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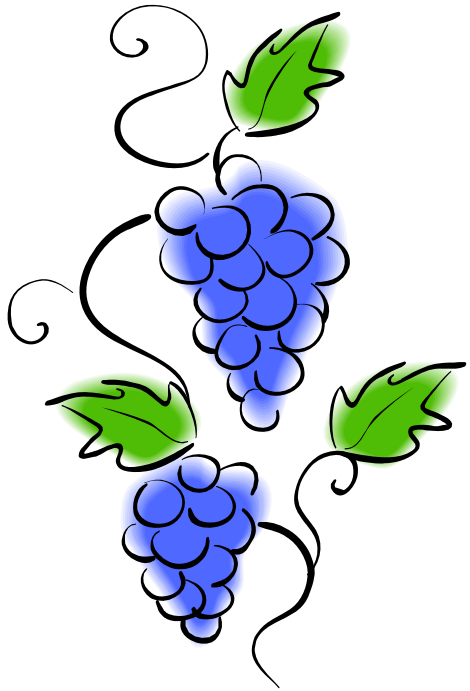
College of Agricultural Sciences

Grapevine Nutrition



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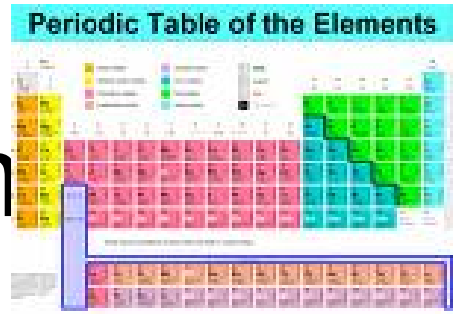
Goals of Vine Nutrition



- Maintain a healthy, productive, sustainable vine
- Getting fruit and wood fully ripe as soon as possible
- Agronomy vs. Viticulture
- With fertilizers, more is not always better
- The special case of “N”
- Promote wine quality through proper nutrition
- Fit these goals into a sustainable viticulture program – do no harm

Vine Balance and Size

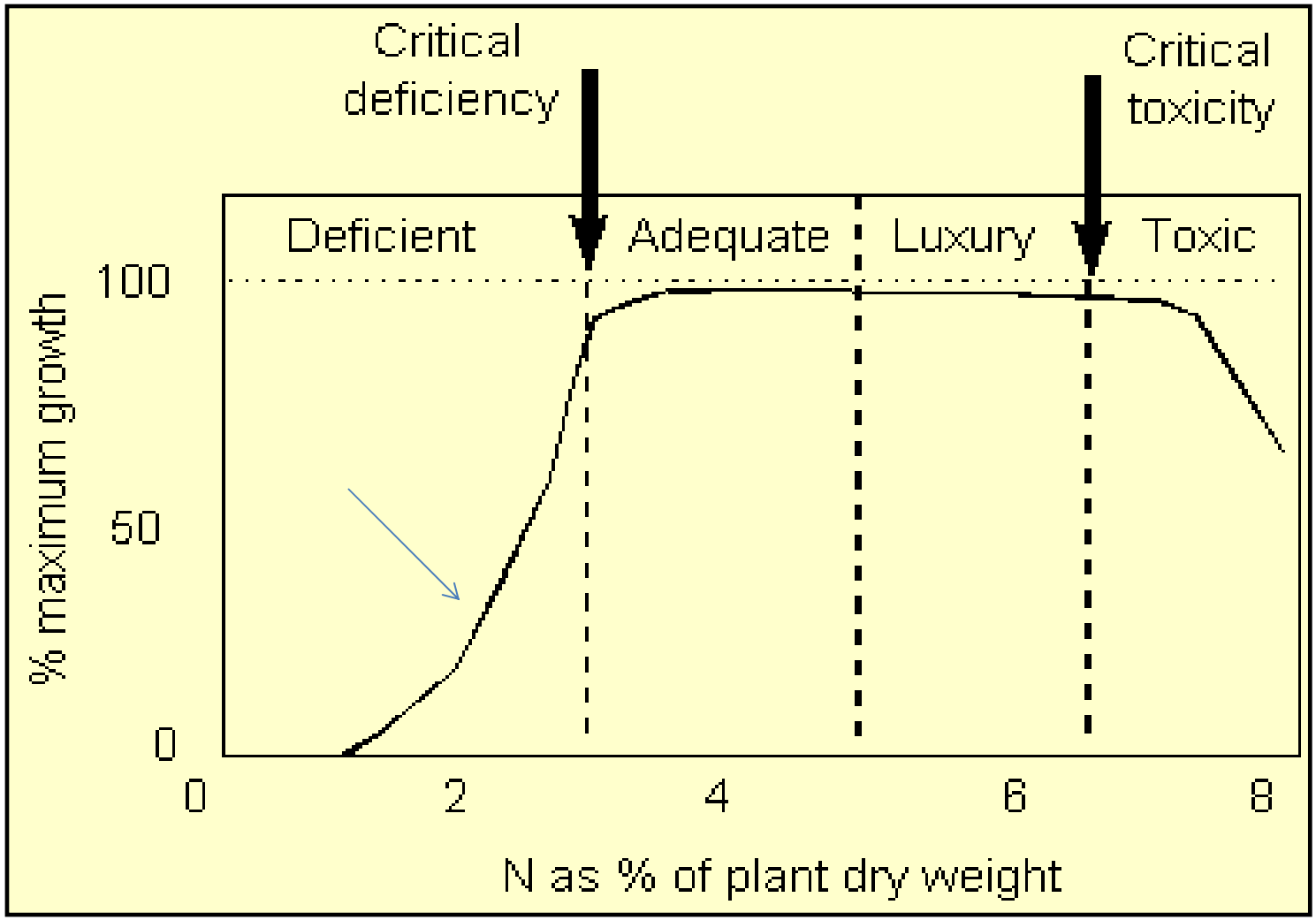
- Create a small to moderate size vine
- Balance amount of foliage and crop

+ better light, air and spray penetration into interior of canopy, improved bud fruitfulness, less disease, lower management costs, riper fruit, easier to manage fruit zone, cold hardiness

- Lots of shade, increased humidity in canopy interior, more disease, increased MPs, more labor and gas (shoot positioning, hedging, thinning, pruning, etc), bull canes, higher pH wines (K+)

Different amounts of vine size and balance: which one applies to you?

Nitrogen levels will affect wine quality



Nutrition begins before the first vine is planted…

- Site assessment
  - Soil chemistry testing
    - Find a reliable lab with viticulture experience
    - Interpreting the data
  - Sensory assessment of the field
    - Above: Vegetation and topography
    - Below: color, texture and aromas

Essential Plant Nutrients for Growth

Derived from 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

Obtained from water and air: Carbon, Hydrogen and Oxygen

ELEMENTS MOST ESSENTIAL TO PLANT STRUCTURE AND ACTIVITIES.

STRUCTURE

MEMBRANES
- Calcium
- Manganese
- Boron

CELL WALLS
- Calcium
- Magnesium
- Iron
- Zinc
- Copper
- Boron

PROTEIN
- Nitrogen
- Phosphorus
- Potassium
- Sulfur
- Manganese
- Zinc
- Copper
- Molybdenum

NUCLEIC ACIDS
- Nitrogen
- Phosphorus
- Boron

ATP, GTP
- Phosphorus

OILS
- Phosphorus

CHLOROPHYLL
- Nitrogen
- Sulfur
- Magnesium
- Manganese
- Iron
- Molybdenum

ENZYMES
- Nitrogen
- Potassium
- Calcium
- Iron
- Magnesium
- Manganese
- Zinc
- Copper
- Cobalt
- Nickel

CARBOHYDRATES
- Phosphorus
- Potassium
- Boron
- Molybdenum

ORGANIC ACIDS
- Potassium

HORMONES
- Calcium
- Iron
- Zinc

ACTION

PHOTOSYNTHESIS
- Phosphorus
- Potassium
- Magnesium
- Manganese
- Copper

CO_2 FIXATION
- Magnesium

NITROGEN ABSORPTION
- Potassium

RESISTANCE
- Potassium

CELL DIVISION
- Potassium
- Magnesium

CELL ELONGATION
- Calcium
- Copper
- Boron

STOMATA OPEN & CLOSE
- Potassium

TRANSPIRATION
- Potassium

pH REGULATOR OF CELL SAP
- Zinc

RESPIRATION
- Sulfur
- Copper

NITROGEN FIXATION
- Molybdenum

ROOT GROWTH
- Calcium
- Zinc
- Copper

LEAF GROWTH
- Sulfur
- Calcium
- Magnesium
- Iron
- Zinc
- Copper

Nutrition Monitoring: 3 parts

- Scout for visual symptoms of deficiency and toxicity. See and observe
- Soil tests – pre-plant and every 3-5 years
- Tissue testing – every 1-2 years

All Elements are not created equal…

The ones you really care about:

- N
- K
- Mg
- Ca
- B
- Zn

The ones you sort of care about:

- P
- Fe
- Mn
- Mo

Soil Testing

- When: before planting and every 3-5 years
- Or when visual symptoms indicate a problem
- Supplement with petiole tests in established vineyards. Use both, not one or the other.
- What to test for: macro and micro nutrients, pH, cation exchange capacity, base saturation, organic matter (also texture if offered)
- The lab and method matter
- Interpreting the results correctly is critical!

Report Number:
R05305-0053
Account Number:
35930

A&L Eastern Laboratories, Inc.

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Fax No. (804) 271-6446 Email: office@al-labs-eastern.com

Send To: GEORGE D TIBONI DESIGN MGMT
41 W MAIN ST
CLINTON, NJ 08809

Grower: KARAMOOR FARM

Submitted By: GEORGE TIBONI

SOIL ANALYSIS REPORT

Page: 1 **Date Received:** 10/31/2005 **Date of Analysis:** 11/1/2005 **Date of Report:** 11/9/2005

Analytical Method(s):
Mehlich III

Sample Number	Lab Number	Organic Matter %	Organic Matter ENR lbs/A	Organic Matter Rate	Phosphorus Available ppm	Phosphorus Available Rate	Phosphorus Reserve ppm	Phosphorus Reserve Rate	Potassium K ppm	Potassium K Rate	Magnesium MG ppm	Magnesium MG Rate	Calcium CA ppm	Calcium CA Rate	Sodium NA ppm	Sodium NA Rate	pH Soil pH	pH Buffer Index	Acidity H meq/100g	C.E.C. meq/100g
1A	4702	1.5	64	L	12	VL			16	VL	180	VH	570	M			6.1	6.9	0.7	5.1
1B	4703	0.4	40	VL	6	VL			16	VL	225	VH	540	L			5.9	6.8	1.0	5.6
2A	4704	1.0	50	L	10	VL			16	VL	150	H	630	M			6.0	6.9	0.8	5.2
2B	4705	0.5	48	VL	5	VL			20	VL	245	VH	610	M			6.2	6.9	0.7	5.9
3B	4706	0.4	38	VL	4	VL			17	VL	345	VH	750	M			6.6	6.9	0.4	7.1

Sample Number	Percent Base Saturation K %	Mg %	Ca %	Na %	H %	Nitrate NO3-N ppm	Nitrate Rate	Sulfur SO4-S ppm	Sulfur Rate	Zinc ZN ppm	Zinc Rate	Manganese MN ppm	Manganese Rate	Iron FE ppm	Iron Rate	Copper CU ppm	Copper Rate	Boron B ppm	Boron Rate	Soluble Salts ms/cm	Soluble Salts Rate	Chloride CL ppm	Chloride Rate	Aluminum AL ppm	Aluminum Rate
1A	0.8	29.5	56.0		13.7	1	VL	10	L	1.6	L	60	VH	66	VH	0.7	L	0.3	VL						
1B	0.7	33.7	48.5		17.2			41	VH	0.6	VL	16	M	84	VH	0.2	VL	0.2	VL						
2A	0.8	23.8	60.0		15.4	1	VL	14	L	1.9	L	81	VH	86	VH	0.7	L	0.3	VL						
2B	0.9	34.9	52.1		12.1	1	VL	21	M	0.9	VL	28	H	75	VH	0.3	VL	0.3	VL						
3B	0.6	40.6	52.9		5.9			24	M	0.5	VL	10	M	74	VH	0.2	VL	0.2	VL						

Values on this report represent the plant available nutrients in the soil.
Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High).
ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams).
Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to the sample(s) tested. Samples are retained a maximum of thirty days after testing. Soil Analysis prepared by: A & L EASTERN LABORATORIES, INC.

by: Paul Chu, Ph.D.

Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park PA 16802
http://www.aasl.psu.edu

SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:
RAY S OSWALD 236 S. WHITEOAK ST KUTZTOWN PA 19530	

DATE	LAB #	SERIAL #	COUNTY	ACRES	FIELD ID	SOIL
04/17/2007	S06-30431	60603	Lehigh		Id-g	

SOIL NUTRIENT LEVELS				Below Optimum	Optimum	Above Optimum
Soil pH		6.1				
Phosphate	(P_2O_5)	779	lb/A			
Potash	(K_2O)	230	lb/A			
Magnesium	(MgO)	637	lb/A			
Calcium	(CaO)	2671	lb/A			

Recommendations For: *GRAPES*

Limestone and Magnesium:

Calcitic Limestone (calcium carbonate equivalent): NONE **Magnesium (Mg):** NONE

Plant Nutrient Needs:

Nitrogen (N):	Phosphate (P_2O_5):	Potash (K_2O):
75 lb/A	NONE	110 lb/A

MESSAGES

Grape cultivar name or type was not included in the information supplied by the grower. Because of this, lime recommendations are calculated to bring soil to a pH of 6.0. American grapes (juice or table such as Concord and Niagara) grow best at a soil pH of 5.5 while vinifera and French Hybrid grapes (wine grapes such as Cabernet Sauvignon, Chardonnay, Chambourcin, Vignoles) generally prefer a soil pH of 6.5.

If grapes are established do not apply lime, if recommended, unless pH is less than 4.5 for American grapes or less than 6.0 for vinifera and French Hybrid grapes. Apply no more than one ton/acre every twelve months to avoid potassium deficiency.

If growth is excessive, reduce nitrogen rate by half or omit entirely.

LABORATORY RESULTS:

[1]pH	[2]P lb/A	Exchangeable Cations (meq/100g) [3]Acidity	[2]K	[2]Mg	[2]Ca	[4]CEC	% Saturation of the CEC K	Mg	Ca	Optional Tests: Organic Matter %	Nitrate-N ppm	Soluble salts mmhos/cm
6.1	340	5.1	0.2	1.6	4.8	11.8	2.1	13.6	40.9			

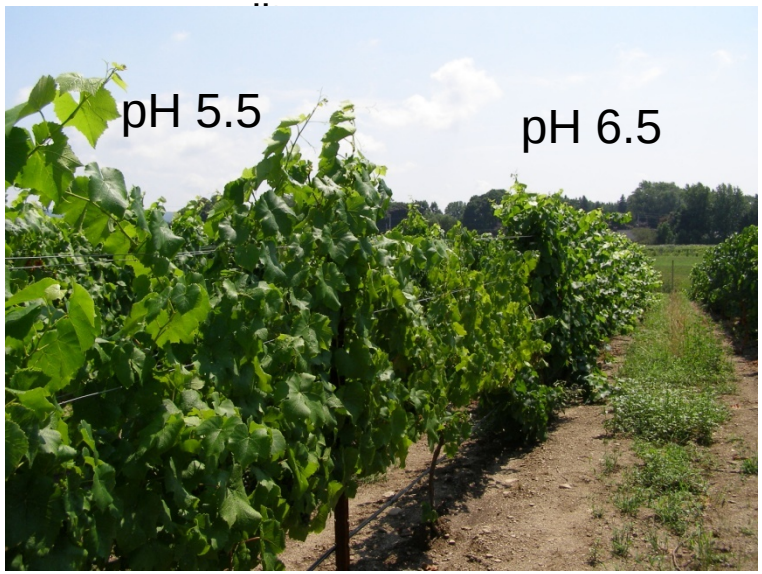
Test Methods: [1]1:1 soil:water pH, [2]Mehlich 3 (ICP), [3]Mehlich Buffer pH, [4]Summation of Cations

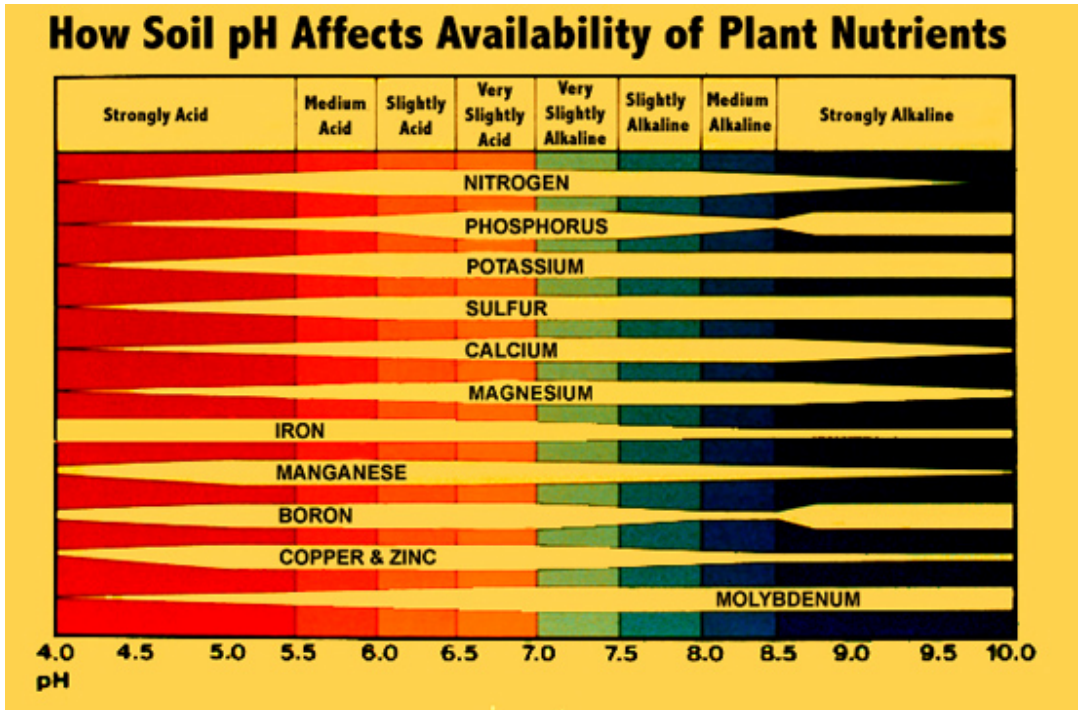
Commercial fruit and vegetable-1

2424

Soil pH: why it matters a lot…

- pH and its relation to vine size
- Cornell example
  - pH 5.5 vs 6.5
  - Effects on vine size and wine

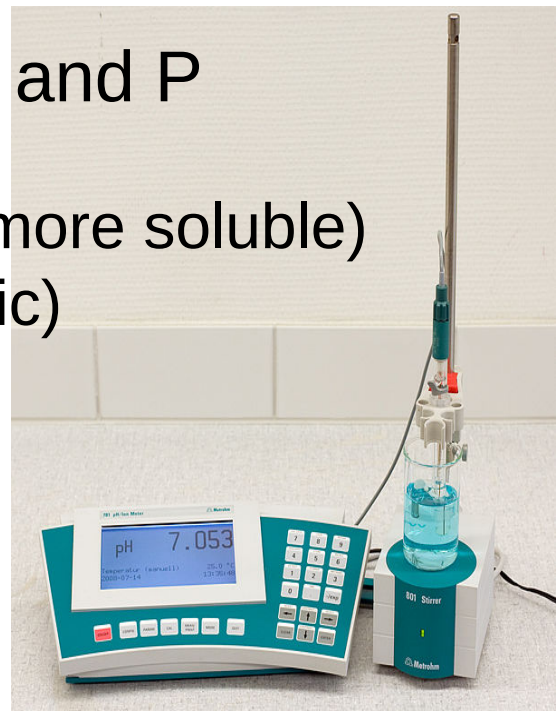




pH is the measure of acidity to alkalinity. Soil pH aff
nutrient uptake and microbial activity. Vines will gro
from pH 4.0-8.5, but below 5.5 and above 8 will
depress yields and create vine problems. pH will oft
drift down with use of fertilizers and sulfur.

Adjusting Soil pH

- Best to do it with a clean and open field
- Remember: soils will progressively acidify with normal farming practices
- Find the right range according to viticulture and wine making goals and pH status
- Low pH – problems with Al toxicity and P deficiency
  - Adjust with lime or gypsum (1000x more soluble)
  - Lime also adds Ca and Mg (dolomitic)
  - Incorporate as deep as possible
- High pH can affect vine growth
- Recommended range: 5.5-7.0



New Vines: easy does it

- Most soils in Eastern N.A are fertile
- How much growth is enough?
- Wait and see approach
- Read the tests: how much organic matter? < 3% vines may benefit
- Small amounts of “complete” fertilizer like 10-10-10 at 20 lbs actual N per acre. Apply to vine not broadcast. Apply correctly as a slow release to kick-start vine

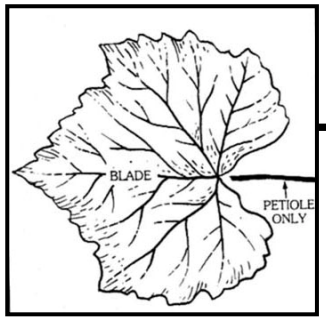
Target values for soil, bloom petiole, and late-summer petiole samplings

Nutrient	Soil		Bloom petiole		Late-summer petiole	
Nitrogen	--[z]	--	1.2 - 2.2	%	0.8 - 1.2	%
Phosphorus	20 - 50	ppm	0.17 - 0.30	%	0.14 - 0.30	%
Potassium	75-100	ppm	1.5 - 2.5	%	1.2 - 2.0	%
Calcium	500 - 2000	ppm	1.0 - 3.0	%	1.0 - 2.0	%
Magnesium	100 - 250	ppm	0.3 - 0.5	%	0.35 - 0.75	%
Boron	0.3 - 2.0	ppm	25 - 50	ppm	25 - 50	ppm
Iron	20	ppm	30 - 100	ppm	30 - 100	ppm
Manganese	20	ppm	25 - 1000	ppm	100 - 1500	ppm
Copper	0.5	ppm	5-15	ppm	5 - 15	ppm
Zinc	2	ppm	30-60	ppm	30 - 60	ppm
Aluminum	*< 100	ppm				
Organic matter	3 - 5	%				

[z] Soil nitrogen is not normally evaluated for vineyards.

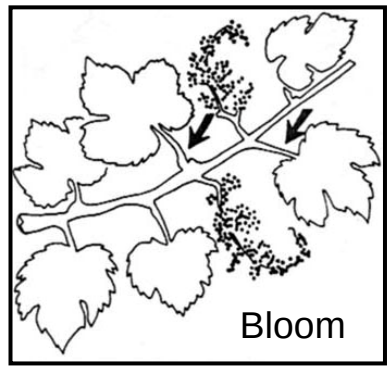
Compost: easy does it!

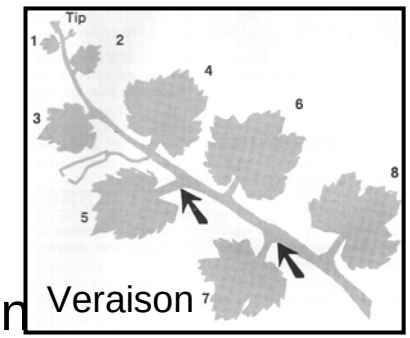
- Easy to get too much of a good thing
  - The case of Roth Vineyard
- It must be properly “composted”
- Hot compost can damage vines, especially young ones
- Commercial vineyard compost guide from Penn State at: http://fpath.cas.psu.edu/compostguide.pdf



Tissue (petiole) Analysis

- Determine vine nutrient status at that moment – sample for maintenance and troubleshooting
- Develop a nutrition history for the vineyard
- Factors the may impact tissue analysis include:
  - Crop load
  - Cultivar and rootstock
  - Cultural practices
  - Growing conditions, i.e. stresses on the vine
- When to sample
  - Bloom (May) for N P K
  - Veraison (mid-July to mid-August) for micronutrien
  - Check with your specific lab for bloom or veraison standards





What to look for now

Potassium deficiency

Magnesium deficiency

Potassium Fertilizers

- Potassium chloride (0-0-60)
- Potassium sulfate (0-0-50)
- Potassium-magnesium sulfate - Sul-Po-Mag (0-0-22)
- Potassium nitrate (13-0-44)
  - Foliar K applications – use sulfate of nitrate forms
  - 6 to 10 lb/100 gal
  - If needed, apply after pollination

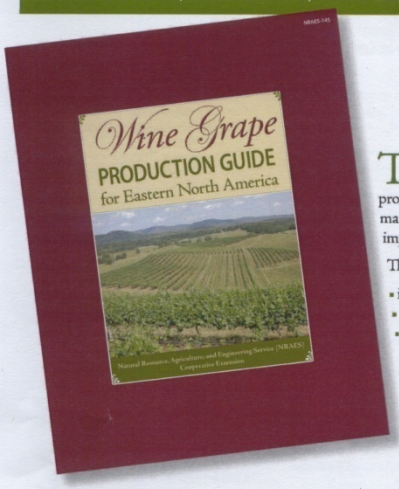
Correction of Mg deficiency

- Tissue analysis test of mature vineyard:
  - Desired bloom-time values of 0.30 - 0.50%
- Example:
- petiole sample shows 0.19 % Mg
  - Immediate foliar application of Epsom salts at 5 lbs/acre in sufficient water to ensure coverage
  - long-term correction by magnesium sulfate application to soil (banded).

Foliar Fertilizers for Grapes

- Most nutrients for grapevines are derived from the soil
- Foliar fertilizers are very soluble fertilizers applied in relatively low quantities
- Generally not satisfactory for supplying N, P, K needs
  - Consider as a supplement only
- Band-aid method: can be used to **temporarily** correct a deficiency
- Particularly useful for micronutrient problems
  - Iron
  - Zinc
  - Boron
  - Manganese

For more information, call 607-255-7654, email nraes@cornell.edu, or visit our web site, www.nraes.org.



Available Fall 2008

Wine Grape Production Guide for Eastern North America

The book will be a comprehensive resource for novice and experienced growers, as well as crop advisors, service providers, educators, communicators, and students. The book manuscript was prepared by the 16 authors listed below and improved after review by 40 experts from 21 states and Canada.

The outcomes expected from publishing the book include:

- improved economic sustainability of eastern vineyards
- improved vineyard design, operation, and profitability
- increased demand for supplies and services from support industries
- cultivar selection that considers the local growing conditions and winery preferences
- improved grape quality through better canopy and crop management
- improved educational programs and college courses
- reduced movement of fertilizers and pesticides off the target area

Book Overview

- 300+ pages
- 174 color photos
- 45+ variety descriptions
- 42 tables of useful information
- 40 line drawings
- Key to Insect and Mite Pests of Grapes
- Glossary

Chapter List

1. Costs and Returns of Vineyard Establishment and Operation
2. Vineyard Site Selection
3. Wine Grape and Rootstock Varieties
4. Vineyard Design and Establishment
5. Pruning and Training
6. Grapevine Canopy Management
7. Crop Yield Estimation and Crop Management
8. Nutrient Management
9. Grapevine Water Relations and Irrigation
10. Spray Drift Mitigation
11. Disease Management
12. Major Insect and Mite Pests of Grapes in the Mid-Atlantic Region
13. Vineyard Weed Management
14. Wildlife Deterrence
15. Grape Purchase Contracts and Vineyard Leases
16. Wine Grape Quality: When Is It Time to Pick?

Tony Wolf, Virginia Tech, Lead Author and Editor
Authors in alphabetical order:

Terry Bates, Cornell University; William Boyd, formerly with Surry Community College; John Boyer, Virginia Tech; Mark Chien, Penn State University; Jeffrey Derr, Virginia Tech; Keith Dickinson, Virginia Cooperative Extension; Gill Giese, Surry Community College; Andrew Landers, Cornell University; Timothy E. Martinson, Cornell University; Douglas Pfeiffer, Virginia Tech; Andrew Reynolds, Brock University (Ontario, Canada); David Ross, University of Maryland; Fritz Westover, Virginia Tech; Wayne Wilcox, Cornell University; Thomas Zabadal, Michigan State University.

See the other side of this flier for information on sponsoring the book or special pre-printing prices.

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Fertilisers for wine grapes

An information package to promote efficient fertiliser practices

3rd Revised Edition

Department of Agriculture
Government of Western Australia

Want to know more about vine nutrition?
Read these two great books…

Magnesium					
	Target Values				
	Soil	Bloom Petiole	Fall Petiole	**AND**	**THEN**
IF <	50 ppm	0.30 %	0.35 %	Acid soil	Adjust soil pH with dolomitic limestone and add MgO to soil as indicated in notes.
IF <	50 ppm	0.30 %	0.35 %	High K or wet season	High soil moisture (high K mobility) can cause transient Mg deficiency. Monitor and apply maintenance rate of Mg fertilizer if necessary
IF <		0.30 %	0.35 %	Neutral or Alkaline soil	Deficiency rare in high pH soils. Adjust with Epsom salts if needed
IF =	50-80 ppm	0.30 – 0.50 %	0.35 – 0.75 %		Skip
IF >		0.50 %	0.75 %	Dry year	Low K availability in dry soil may inflate Mg readings – monitor
IF >		0.50 %	0.75 %	Normal year – neutral soil	Skip and monitor for K deficiency
Notes	Low magnesium availability typically associated with low soil pH. If soil K/Mg ratio is greater than 3, magnesium deficient may develop. Can be aggravated in acid soils with high K application. Adjust with dolomitic limestone in low pH vineyards. Use Epsom salts in neutral and high pH soils. Excessive soil Mg (either natural or fertilizer applied) may cause K deficiency and vine size reduction. Monitor petiole K and Mg.				
Sources	Dolomitic limestone (variable % Mg), most common Epsom salts (magnesium sulfate, 10% Mg) Sulpomag (22% K2O, 11% Mg), has both K and Mg, more expensive				
Rates	Soil test shows 50 lbs/acre Mg and pH of 6.1 (want 100 to 160 lbs/acre) Rx: adjust pH with dolomitic lime to raise pH to 6.8. This is likely to bring Mg within recommended range. If pH acceptable, adjust Mg with $MgSO_4$ (300 to 600 lbs/acre, depending upon soil deficit. Foliar applications of Epsom salts (5 – 10 pounds/acre in 100 gallons water) can be used for short-term correction.				

Sample from Wine Grape Production Guide for Eastern North American

Other Recommendations

- Before you apply an ounce of fertilizer. STOP. Ask “why am I doing this.”
- There is no recipe for nutrition management
- Low to moderate fertility can improve wine quality
- Multiple applications are better than a single large one
- Soil treatments are usually more durable than foliar
- Foliar feed micronutrients and soil treats the macronutrients
- If you already have acidic soils, try to use pH neutral fertilizers
- Most fertilizers, soil and foliar, are best applied between fruit set and veraison, with the exception of B and Zn
- Don’t pollute. Manage nutrients as you would pesticides

Soil and Tissue Analysis Labs

- A&L Eastern, Richmond, VA – www.al-labs-eastern.com
- Penn State Agricultural Analytical Lab Services http://www.aasl.psu.edu/plant_tissue_prog.html
- Brookside Labs, OH - http://www.blinc.com/
- Cornell Nutrient Analysis Lab: http://cnal.cals.cornell.edu/

Thank You!

- Dr. Carl Rosen, Dept of Soil, Water and Climate. University of Minnesota
- Mark Greenspan, Advanced Viticulture, Napa, CA
- Dr. Tony Wolf, Virginia Tech and Fritz Westover, Texas A&M University