+ ☐ 2-3 ☐ 0-1															Nitrate ☐ 0-6"/6-24" sample $5.00 ☐ 0-24" sample $5.00
				☐ 4+ ☐ 2-3 ☐ 0-1		☐ 4+ ☐ 2-3 ☐ 0-1															Nitrate ☐ 0-6"/6-24" sample $5.00 ☐ 0-24" sample $5.00
				☐ 4+ ☐ 2-3 ☐ 0-1		☐ 4+ ☐ 2-3 ☐ 0-1															Nitrate ☐ 0-6"/6-24" sample $5.00 ☐ 0-24" sample $5.00

Recommendations available for these crops

** See comment on back side

* THE REGULAR SERIES NOW INCLUDES PERCENT ORGANIC MATTER

Crop Code	Name	Yield Unit
	LEGUMES	
01.	Alfalfa, New Seed	tons/acre
02.	Alfalfa, Established	tons/acre
03.	Birdsfoot Trefoil	tons/acre
04.	Legume/Grass Hay	tons/acre
05.	Legume/Grass Pasture	-
06.	Red Clover	tons/acre
	CORN	
07.	Corn, Grain	bu./acre
08.	Corn, Silage	tons/acre
09.	Sweet Corn	tons/acre
	SMALL GRAINS	
10.	Barley	bu./acre
11.	Oats	bu./acre
12.	Rye/Triticale	bu./acre
13.	Wheat	bu./acre
	MISCELLANEOUS	
14.	Buckwheat	lb./acre
15.	Edible Beans	lb./acre
16.	Fallow	-
17.	Flax	bu./acre
18.	Grass Hay	tons/acre
19.	Grass Seed Prod.	lb./acre
20.	Grass Pasture	-
21.	Millet	lb./acre
22.	Native Grasses	tons/acre
23.	Potatoes	cwt/acre
	MISCELLANEOUS (continued)	
24.	Rape/Mustard/Canola	cwt/acre
25.	Sorghum Sudan	-
26.	Soybeans	bu./acre
27.	Sugarbeets	tons/acre
28.	Sunflowers	lb./acre
29.	Wild Rice	-
	VEGETABLES	
30.	Asparagus, New Planting	
31.	Asparagus, Establ. Planting	
32.	Beans, Snap	
33.	Beets, Table	
34.	Broccoli	
35.	Brussels Sprouts	
36.	Cabbage	
37.	Cauliflower	
38.	Carrots	
	VEGETABLES (continued)	
39.	Celery	
40.	Cucumbers	
41.	Lettuce	
42.	Melons	
43.	Onions, Dry	
44.	Onions, Green	
45.	Parsnips	
46.	Peas	
47.	Peppers	
48.	Pumpkins/Squash	
49.	Radishes	
50.	Turnips	
51.	Rhubarb	
52.	Rutabagas	
53.	Spinach	
54.	Tomatoes	
	FRUITS	
55.	Apples	
56.	Blueberries	
57.	Grapes	
58.	Raspberries/Brambles	
59.	Strawberries	
	TURF	
60.	Cultured Sod	
61.	NURSERY – FIELD STOCK TREES/SHRUBS Suggested tests: Regular, Soluble Salts, Nitrate. For sampling instructions, please see Nursery Form MI-3658-GO.	
62.	Other ______________	

REV 3/03

University of Minnesota
Soil Testing Laboratory

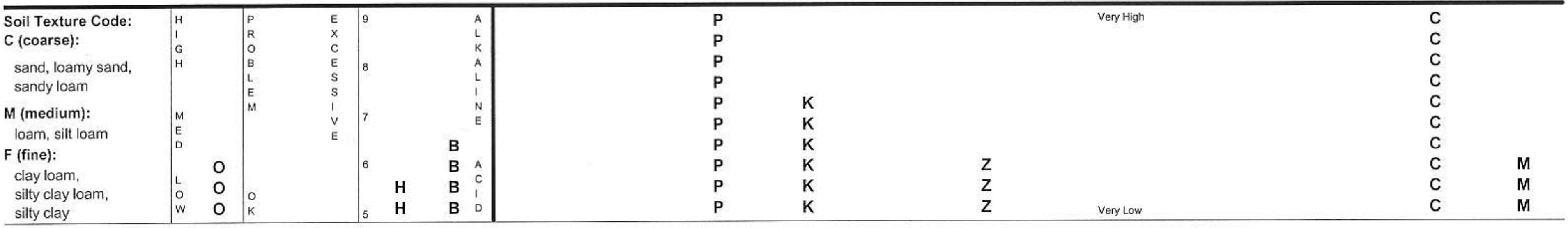
SOIL TEST REPORT
Farm and Field

Client Copy
Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

FARMER DOE
ROUTE 1
ANYWHERE MN 55000

Page	1
Report No.	9
Laboratory No.	146999
Date Received	03/08/2005
Date Reported	03/20/2005

INTERPRETATION OF SOIL TEST RESULTS



SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
	Medium	**3.0**		**5.5**	**6.5**			**30**	**85**		**0.5**					**1500**	**70**

RECOMMENDATIONS **Crop Before Last: Grapes; Last Crop: Grapes**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Grapes	Broadcast	**2500**	**30**	**50**	**100**		**10**					**0**	**50**
	Row/Drill						**2**						**10**

Comments: 3,18,24,50,53,64

Pre-Plant Soil Testing Sufficiency Ranges

Test	OSU*	ISU	U of MN	NRAES-145**
Soil pH	**5.5 - 6.5**	**6.0 - 6.5**	**6.0 to 7.0**	**
Phosphorus (P)	**20 - 50 ppm**	**> 30 ppm**	**> 25 ppm**	**20 - 50 ppm**
Potassium (K)	**125 - 150 ppm**	**> 150 ppm**	**> 160 ppm**	**75 - 100 ppm**
Magnesium (Mg)	**100 - 125 ppm**	**100 - 125 ppm**	**~ 100 ppm**	**100 - 250 ppm**
Zinc (Zn)	**4 - 5 ppm**	**3 - 4 ppm**	**> 1 ppm**	**2 ppm**
Organic matter	**2 - 3 %**	**2 - 3** (4) **%**	**- -**	**3 - 5 %**
Calcium (Ca)	- -	- -	> 600 ppm	500 - 2000 ppm
Boron (B)	.75 - 1.0 ppm	- -	> 1 ppm	0.2 - 2.0 ppm
Manganese (Mn)	- -	- -	> 6 ppm	20 ppm
Copper (Cu)	- -	- -	>0.2 ppm	0.5 ppm
Iron (Fe)	- -	- -	--	20 ppm
Sulfur (S)	- -	> 7 ppm	> 7 ppm	- -

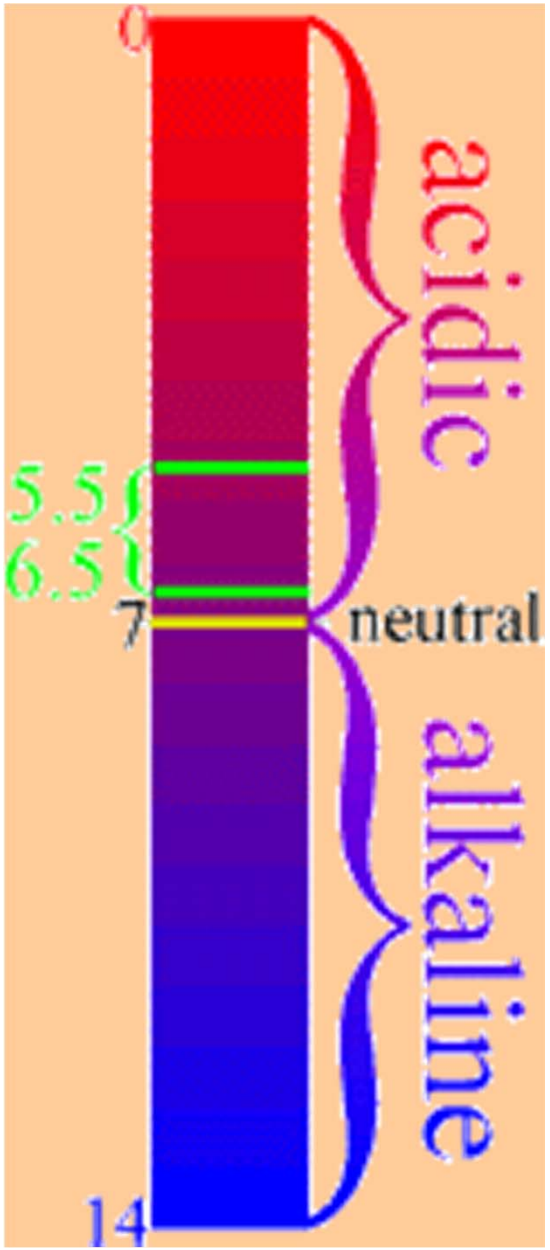
* **Midwest Small Fruit Pest Management Handbook** (OSU Ext. Bull. 861)
& **Midwest Grape Production Guide** (OSU Ext Bull. 919)

** **Wine Grape Production Guide for Eastern North America.**

Soil pH: **
5.0 *V. Labrusca*
6.0 hybrids
6.5 *V. vinifera*

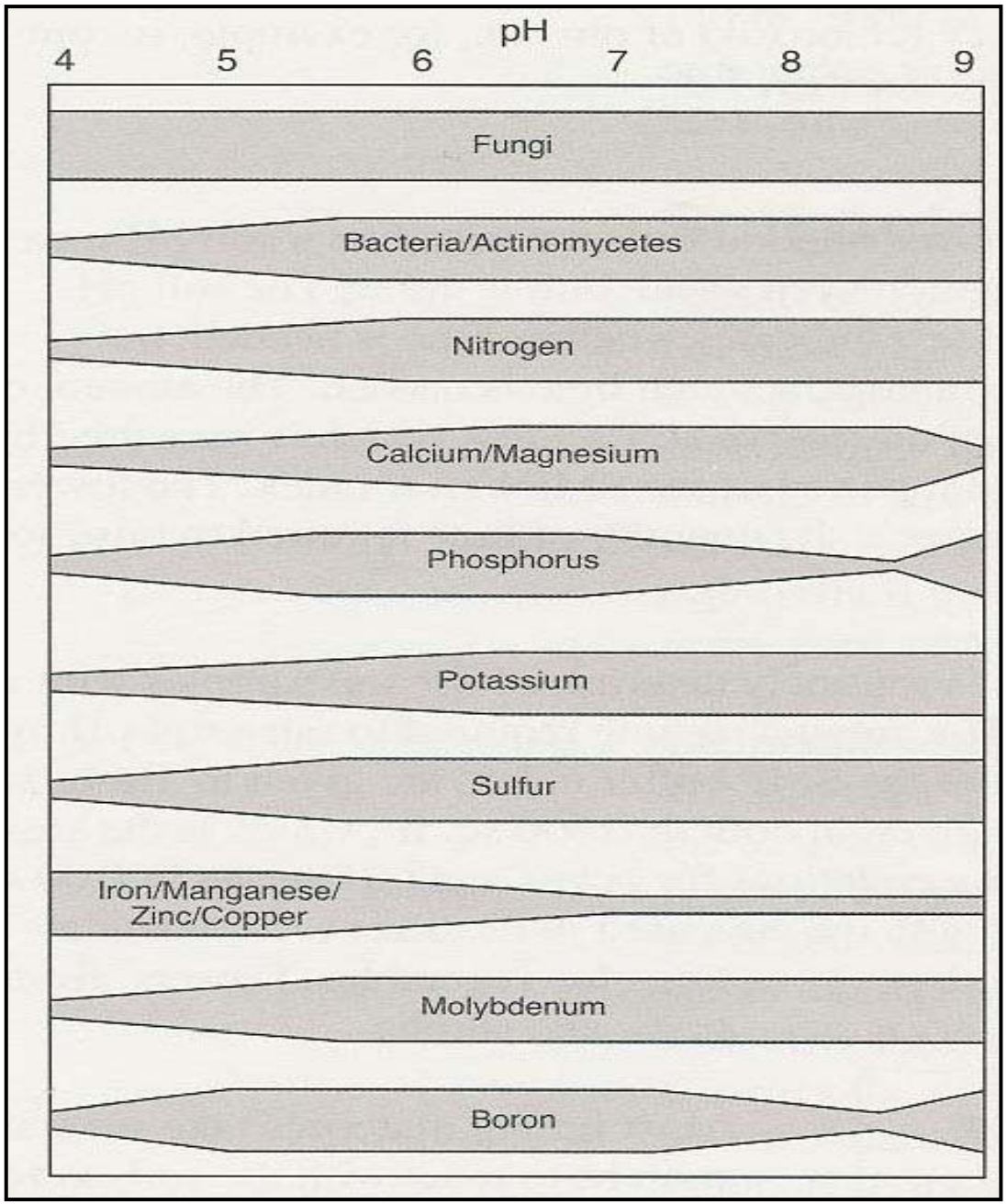
Soil pH

- Ideal pH range for grapes: 6.0 to 7.0
- Low pH easily modified before planting; high pH is often a problem – particularly with high carbonates
- Difficult to change after planting



Soil pH

- Microbial activity
- Nutrient availability



Mineral soils

Modifying Soil pH

- Lime recommended if pH <6.0
  - Rate based on buffer pH
- Lime also adds Ca and Mg
  - Dolomitic lime contains Mg
- Incorporate lime 8 to 10 inches
  - Apply one year before planting
- Acidification of high pH soils is difficult and can be expensive

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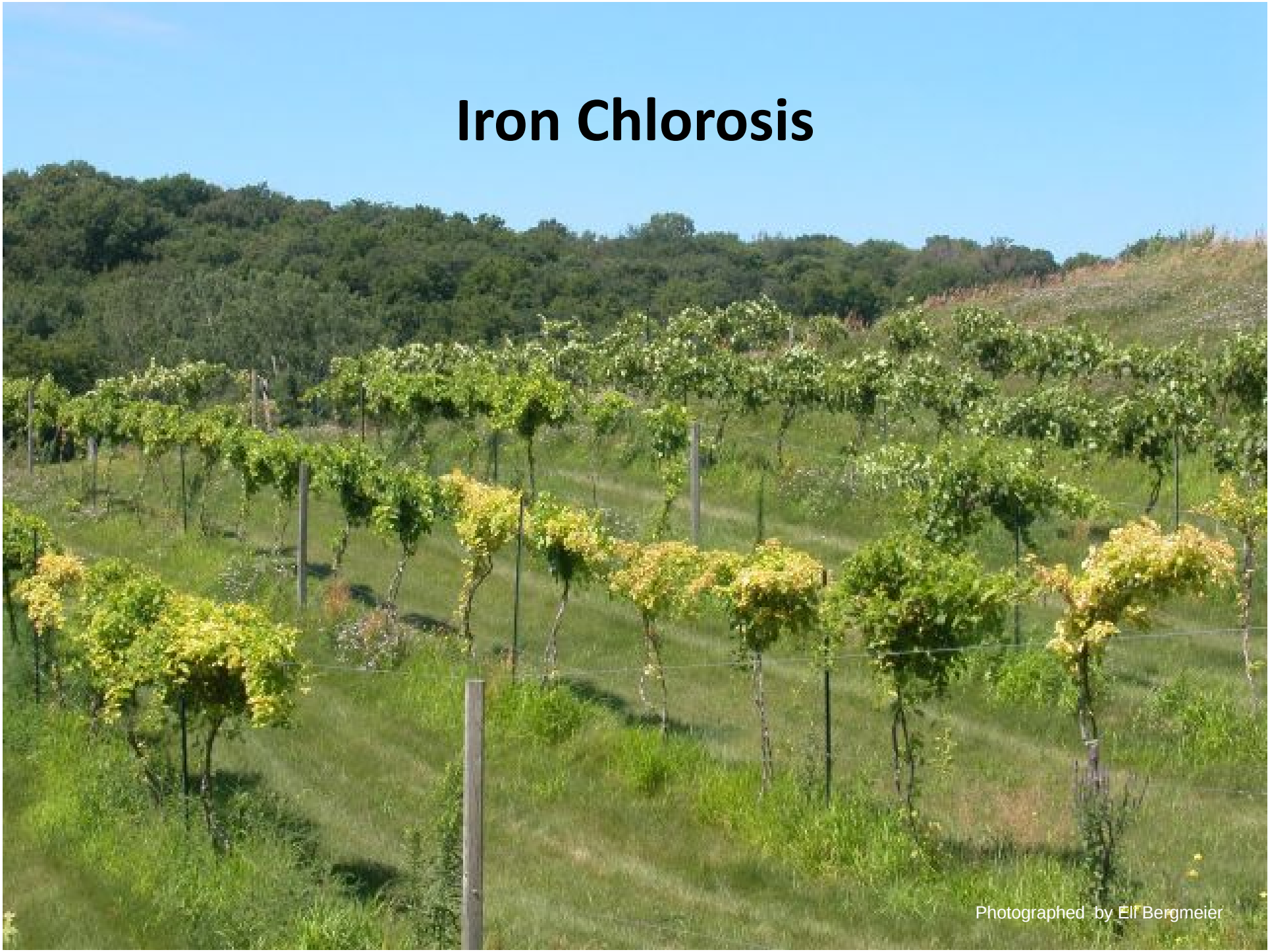
Iron Chlorosis



Lowering Soil pH Before Planting a Vineyard

- **Soil pH between 6.5 to 7.0**
  - Do nothing? (labrusca types vs interspecific hybrids)
  - Apply sulfur to lower the pH to 6.5 or 6.0 ***or***
  - Take other measures to lower the soil pH
    - Acidifying forms of N fertilizer

N Source (1 lb)	lbs of lime neutralized
Ammonium sulfate	5.4
Urea	1.8
Manure, compost, etc	variable

- **Soil pH 7.0 to 7.5**
  - Apply sulfur to lower the pH to 6.5 or 6.0 ***and***
  - Take other measures to lower the soil pH
    - Acidifying forms of N fertilizer

Acidifying sources:
Elemental S (1x)
Aluminum sulfate (6x)
Ferrous sulfate (8x)

- **Soil pH above 7.5**
  - Apply sulfur to lower the pH to 6.5 or 6.0 if free of carbonates
  - If carbonates present - Not recommended due to cost
    - Use soil applied iron chelates if chlorosis is a problem

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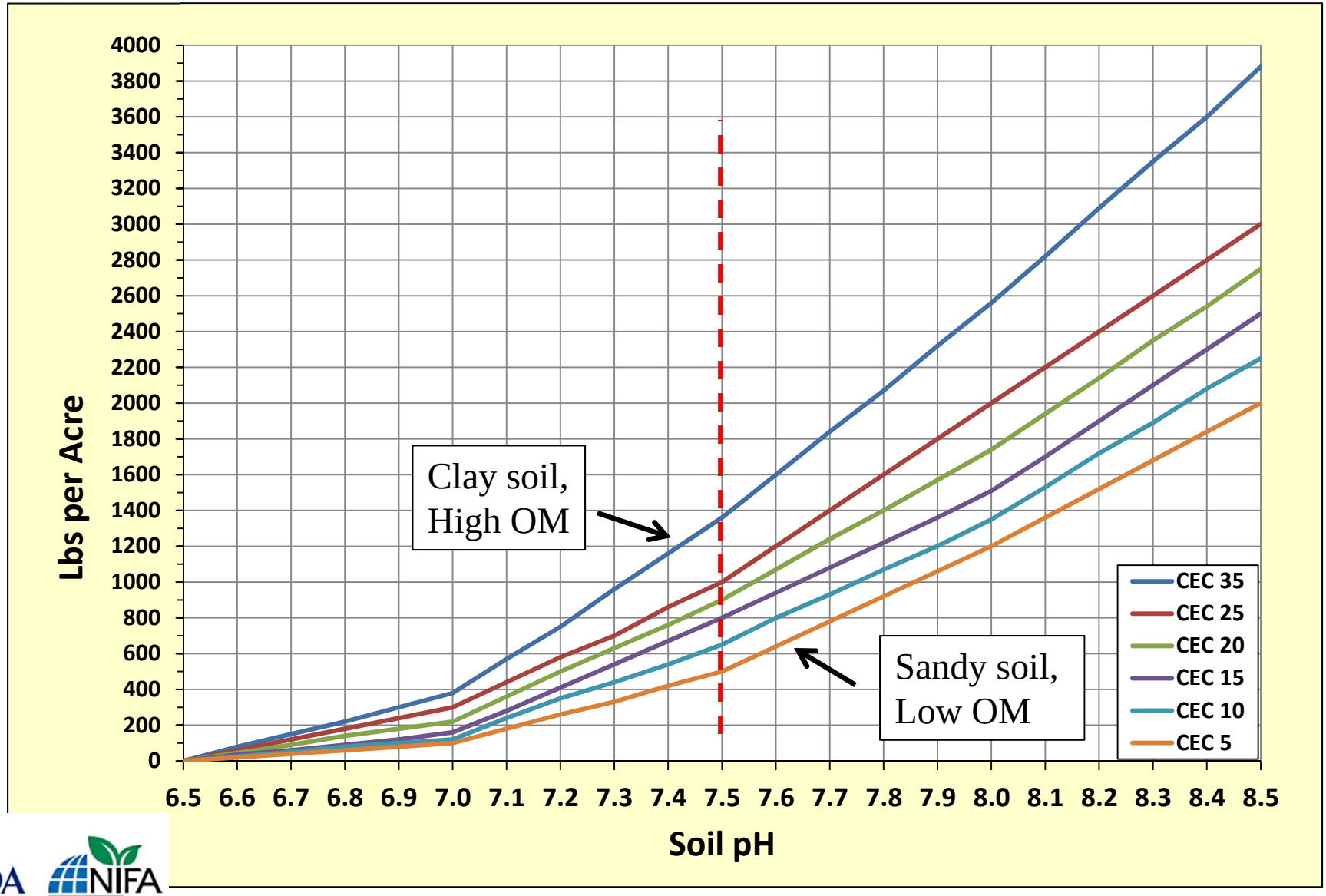
Sulfur Required to Lower the Soil pH to 6.5

For a Carbonate-free Soil



Fizz Test for Calcareous Soils*

Applying a few drops of household vinegar to a soil sample and listen and observe for bubbling.

Fizz test result	Estimated carbonates present (%)
None	0
Heard (barely audible)	0 – 1
Slight (few bubbles)	1 – 2
Moderate (several bubbles)	2 – 3
Vigorous (many bubbles)	> 3

* From: *Acidifying Soil for Crop Production: Inland Pacific Northwest*. Oregon St. Univ. Ext, Publ. EM 8917-E

Fertilizer Additions

(Before Planting)

- Base P and K needs on a soil test
  - Also Mg, Zn, and B
- Very difficult to correct P and K deficiencies after vines are planted
- Broadcast and incorporate to a depth of 8 to 10 inches

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Preplant Phosphorus Recommendations

Relative Soil Test P	Amount of Phosphate to Apply, lb P_2O_5/A
Very Low	150
Low	125
Medium	100
High	75
Very High	25

Preplant Potassium Recommendations

Relative Soil Test K	Amount of Potash to Apply, lb K_2O/A
Very Low	250
Low	200
Medium	150
High	100
Very High	0

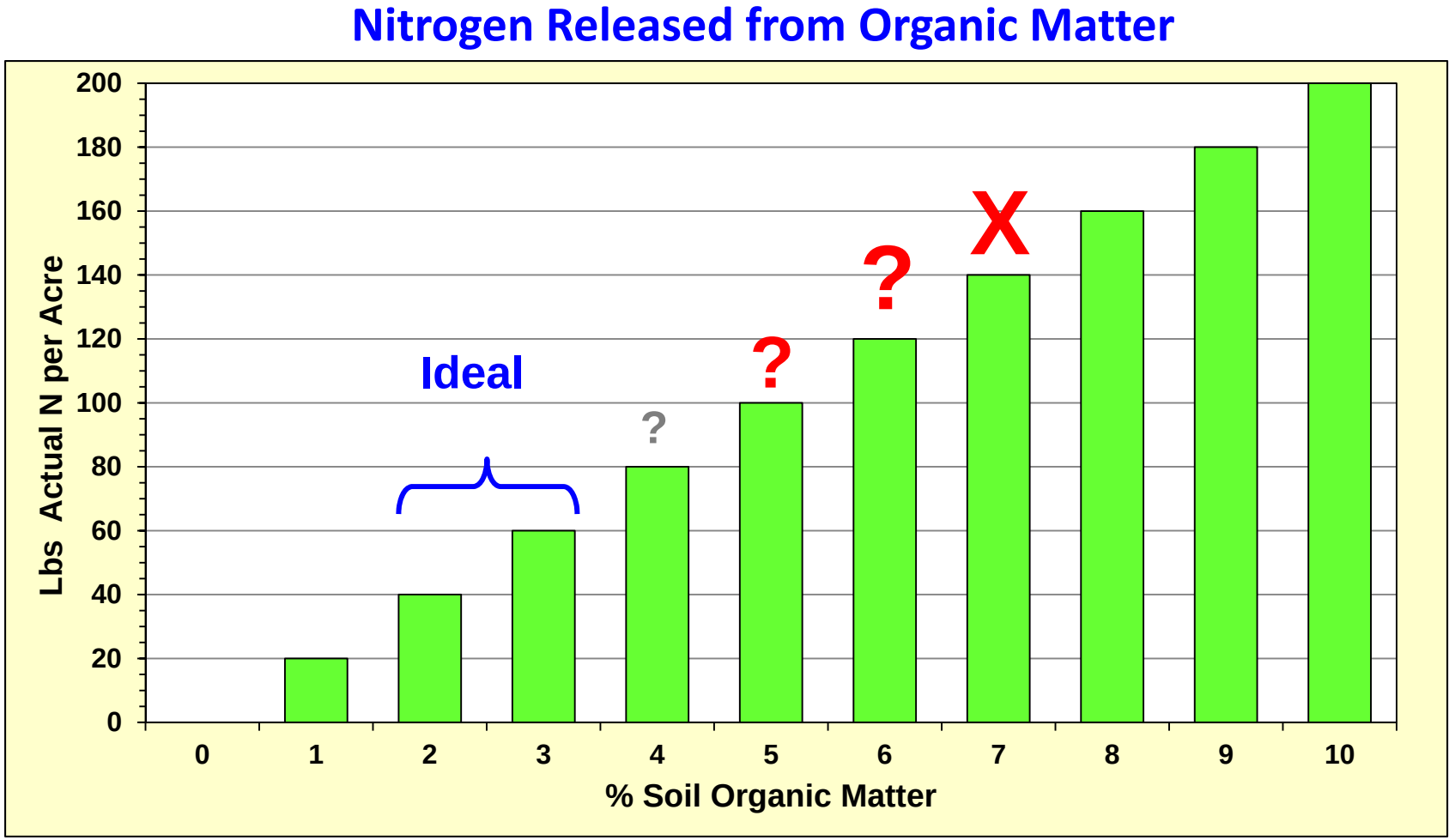
Potassium Stratification

Soil Depth (inches)	K Level (ppm)
0-3	250
3-8	95

Preplant Magnesium Recommendations

Relative Soil Test Mg	Amount of Magnesium to Apply, lb Mg/A
Low	100
Medium	50
High	0

Soil Organic Matter Content:



Need to adjust N fertilization practices based on the organic matter content of the soil.

N Fertilizer Recommendations

(Non-Bearing Vines 1st or 2nd year)

- General N recommendations:
  - 0-20 lb N/ac – high OM soils (>4.6%)
  - 20-30 lb N/ac – medium OM soils (3.1-4.5%)
  - 30-50 lb N/ac – low OM soils (<3.1%)
- Account for N from manure, compost, legume cover crops
- Apply inorganic N sources after planting
  - Split applications on sandy soils

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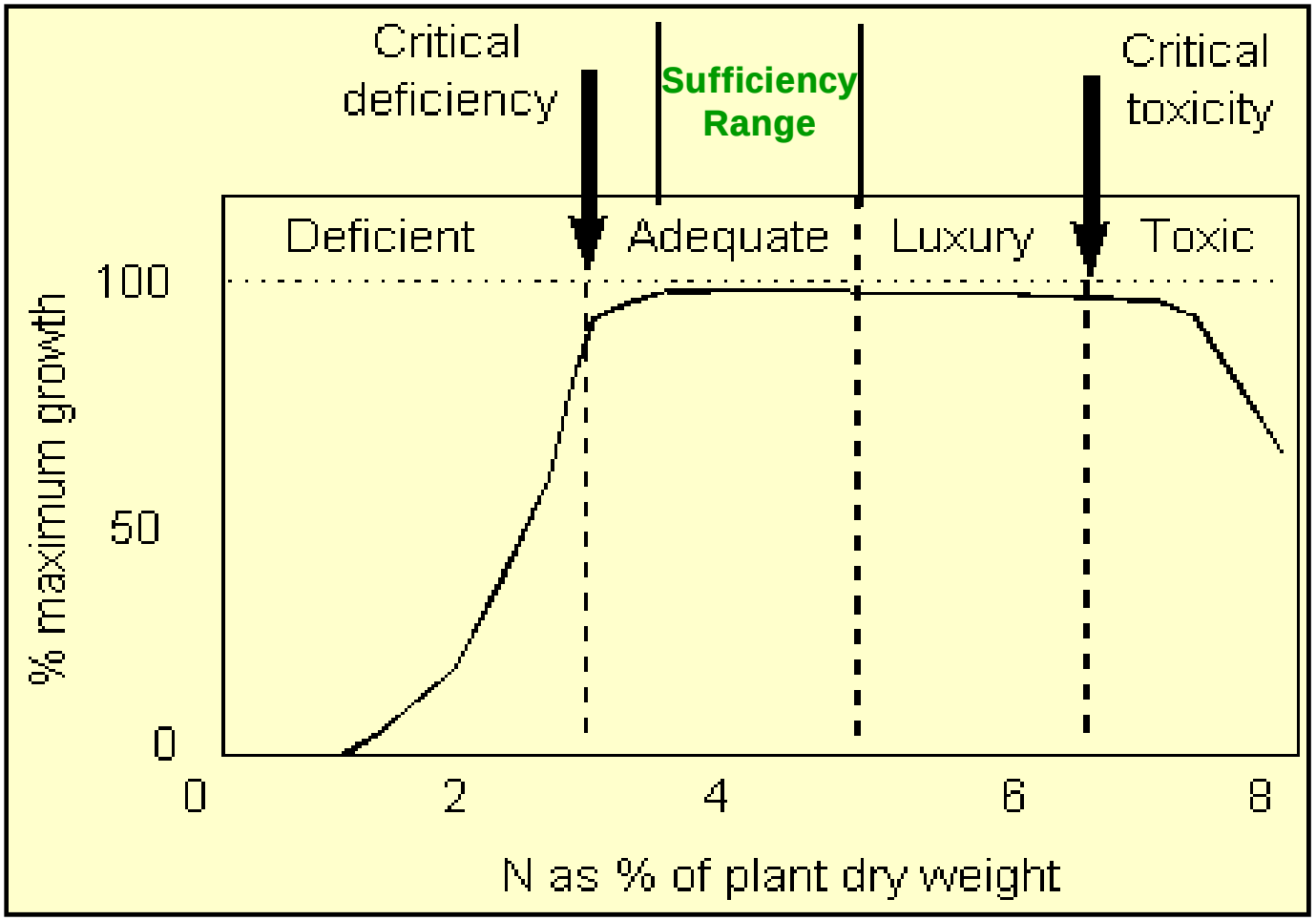
Tissue (petiole) Analysis

- Most reliable method of determining nutrient needs of established vines (start first year of fruiting or earlier)
- Submit samples on a yearly basis
- Compare to established sufficiency/deficiency ranges
- Some experience needed for interpretation
  - Adjust for site-specific factors

Critical Nutrient Level & Sufficiency Range



Tissue Analysis

Factors Affecting Nutrient Levels

- Crop load
- Cultivar/rootstock
- Cultural practices
- Insect and disease incidence
- Growing conditions (weather)

Recommended Times to Sample

- **Full bloom**
  - Mid to late June
- **Early veraison**
  - Mid-July to mid-August

- The mid-July to mid-August sampling date generally provides more accurate assessments of vine nutrition.

Normal Nutrient Ranges for Grapes

Based on Petiole Analysis

Nutrient	At Bloom (*for* American hybrids) *	Mid-July to Mid-Aug.** (*Fertilizing Fruit Crops*. OSU Bull. 458)
Nitrogen (N)	1.6 to 2.8 %	0.9 to 1.3 %
Phosphorous (P)	0.20 to 0.60 % ?	0.16 to 0.29 %
Potassium (K)	? 1.50 to 5.00 % ?	1.50 to 2.50 % ?
Calcium (Ca)	0.40 to 2.50 % ?	1.20 to 1.80 %
Magnesium (Mg)	0.13 to 0.40 %	0.26 to 0.45 %
Sulfur (S)	*No data (>0.1%)*	*No data (>0.1%)*
Manganese (Mn)	18 to 100 ppm	31 to 150 ppm
Iron (Fe)	40 to 180 ppm	31 to 50 (200) ppm
Boron (B)	25 to 50 ppm	25 to 50 ppm
Copper (Cu)	5 to 10 ppm	5 to 15 ppm
Zinc (Zn)	20 to 100 ppm	30 to 50 ppm
Molybdenum (Mo)	0.2 to 0.4 ppm	0.3 to 1.5 ppm

* Mills, H.A. and J.B. Jones. 1996. **Plant Analysis Handbook II**. MicroMacro Publishing

** With exception of Mo, ranges are published in the *Midwest Grape Production Guide*, OSU Bull. 919, & the *Midwest Small Fruit Pest Management Handbook*, OSU Bull. 861.

Normal Nutrient Ranges for Grapes

Based on Petiole Analysis

Nutrient	NRAES 145*	
	At Bloom	70-100 Days After Bloom
Nitrogen (N)	1.2 to 2.2 %	0.8 to 1.2 %
Phosphorous (P)	0.17 to 0.30 %	0.14 to 0.30 %
Potassium (K)	1.5 to 2.5 %	1.20 to 2.00 %
Calcium (Ca)	1.0 to 3.0 % ?	1.0 to 2.0 %
Magnesium (Mg)	0.3 to 0.5 %	0.35 to 0.75 % ?
Sulfur (S)	*No data*	*No data*
Manganese (Mn)	25 to 1,000 ppm ?	25 to 1,500 ppm ?
Iron (Fe)	20 ppm	30 to 100 ppm
Boron (B)	25 to 50 ppm	25 to 50 ppm
Copper (Cu)	5 to 15 ppm	5 to 15 ppm
Zinc (Zn)	30 to 60 ppm	30 to 60 ppm
Molybdenum (Mo)	.5 ppm	.5 ppm

* Wine Grape Production Guide for Eastern North America.

Collecting a Petiole Sample

- **Collect at the same time each year!**
- Do not mix cultivars into one sample!
- If a planting is located on more than one soil type, collect separate samples for each soil type.
- If a planting received different fertilizer applications, separate samples should be collected.
- A sample should consist of 100 petioles, or 150-200 for cultivars with small petioles.

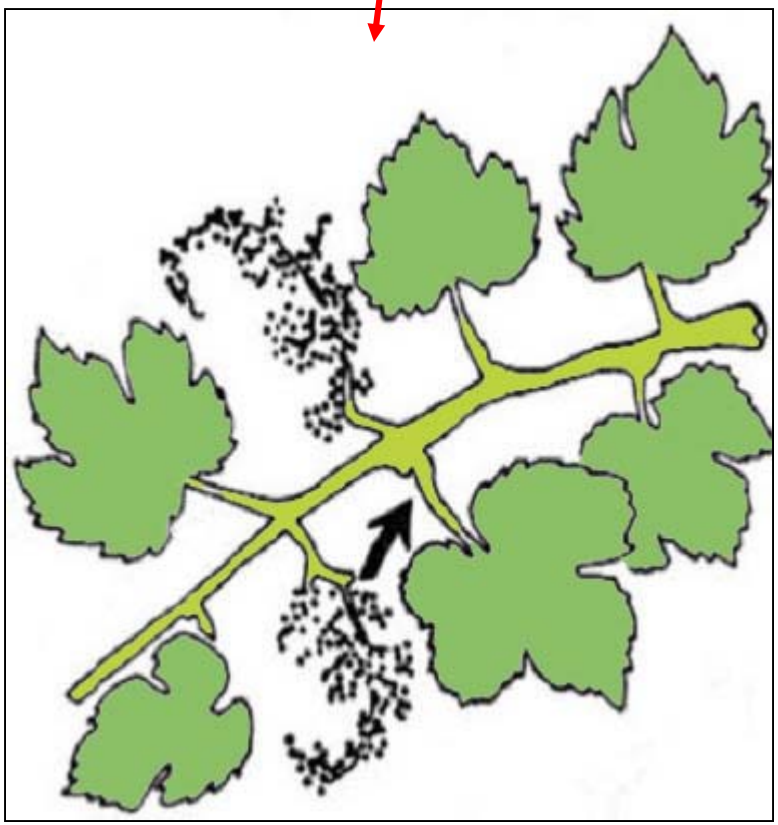
Collecting a Petiole Sample

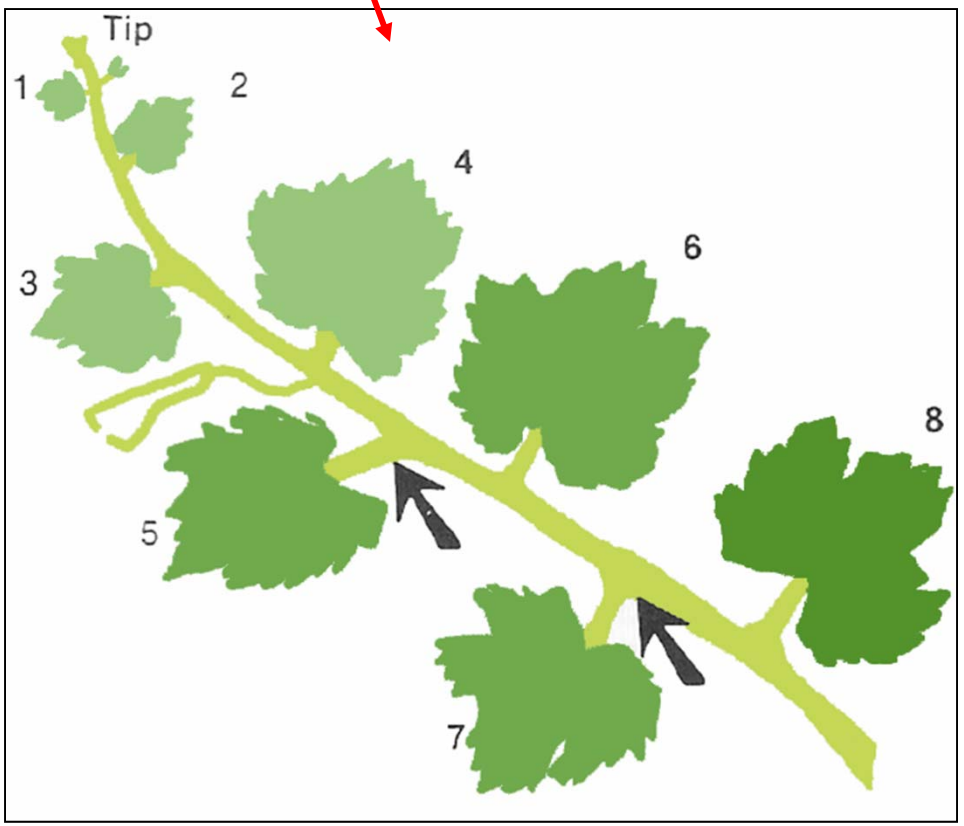
- Collect petioles randomly from representative vines in the designated sampling area.
- Collect petioles from fruit bearing shoots.

  Full bloom: Petiole opposite first cluster.

  Mid-summer: Most recently fully expanded leaf.
- Collect no more than one petiole per shoot.
- Avoid sampling from abnormal, weak or unhealthy vines unless they will be sampled and submitted separately.
- Choose leaves free from insect, disease or mechanical injury.

Full Bloom vs Mid-Summer





Opposite of the first cluster.

Most recently fully expanded leaf.

Figures adapted from: *Grapevine Nutrition and Fertilization in the San Joaquin Valley*. 1978 Univ. of California publ. 4087

Cleaning the Sample?

Best to allow nature to take care of by collecting after a heavy rain.

If the samples are dirty, or if foliar nutrients were recently applied:

- Rinse the sample in a mild detergent solution followed by 2 distilled or de-ionized water rinses.
- Wash while the leaves / petioles are still fresh.
- After rinsing, pat sample dry with clean paper towels.
- The whole procedure should be completed within a minute.

Preparing a Petiole Sample

- Remove the leaf blades.
  - **DO NOT use a metal utensil.**
- Place the petioles in an unused paper bag, or bag provided by the Lab.
- On the bag, Identify the sample:
  - Your name & address
  - Crop & cultivar
  - Field / sample number
- Map & identify each sampling area for your future reference.
- Submit the sample.

Trouble-shooting

- If you are trying to diagnose specific symptoms, send in two samples of 75 to 100 petioles:
  - One set from vines showing the symptoms.
  - Another set from vines not showing symptoms.

- This can be done at any time of the growing season.

Interpreting a Petiole Analysis

Submit the sample to a Lab for analysis

- **Most Labs will provide an interpretation of the results.**
  - Make sure the Lab used the sufficiency ranges for the time you sampled.
  - If you have doubts, send the results to your Extension Specialist to look over the interpretation.

Interpreting a Petiole Analysis

Petiole analysis is not an exact science.

- Can tell if you need to apply more or less of a nutrient.
- The more information available, the better.
- Annual testing allows you to fine-tune your fertilizer program.

To assist, additional information suggested:

  - The vigor & health of the vines.
  - Soil type, texture and internal drainage classification.
  - Previous soil test results.
  - Production potential for current and previous season.
  - Current and past fertilizer program.
  - Spray materials applied prior to collecting the sample.
    - Micro-nutrient containing fungicides
    - Foliar nutrient sprays

Normal Nutrient Ranges for Grape Petioles

Mid-July to Mid-August (early veraison) Sampling

Nutrient	Deficient	Below Normal	Normal	Above Normal	Excessive
N (%)	0.30 - 0.70	0.70 - 0.90	0.90 - 1.30	1.40 - 2.00	>2.10
P (%)	≥0.12	0.13 - 0.15	0.16 - 0.29	0.30 - 0.50	>0.51
K (%)	0.50 - 1.00	1.10 - 1.40	1.50 - 2.50	2.60 - 4.50	>4.60
Ca (%)	0.50 - 0.80	0.80 - 1.10	1.20 - 1.80	1.90 - 3.00	>3.10
Mg (%)	≥0.14	0.15-0.25	0.26-0.45	0.46-0.80	>0.81
S (%)	*No data*	*No data*	>0.10	*No data*	*No data*
Mn (ppm)	10 - 24	25 - 30	31 - 150	150 - 700	>700
Fe (ppm)	10 - 20	21 - 30	31 - 100	101 - 200	>200
B (ppm)	14 - 19	20 - 25	25 - 50	51 - 100	>100
Cu (ppm)	0 - 2	3 - 4	5 - 15	15 - 30	>31
Zn (ppm)	0 - 15	16 - 29	30 - 50	51 - 80	>80
Mo (ppm)			0.3 - 1.5		

From: Fertilizing Fruit Crops. Ohio Coop. Ext. Ser. Bull. 458.
Reprinted in: Midwest Grape Production Guide. OSU Ext. Bull. 919.

What if petiole analysis shows a need for a nutrient?

How much should be applied?

When should it be applied?

How often should it be applied?

How should it be applied? (soil vs foliar)

Factors that need to be considered:

- Mobility of the nutrient.
- Soil texture / cation exchange capacity.
- Soil pH as it affects nutrient availability/solubility.
- Soil organic matter content.

Nitrogen (N)

(OSU: 0.9 – 1.3 %)

(NRAES: 0.8 – 1.2%)

Nitrogen Fertilizer Recommendations* Based on Petiole Analysis (mid-July to mid-August)	
Petiole N (0.9 – 1.3%)	**N Fertilizer to Apply (lbs actual N / A)**
> 1.5	**0**
1.3 – 1.5	**20**
0.9 – 1.3	**30**
< 0.9	**40 - 50**

* Dr. Carl Rosen, Univ. of Minnesota

Other concerns: petiole K & Zn content

What form of nitrogen should be used?

Nitrogen Fertilizers:

- **Nitrate forms - NO_3 :**
  - Raise the soil pH.
  - Readily available to plants.
  - Very subject to leaching.
- **Urea - $CO(NH_2)_2$:**
  - Little change in the soil pH.
  - Taken up as urea, or converted to NH_4-N then to NO_3-N.
  - Will volatilize under warming temperatures when surface applied.
  - Will volatilize when surface applied on higher pH soils.
- **Ammonium forms – NH_4 :**
  - Lower the soil pH,
  - Slowly available, must convert to NO_3-N to be taken up by vines.
  - Requires soil temperatures above 50^o F to convert to NO_3-N.
  - Can be tied up on soil particles.
    - Less prone to leaching.

Applying Nitrogen

How much could be leached out of the root zone?

- Sandy soils are more prone to leaching.
  - Consider split N applications – half pre-bud break & the other half ~ 4-6 weeks after bud break.
  - With trickle irrigation, apply multiple applications spread out from bud break to about early-July.

Using Complete fertilizers (13-13-13)?

- Only if there is a need for each of the nutrients.
  - Expensive
  - Immobility of P and K.
  - Risk of K-induced Mg deficiency on sandy soils.

Phosphorous (P)

(OSU: 0.16 – 0.29 %)

(NRAES: 0.14 – 0.30%)

- **Practically immobile in the soil.**
  - Pre-plant soil analysis & amend before planting.
- **Generally not a problem.**
  - Plants often do well on low P soils.
    - **Unavailable ⇄ Exchangeable ⇄ Available P in the soil.**
    - **Soil mycorrhizal organisms aid in making P available.**
- **Can be a problem on sandy, low CEC soils.**
  - Apply manure in the fall as an N source.
    - **N (1-3%), P (0.3-3.2%), K (.5-2.9%); OM (30-74%)**
  - Winery pomace (dried).
    - **N (1-2%), P (~1.5%), K (.5-1.0%); OM (80%)**
  - Apply ammonium mono phosphate (11-52-0) as a N source.
  - Apply P as a foliar application (refer to labels).

Potassium (K)

(OSU: 1.50 – 2.50 %)

(NRAES: 1.20 – 2.00%)

Moves very slowly in the soil.

- For perennial crops, high rates of K are needed to move the K down into the root zone.
- **If petiole analysis shows a need for K.**

Potassium Fertilizer Recommendations* Based on Petiole Analysis (mid-July to mid-August)	
Petiole K (1.5 – 2.5%)	**K Fertilizer to Apply (lbs K_20 / A)**
> 2.0	**0**
1.5 – 2.0	**100 – 200**
1.0 – 1.5	**200 – 300**
< 1.0	**300 - 400**

* Dr. Carl Rosen, Univ. of Minnesota

Potassium Management

Soil K applications:

- **Apply when the need has been identified:**
  - Potassium chloride (0-0-62)
  - Potassium sulfate (0-0-50)
  - Potassium magnesium sulfate, Sul-Po-Mag (0-0-22 + 22% S, 11% Mg)
- **Apply in the spring:**
  - Potassium nitrate (13-0-44) *as a source of N*

Foliar K applications:

- Often needed in addition to soil applications to correct deficiencies for the first year or two.
- **Begin applying early in the season:**
  - Potassium nitrate (44% K, 13% N) &
  - Potassium sulfate (53% K, 18% S)
    - Apply at 6 to 10 lb / 100 gallons (1 to 3 applications/season).
  - Vigor-K™ (20% K) *follow label directions*
  - Nutri-K® (15% K) *follow label directions*

Apply a straw mulch under the vines.

Magnesium (Mg)

(OSU: 0.26 – 0.45 %)

(NRAES: 0.35 – 0.75 %)

Can be a problem on sandy soils, particularly when K has been over applied.

- If the soil pH is low (acid), apply dolomitic lime to raise the pH to 6.0 or 6.5.
- If the soil pH is in the optimal range, apply:
  - 50 to 100 lb magnesium oxide (MgO) /A.
  - 300 to 600 lb Epson salt ($MgSO_4$) /A.
- Foliar applications of Epson salt at 10 lb/100 gal.
  - Apply as 2 post-bloom applications.

Excessive Mg can be a problem on some calcareous soils.

- Inhibits K uptake.

Boron (B)

(25 – 50 ppm)

Can be low in many Midwest & high pH soils

- B is involve in fruit set.
  - Improves the rate of pollen tube growth and thereby improves fertilization of the flowers.
- If there is a need for B.
  - 4 to 6 lbs B / A as a soil application.
  - Pre- and post-bloom foliar applications of Solubor (20% B) at a rate of 2 to 4 lbs/A per application.
    - First application at about the 3-inch stage of shoot growth.
    - Post bloom application, if needed.
    - Tight vs loose clustered variety?

Manganese (Mn)

(OSU: 31 – 150 ppm)

(NRAES: 25 – 1,500 ppm)

Can be low on sandy and high pH soils.

- If Mn is low.
  - **Include a Mn-containing fungicide in your early season disease control program.**
    - **mancozeb** (Dithane M-45, Maneb, Penncozeb)
      - **Contains 16% Mn.**
      - **66 day pre-harvest interval.**
  - Apply a chelated form of Mn as a foliar spray (*refer to label*).

Can be excessive (> 700 ppm) on low pH soils.

- Apply lime to raise the soil pH.

Zinc (Zn)

(OSU: 30 – 50 ppm)
(NRAES: 30 – 60 ppm)

Can be low on sandy, high pH, eroded, terraced or leveled soils.

- **If Zn is low:**
  - **Soil application of zinc sulfate (36% Zn) to bring the available Zn up to 6-8 lb/A.**
  - **Include a Zn-containing fungicide in your early season disease control program.**
    - **mancozeb (Dithane M-45, Maneb, Penncozeb)**
      - **Contains 2% Zn.**
      - **66 day pre-harvest interval.**
    - **Ziram**
      - **Contains 16% Zn.**
      - **21 day pre-harvest interval.**
  - **Apply a chelated form of Zn as a foliar spray** (*refer to label*)**.**

Iron (Fe)

(OSU: 31 – 50 (*200*) ppm)

(NRAES: 30 – 100 ppm)

Can be low on high pH soils (> 7.4) and some sandy soils.

- If Fe is low.
  - Apply Fe chelate as a foliar spray at a rate of 1-2 lb/A. per application.
    - Start early and repeat every 10-20 days (*refer to label*).
  - Take measures to lower the soil pH.

Summary of Vineyard Fertilizer Management

- **Pre-plant:**
  - Soil Test: **pH, P, K, Mg, Zn, CEC, O.M.**
  - Amend soil as needed and incorporate.
- **After planting:** Apply some N (~.5 oz actual N/vine) , to get vines off to a good start.
- **Non-bearing years:** Apply N based on the soil's organic matter content.
- **When production begins:**
  - Begin petiole analysis on an annual basis.
  - Adjust N fertilizer rates based on test results and vine vigor.
  - Apply other nutrients as needed based on petiole analysis results.
- **DO NOT apply any nutrients unless there is a need!**

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