



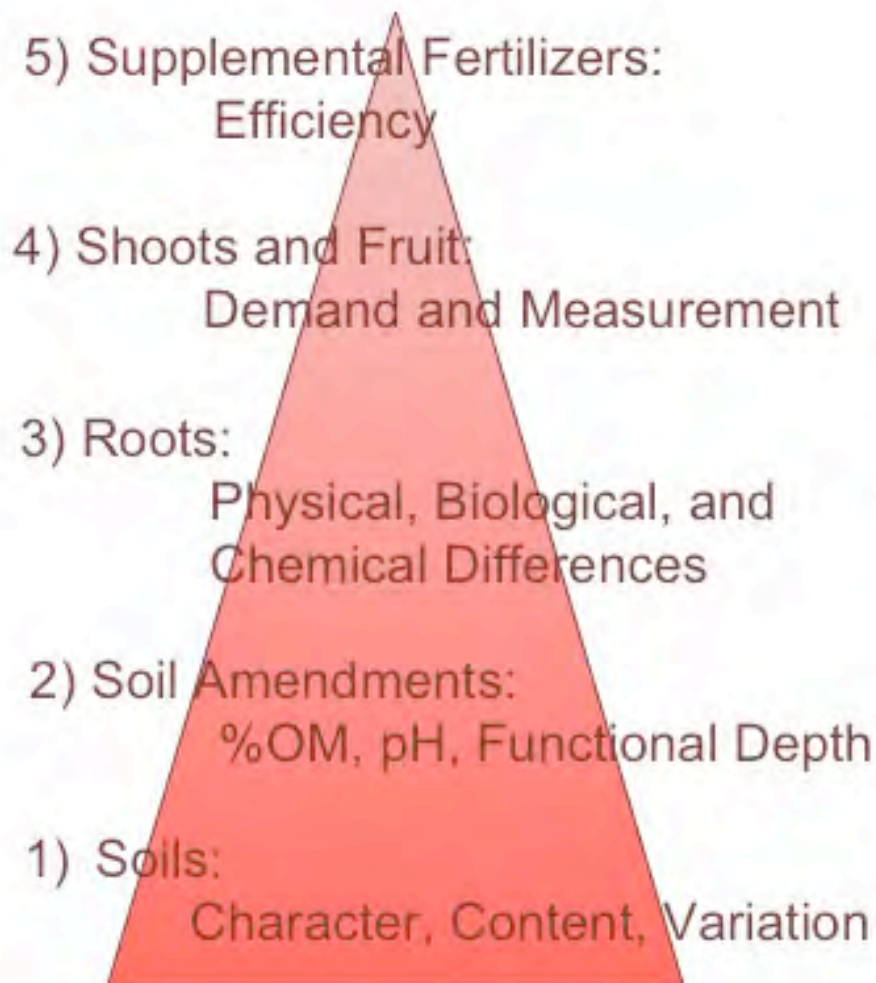
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Vineyard Nutrient Management



Hans Walter-Peterson
Finger Lakes Grape Program
October 29, 2013





Source: LERGP G.R.a.P.E. Pages, <http://lergp.org/year-planting/nutrient-management>





Questions

- How many nutrients do the vines lose every year?
- What levels of nutrients do the vines need to have?
- What does the soil already supply to the vines?
- How much do we need to supply, and how do we supply them?





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Nutrient Loss



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Amount of nutrients exported with fruit harvest at different cropping levels. Adapted from Mullins et al. (1992).											
Crop level (ton/acre)											
	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Nutrients Removed (lbs.)											
N	2.9	4.4	5.8	7.3	8.8	10.2	11.7	13.1	14.6	16.1	17.5
P	0.6	0.8	1.1	1.4	1.7	2.0	2.2	2.5	2.8	3.1	3.4
K	4.9	7.4	9.9	12.4	14.8	17.3	19.8	22.2	24.7	27.2	29.6
Ca	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
Mg	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
Source: Low Input Viticulture and Enology (LIVE) Program Handbook											



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Element	Symbol	Pounds/Acre used by 3-year-old Concord
Nitrogen	N	36.7
Potassium	K	31.2
Calcium	Ca	18.6
Phosphorous	P	7.2
Magnesium	Mg	5.7
Iron	Fe	0.7
Boron	B	0.1
Manganese	Mn	0.7
Copper	Cu	0.7
Zinc	Zn	0.2

Source: LERGP G.R.a.P.E. Pages, <http://lergp.org/year-planting/nutrient-management>



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How much do they need?

“A little extra fertilizer
is cheap insurance”



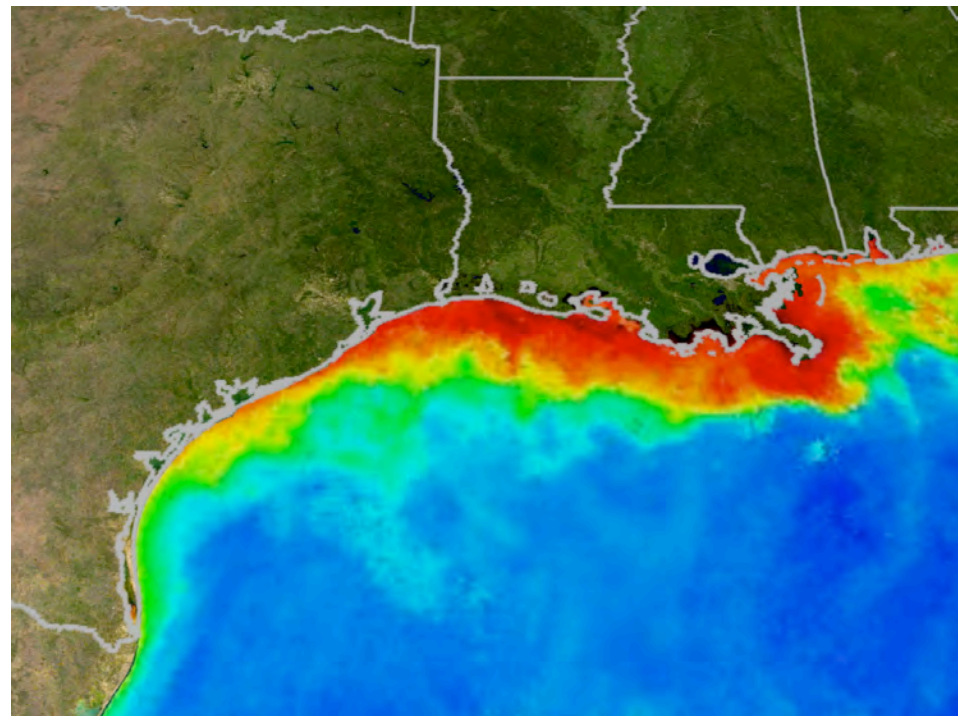
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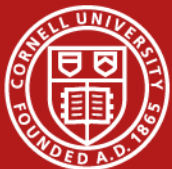
Source: Buffalo News, Sept. 10, 2013.
<http://www.buffalonews.com/city-region/environment/green-menace-of-toxic-algae-threatening-lake-erie-20130914>



<http://serc.carleton.edu/microbelife/topics/deadzone/index.html>



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Nutrient	Chemical symbol	Target values		
		Soil	Bloom petiole	Late-summer petiole (70–100 days after bloom)
Total Nitrogen	N	— ^a	1.2%–2.2%	0.8%–1.2%
Phosphorus	P	20–50 ppm	0.17%–0.30%	0.14%–0.30%
Potassium	K	75–100 ppm	1.5%–2.5%	1.2%–2.0%
Calcium	Ca	500–2,000 ppm ^b	1.0%–3.0%	1.0%–2.0%
Magnesium	Mg	100–250 ppm	0.3%–0.5%	0.35%–0.75%
Boron	B	0.3–2.0 ppm	25–50 ppm	25–50 ppm
Iron	Fe	20 ppm	30–100 ppm	30–100 ppm
Manganese	Mn	20 ppm	25–1,000 ppm	100–1,500 ppm
Copper	Cu	0.5 ppm	5–15 ppm	5–15 ppm
Zinc	Zn	2 ppm	30–60 ppm	30–60 ppm
Molybdenum	Mo	— ^c	0.5 ppm	0.5 ppm
Aluminum	Al	< 100 ppm ^b		

From: Bates, T and T. Wolf (2008). Nutrient Management. *Winegrape Production Guide for Eastern North America*, Tony Wolf (ed.).



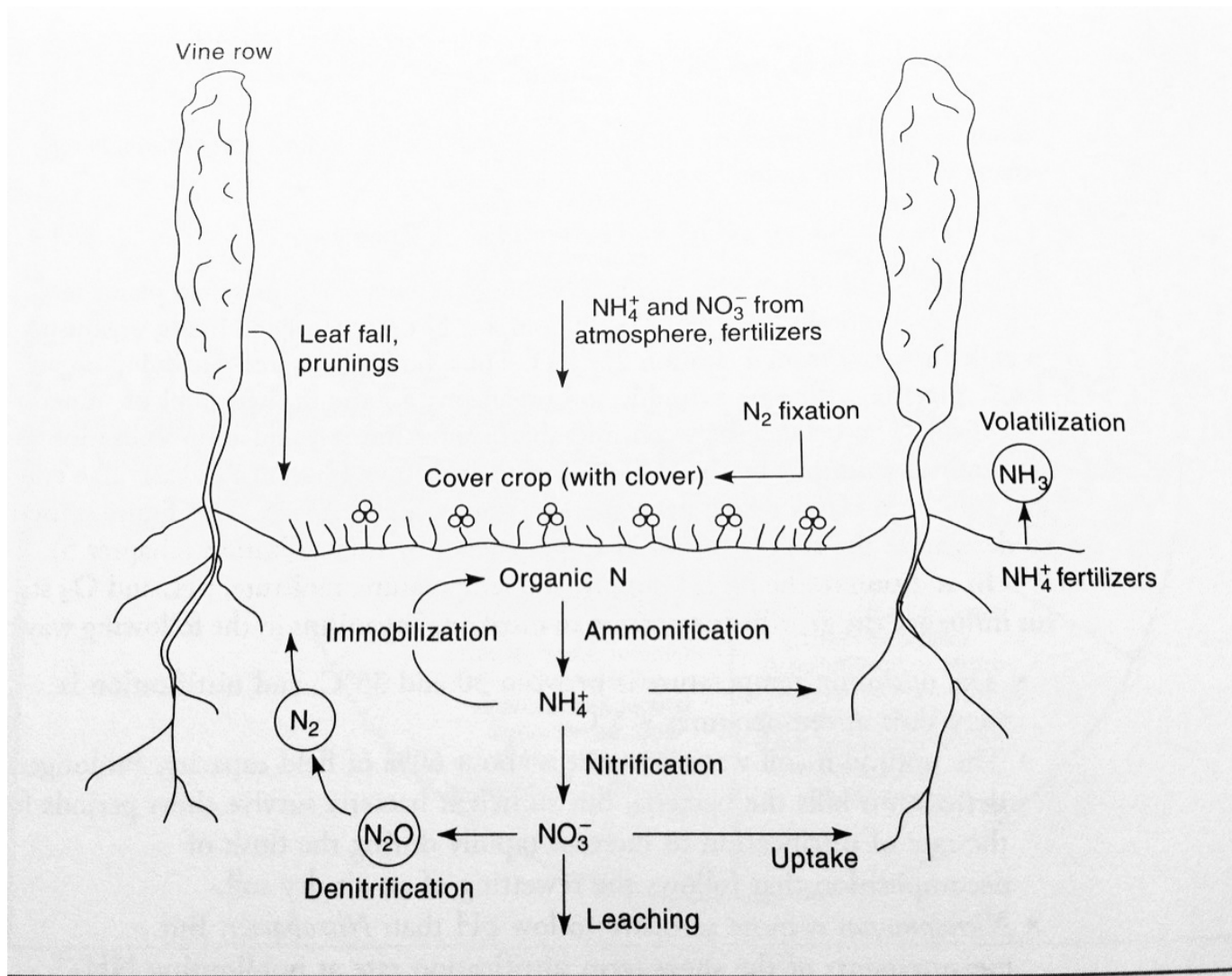
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What are the sources of nutrients?

- Soil
 - Mineralization of organic matter
 - Weatherization of minerals
- Biomass (e.g., cover crops, prunings)
- Vine reserves
 - Woody tissues
 - Older leaves
- Supplemented by grower





White, R.E. *Soils for Fine Wine*. 2003.



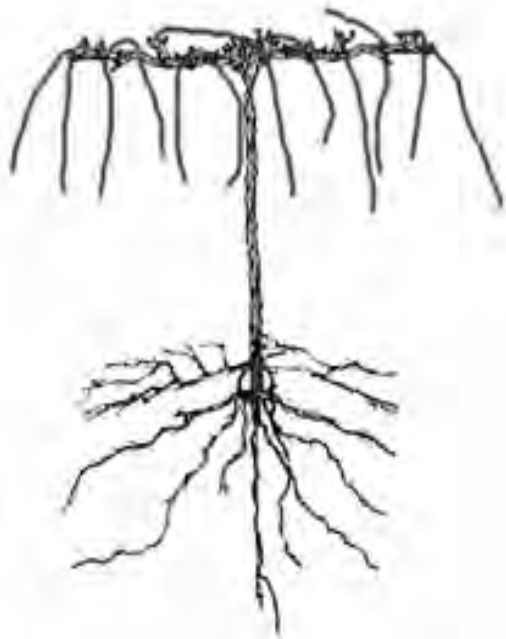
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THE BIG DIG



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Dry Weight

41%

Starch

16%

N

25%

P

23%

59%

84%

75%

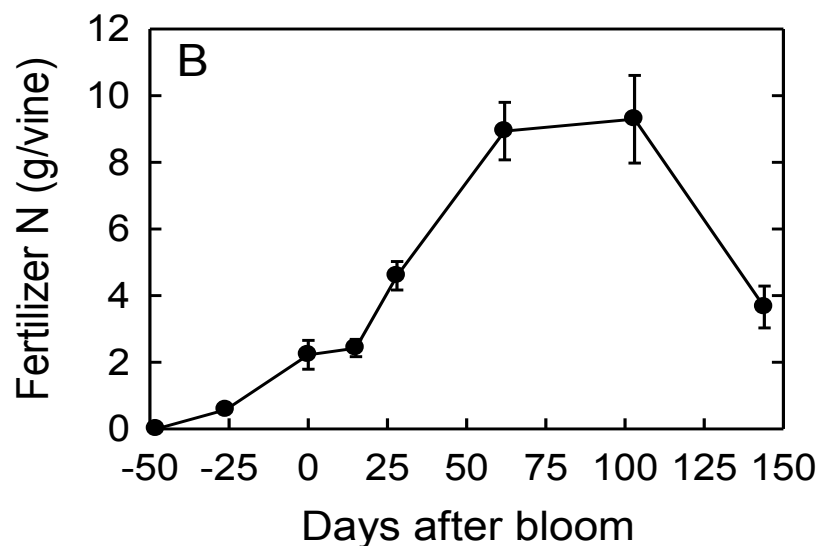
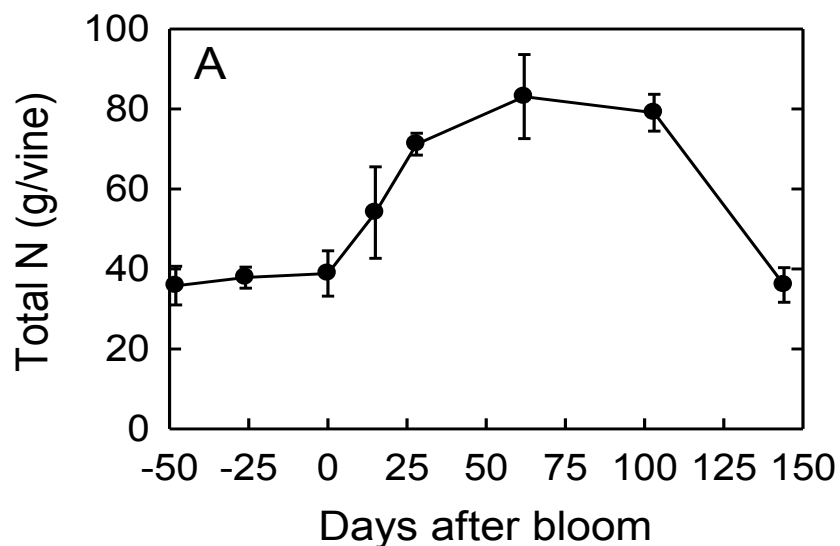
77%

Source: T. Bates, "Lessons from the Big Dig: dry matter, nitrogen uptake and fertilizer efficiency"
<http://grapesandwine.cals.cornell.edu/cals/grapesandwine/appellation-cornell/issue-14/big-dig.cfm>





Mature Concord vines required 40 g of N/vine during the growing season.



N fertilizer applied at budbreak supplied about 9 g/vine (22.5% of total N required).





N Supply From Reserves

- Reserve N provides 15 to 30% of the total vine N demand.
- Reserve N is a main source for vine growth from budbreak to bloom





Factors that influence nutrient uptake

- Soil conditions
 - Compaction, saturation
 - pH
- Soil moisture content
- Varieties & Rootstocks



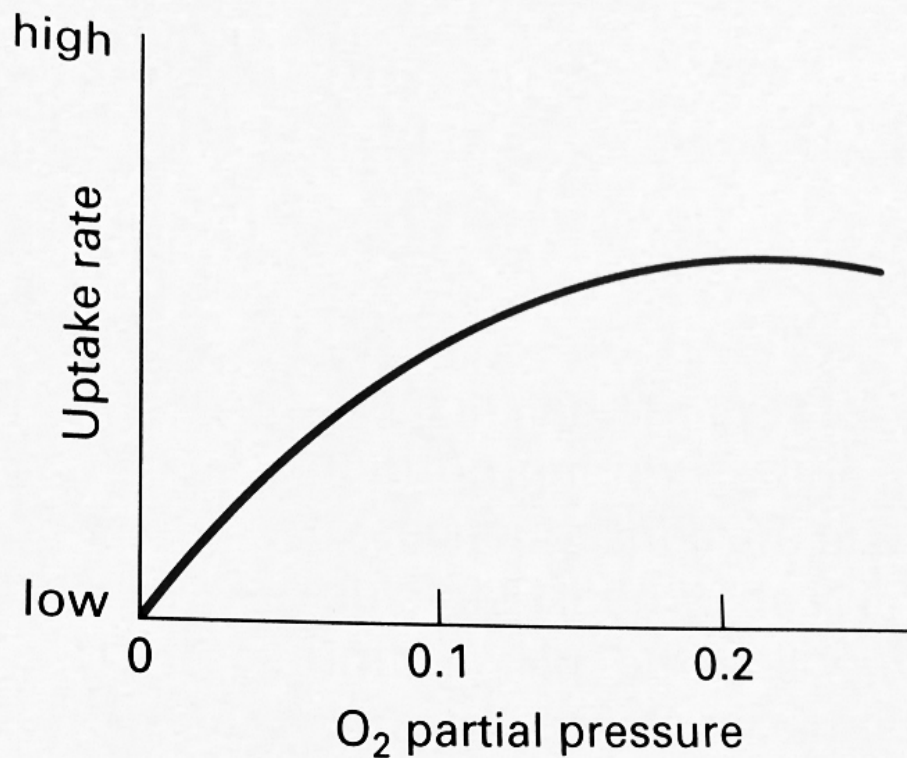
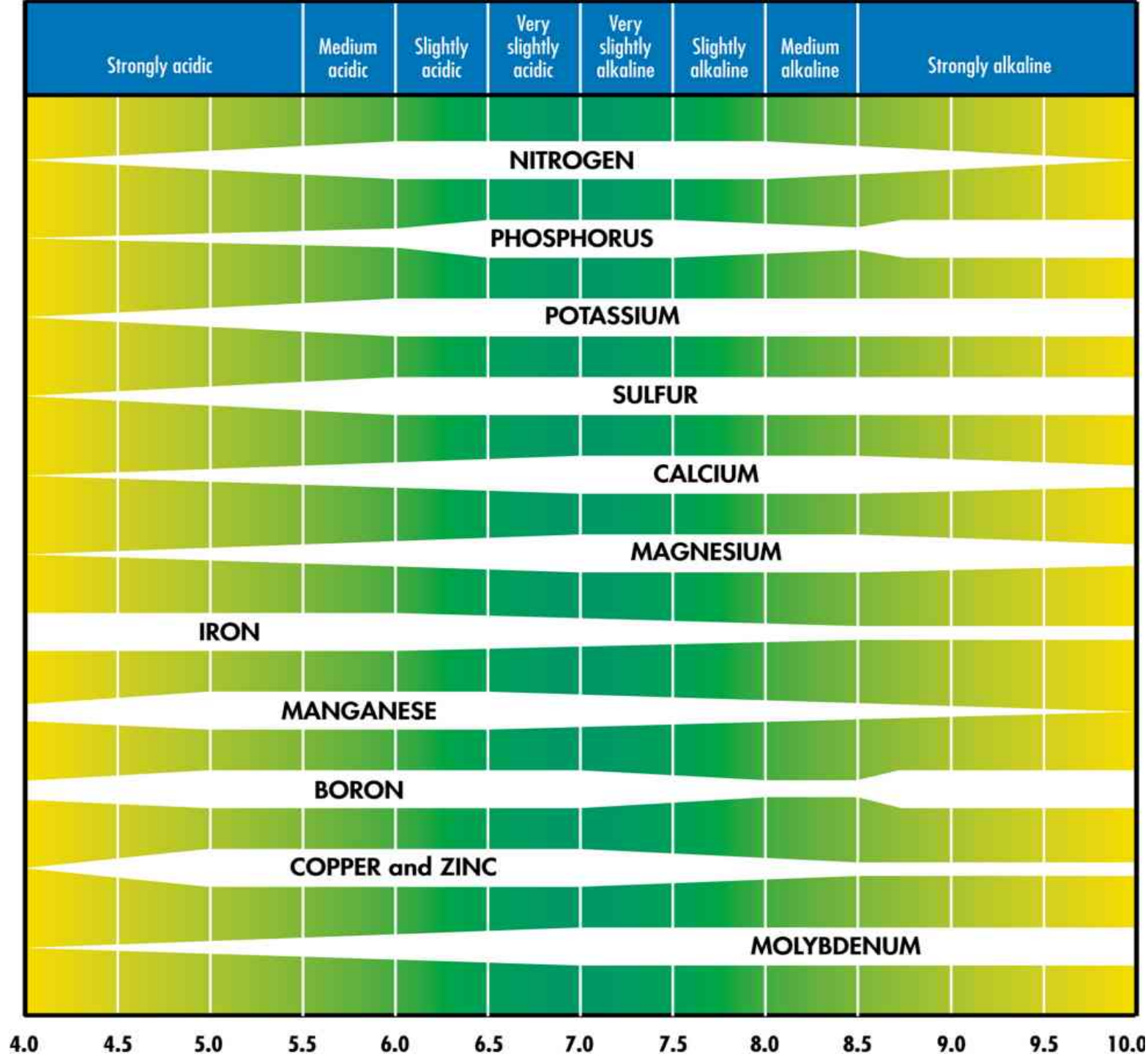


FIGURE 9-4 Rates of nutrient uptake as affected by temperature and oxygen supply.

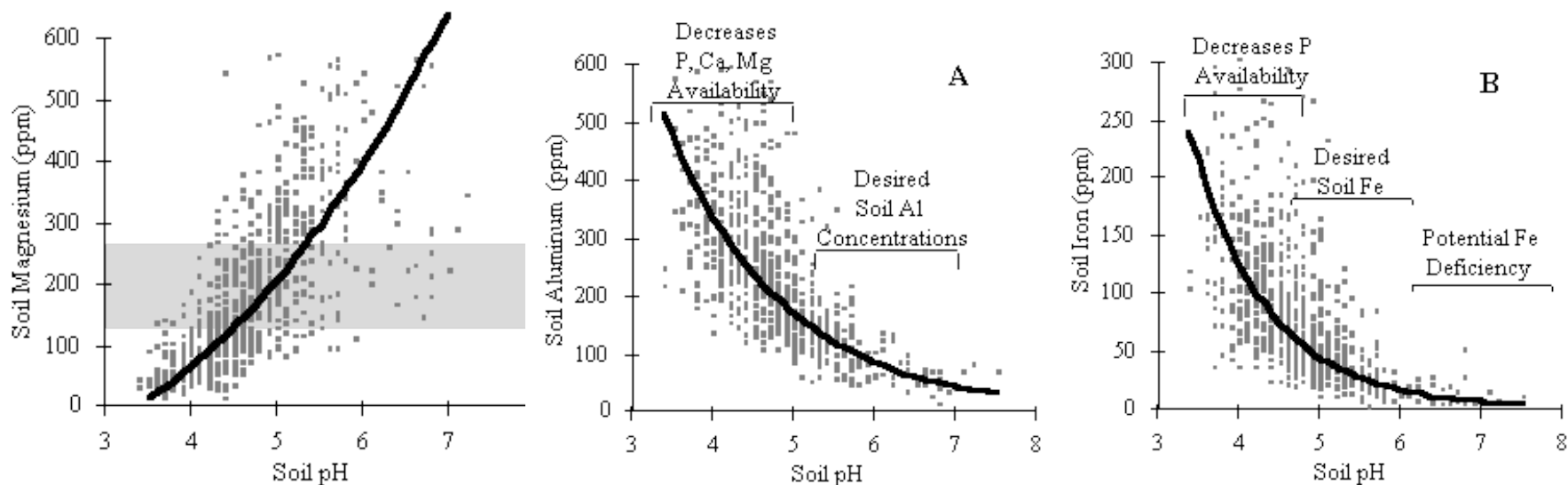
Singer, M.J. and D.N. Munns. *Soils: An Introduction*.





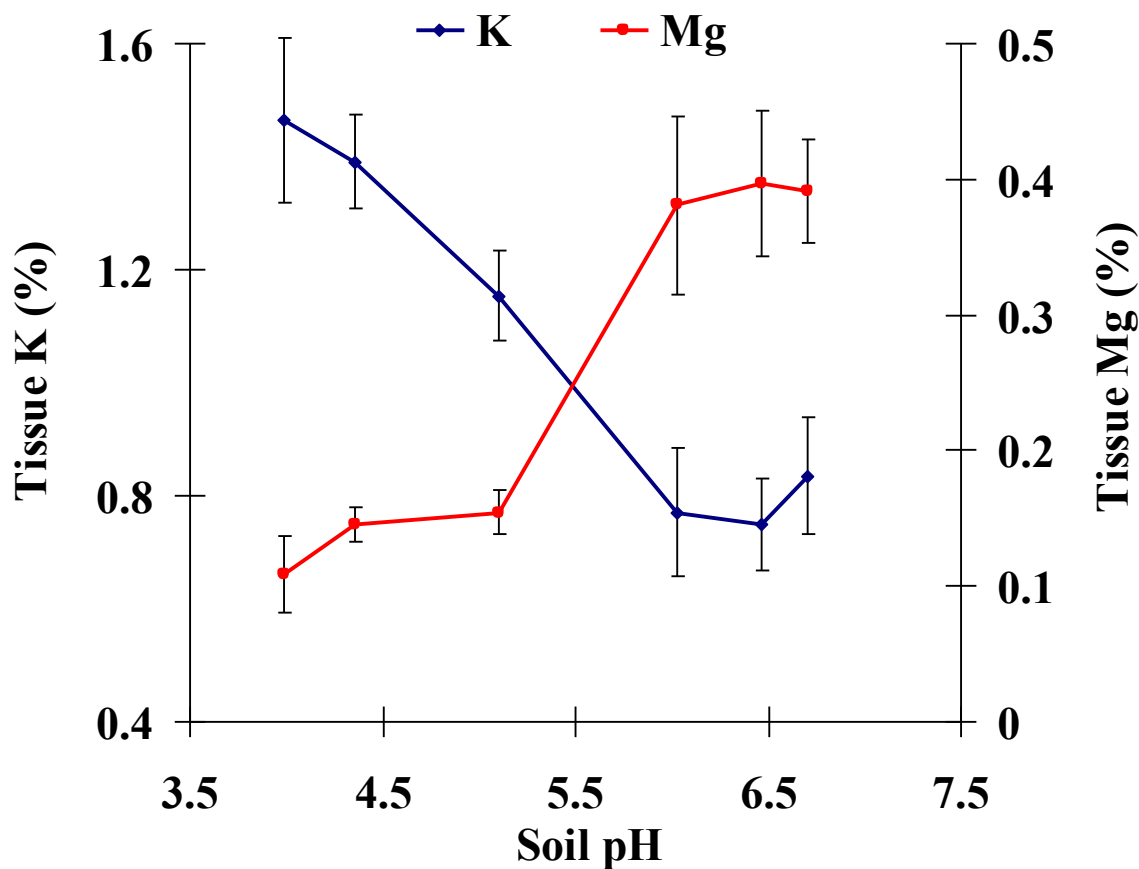


Influence of soil pH



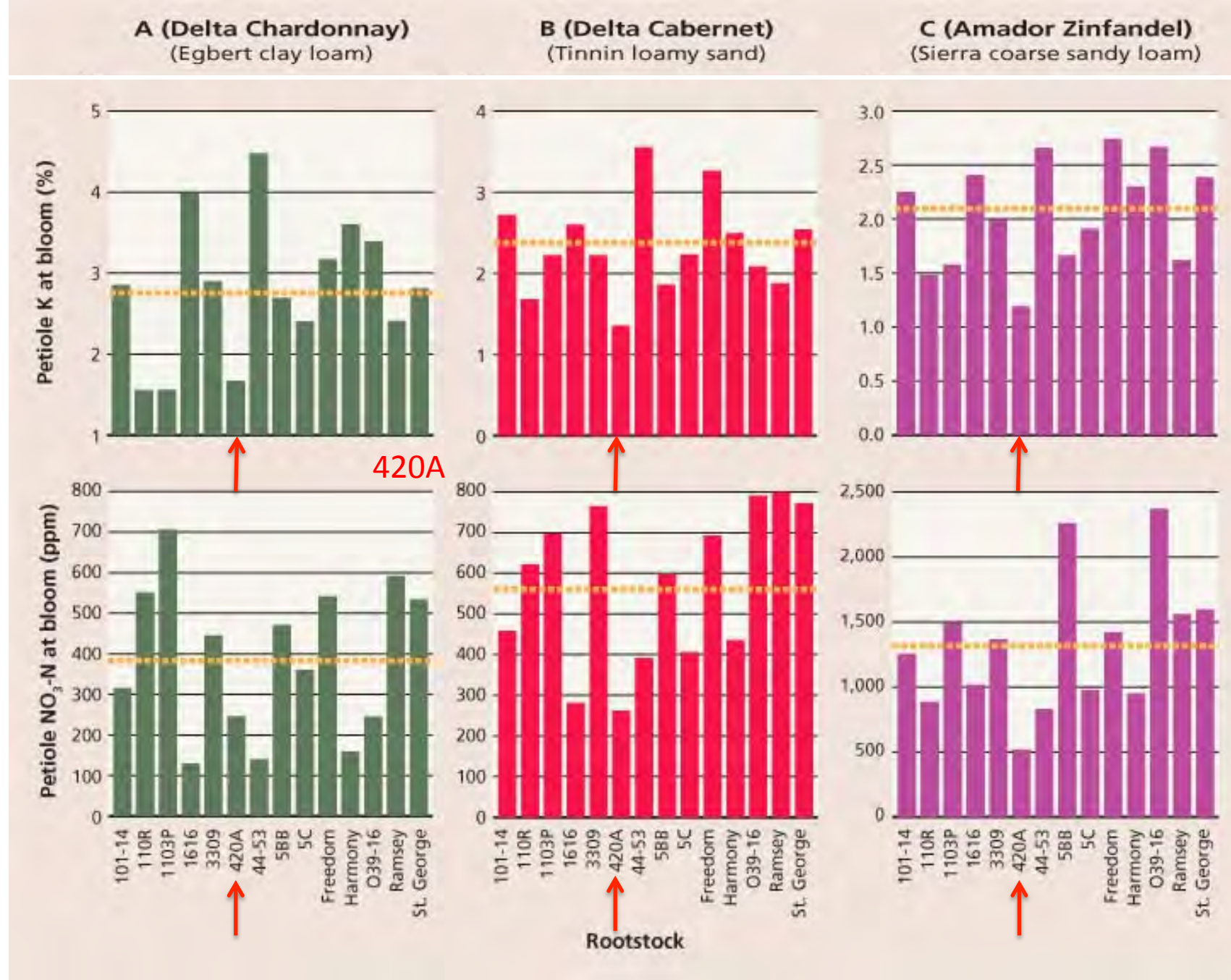
Source: T. Bates, "Concord Production Ten Commandments" (slide presentation), Lake Erie Regional Grape Growers Conference, March 2002.



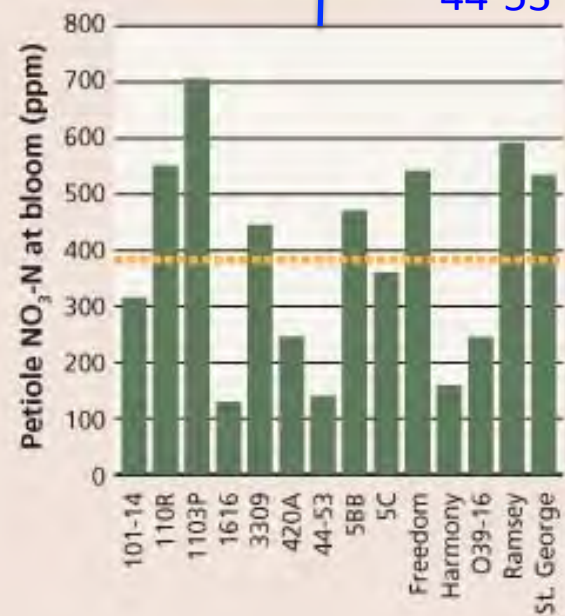
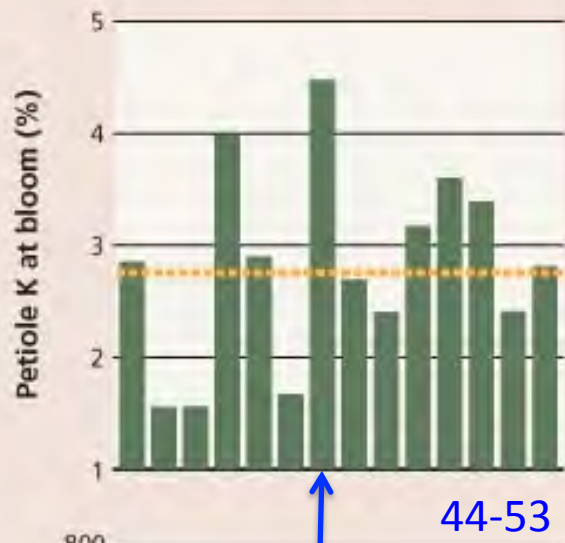


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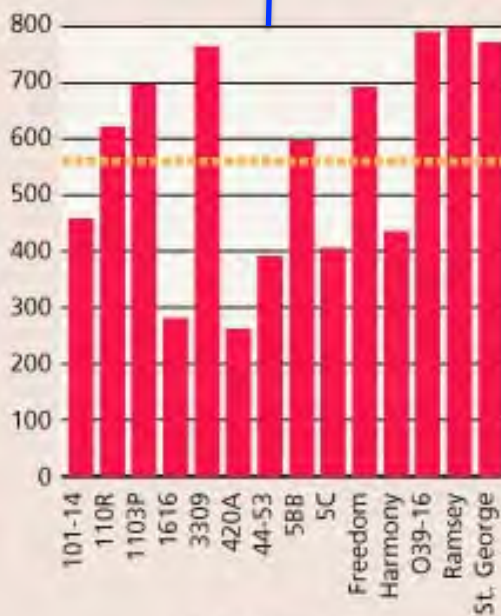


A (Delta Chardonnay)
(Egbert clay loam)



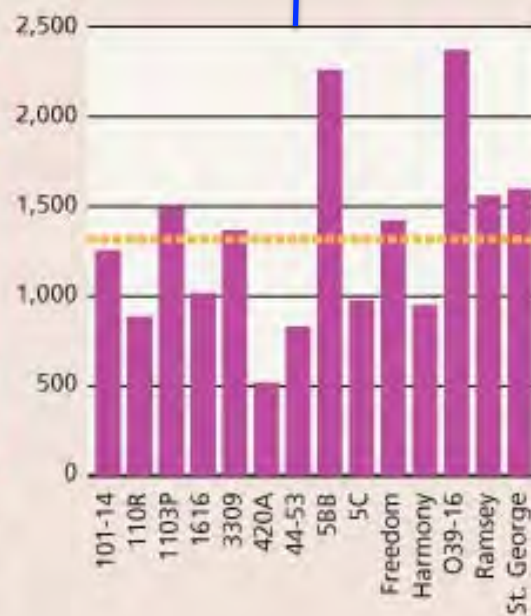
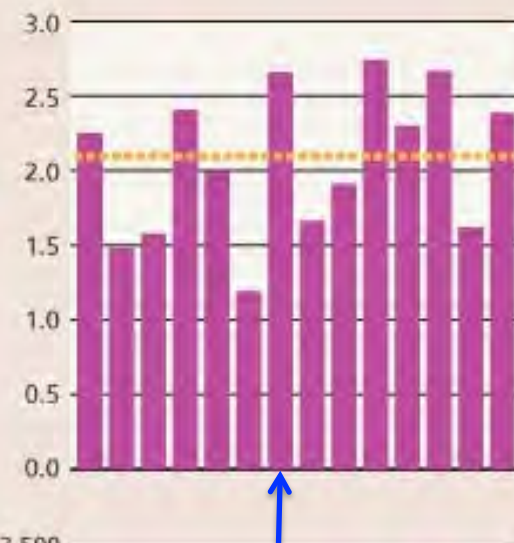
44-53

B (Delta Cabernet)
(Tinnin loamy sand)



Rootstock

C (Amador Zinfandel)
(Sierra coarse sandy loam)





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How much do I need to supply?



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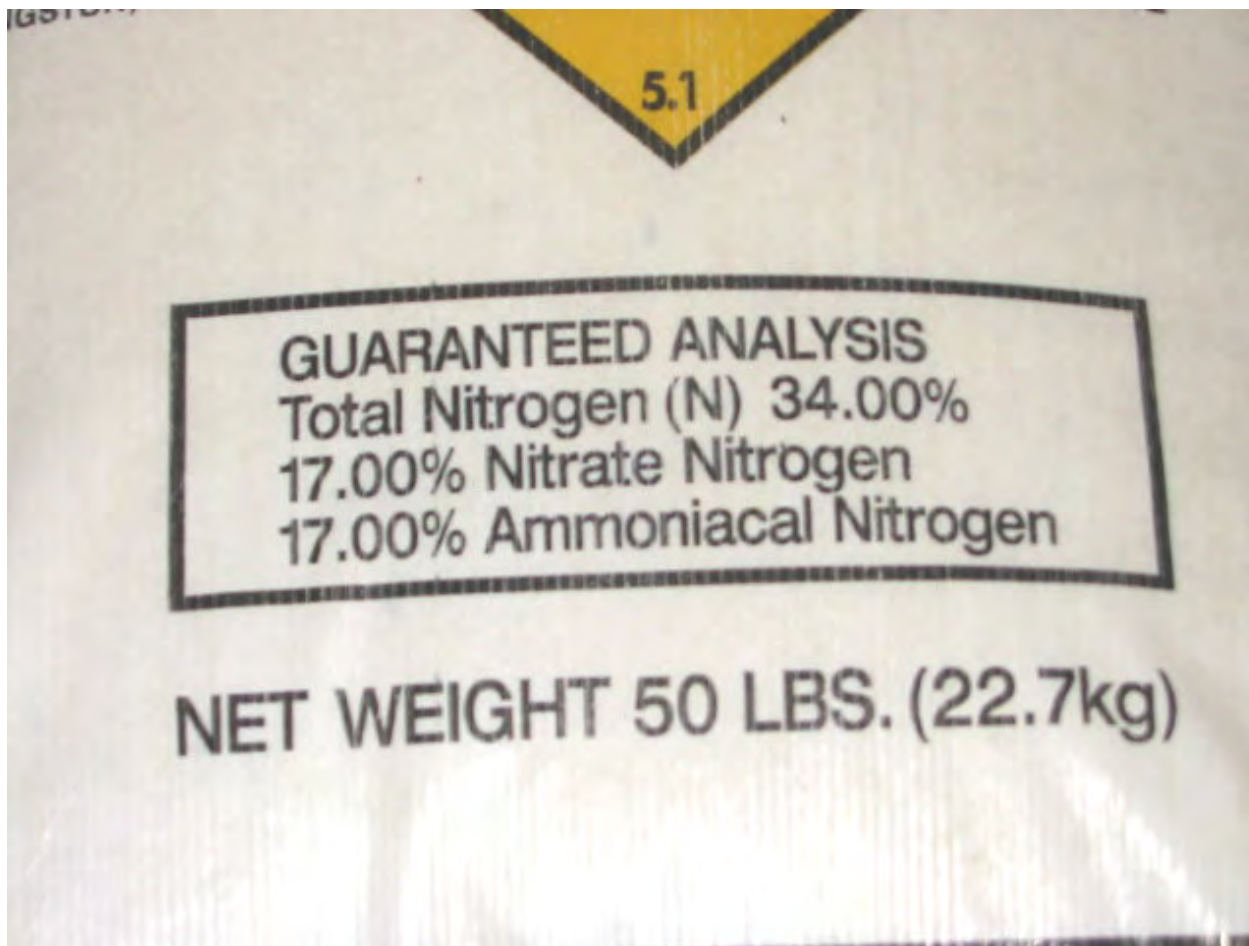


Petiole and Soil Sampling





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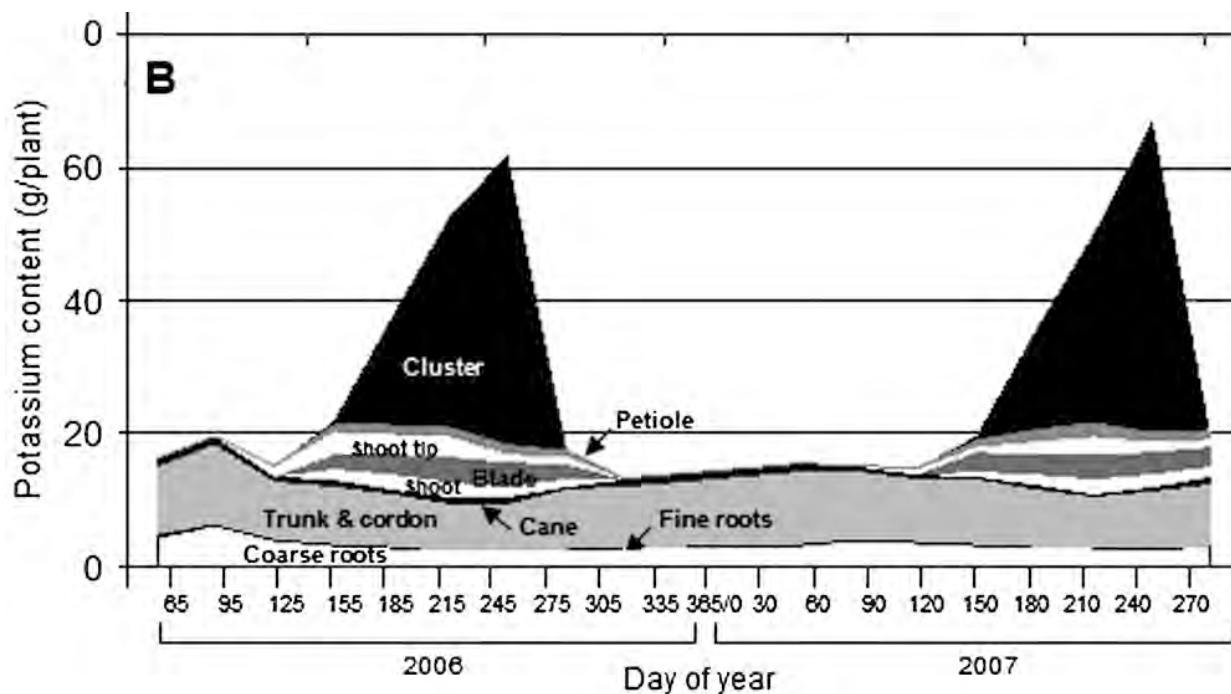
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Nitrogen Requirements & Costs Worksheet for Concord Vineyards

		Sample (1)	Sample (2)	Sample (3)	Your Vineyard	Units
1	Soil Organic Matter (OM): Values can be obtained from soil test reports	2.30%	2.30%	2.30%		% OM
2	Pounds of N / % soil OM	20.0	20.0	20.0	20.0	lbs N/acre
3	Pounds of N/acre supplied by mineralization of OM (Line 1 x Line 2 x 100)	46.0	46.0	46.0		lbs N acre
4	Equivalent lbs N/acre required by Concord	50.0	50.0	50.0	50.0	lbs N/acre
5	Lbs N/acre required from supplemental fertilizer (line 4 - Line 3)	4.0	4.0	4.0		lbs N/acre
6	% N content of supplemental fertilizer	46%	46%	46%		% N
7	Lbs of fertilizer/acre to apply assuming 100% uptake (line 5 / (line 6)	8.7	8.7	10.0		lbs F/acre
8	Uptake efficiency of N: At budbreak .1; Two weeks post bloom .17	0.17	0.1	0.1		
9	Pounds of fertilizer per acre (line 7 / line 8)	51	87	100		lbs F/acre
10	Cost per ton of fertilizer	450	450	450		\$/ton
11	Cost per acre (Line 10 / 2000 x Line 9)	11.51	19.57	22.50		\$/acre



Potassium Demand



Pradubsuk and Davenport. 2010. Seasonal Uptake and Partitioning of Macronutrients in Mature 'Concord' Grape. J. Amer. Soc. Hort. Sci. 135(5): 474–483.





Material	% K ₂ O
Potassium chloride (muriate)	60
Potassium sulfate	50
Potassium magnesium sulfate (Sul-Po-Mag)	22 (11% Mg)
Potassium nitrate	44





Calculating K requirements

- 1) Tons/acre x 5 lbs K/ton of grapes = K removed by crop
- 2) K removed / % K_2O of fertilizer (decimal) = K fertilizer to replace loss

Example:

8 ton/acre crop x 5 lbs K/ton of grapes = 40 lbs/acre K lost to crop

40 lbs/acre / 0.60 (K_2O content of muriate of potash) = 67 lbs/acre muriate to replace





Foliar fertilizers?

- Macronutrients
 - Hard to justify based on current knowledge (except Mg)
- Micronutrients
 - Supply what you need; nothing more
- Other impacts not measured by current sampling protocols?





Nutrients from Compost

- Slow Release
 - 1 to 5 years to release
 - Relies on microbial activity; less predictable nutrient release
- Testing
 - Compost/feedstocks
 - Soil
 - Petiole





Nitrogen from Compost

- Slowly released by microbial activity
- About 30% of *total N* (from analysis) available to vines
 - 15% in 1st year, 8% in 2nd, 4% in 3rd, 2% in 4th, 1% in 5th
- N Example
 - Total N: 15.8 lbs N/T (0.79%)
 - $15.8 \text{ lbs/T} \times 0.15 = 2.37 \text{ lbs N/T} \times 10 \text{ T/A} = 23.7 \text{ lbs/A}$





Potassium from Compost

- Virtually all is released to soil
 - About 85% in 1st year, remainder in 2nd
- K can be high in compost made from pomace
 - Potential for Mg deficiency
 - High K linked to high pH in wines





Monitoring Nutrient Status

Supply monitoring

- Soil analysis
- Soil amendment analysis
- Fertilizer analysis

Demand monitoring

- Visual observations of plant condition
- Plant tissue analysis



