
University of California
Cooperative Extension

Micro-Nutrients
Major Effects

Calaveras Grape Growers Meeting

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Deficiencies

Common	Infrequent	Rare
N	P	S
K	Mg	Cu
Zn	Fe	Mo
B	Mn	Ca

Excesses - Toxicity

N

B

Zn

Cl

Na

Mg (Serpentine)

Nutrient Demand Factors

- Soil
- Previous crop
- Inputs
- Irrigation
- Vineyard Practices
  - » Cultivation
  - » Cover Crops

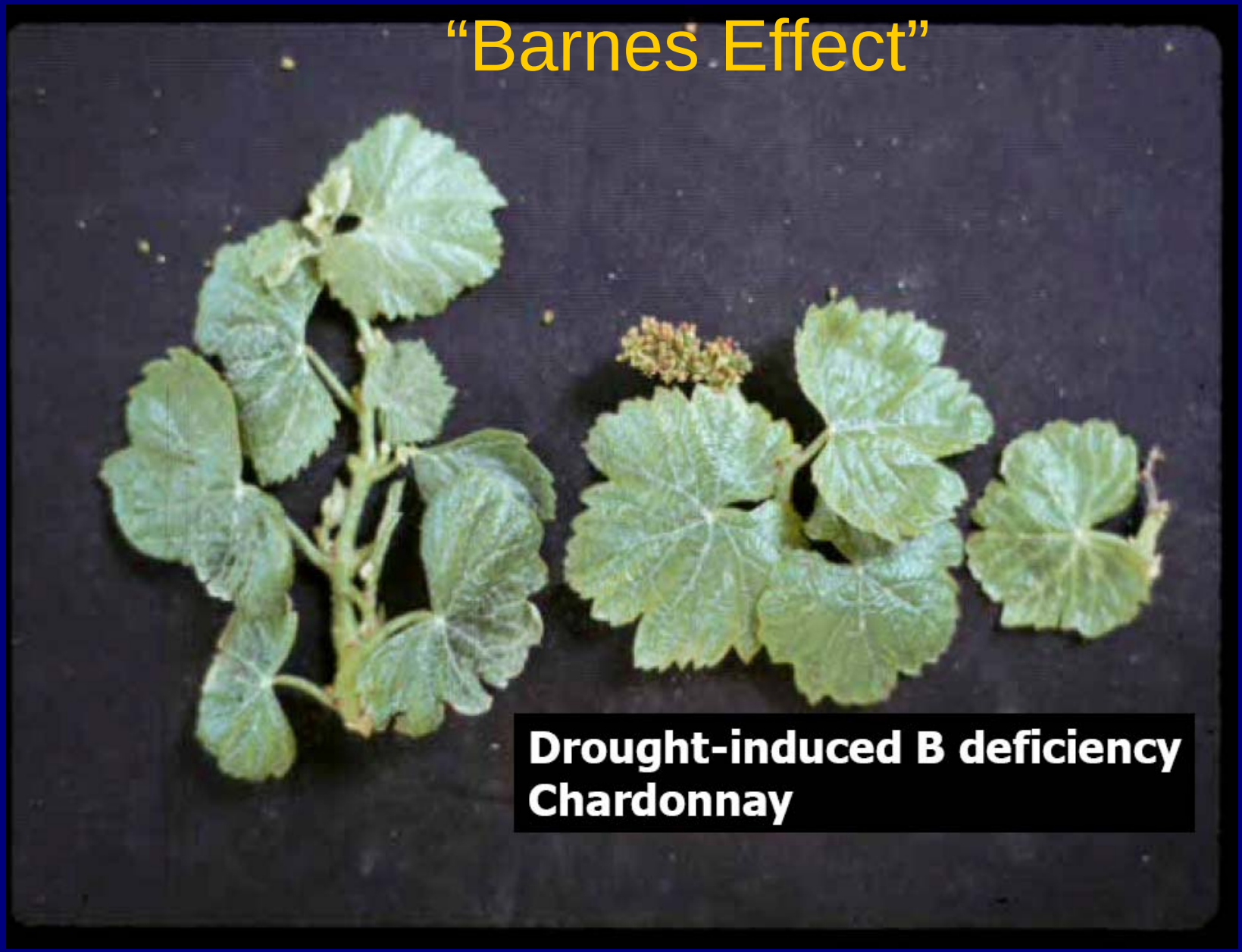
Fruit Demand of Nutrients

• Nitrogen	N	2.92	
• Potassium	K	4.94	
• Phosphorus	P	0.56	
• Calcium	Ca	1.0	
• Magnesium	Mg	0.2	
• Zinc	Zn	0.0015	5 TPA = 0.1 oz
• Boron	B	0.00065	= 0.05 oz

Actual Deficiency vs Induced

- Variety/Rootstock
- Antagonistic
- Water Quality
- Irrigation
- Soil pH
- Rainfall
- Biological

“Barnes Effect”



Lime Induced Chlorosis

Rootstock Tolerance to Calcareous Soils

Rootstock	***% Active Lime in Soil***
Fercal	50+
41B, 333EM	40
161-49C	25
Kober 5BB, 420A, 140Ru, Borner	20
99R,110R,1103P,SO4	17
St George	14
Ganzin,1202C	13
3309C,1616C	11
4453M	10
101-14	9
Riparia Gloire, Castel 196-17	6
Schwarzmann	Med
Freedom	Med
Ramsey	Med
Dogridge	High

Rootstocks with Zinc Deficiency

- Dogridge
- Ramsey (Salt Creek)
- St. George
- Freedom

Availability of Micro-Nutrients

- Soil Parent Material
- pH
- Texture
  - Clay type and amount
  - O.M.
  - Competition
- Climate
  - Soil Temperature
  - Leaching
  - Weathering
- Soil pH

Soil Types Associated with Micronutrient Deficiencies

Texture/Type	pH < 6	pH 6-7	pH > 7
Sandy	Mo, Cu, Zn	Mn, Cu, Zn	Mn, B, Cu, Zn, Fe
Sandy loam	Mo, Cu, Zn	Mn, B, Cu	Mn, B, Cu, Fe
Loam	Mo	Mn, B	Mn, B, Cu, Fe
Clay Loam	Mo	Mn	Mn, B
Clay Loam	Mo	-	Mn, B
Organic	Cu, Zn	Mn, Zn, Cu	Mn, Zn, Cu

Monitoring Nutrients

- Soil
- Tissue
- Water
- Visual
- Yield History

- Timing
  - Bloom
  - Veraison
  - Pre-Harvest
  - Other?

Monitoring

Visual

Tissue Analysis

Visual Symptoms

- Shoot Growth
- Leaves
- Fruit
- Soil

Tissue Analysis

Affected By:

- *Soil Type*
- *Rootstock*
- *Variety*
- *Trellis System*
- *Irrigation*
- *Time of Season*

Tissue Analysis

- *Petioles at bloom time*
- *Petioles at veraison*
- *Nitrogen monitoring not diagnostic*
- *Blades are good only if B is a problem*
- *Labs are all good but vary*
- *Keep part of dried samples*
- *No ideal ratios*

- *= Comparison samples good anytime*

Zinc (Zn) & Boron (B)

Shoots – *zig zag, short internodes*
shoot tip death

Leaves – *mottled chlorosis*
Zn early season young leaves
B later season to fall

Clusters – *poor set and "shot berries"*

Zinc *Deficiency*

-Zn

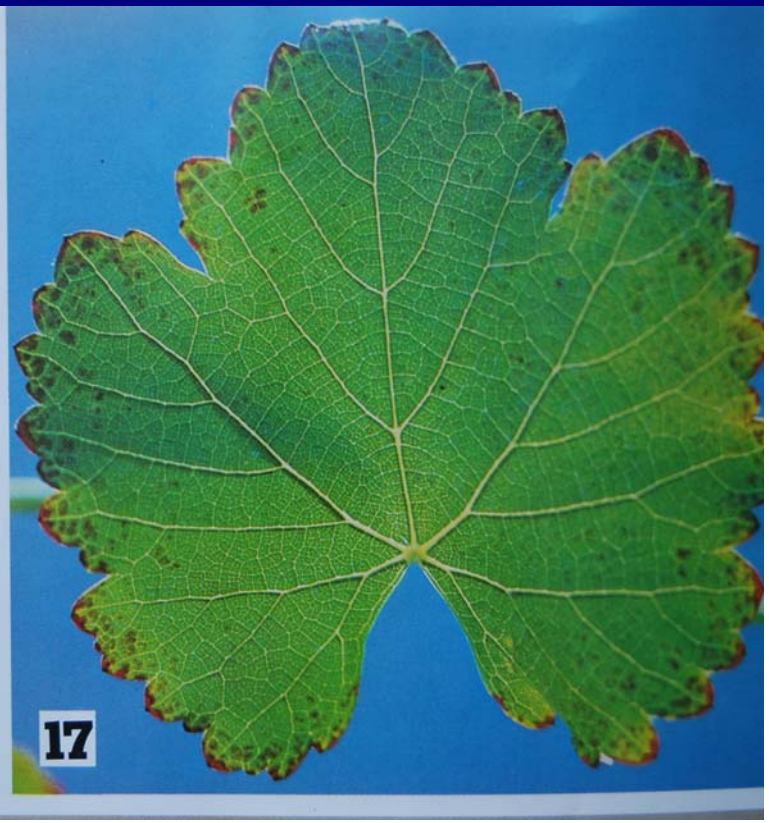
Normal

Chardonnay

Boron

Deficient

Excessive



Zinc

Small berries, wide range of size & round shape

Boron

Uniformity of small size, flattened pumpkin shape

Confusion from Symptom Overlap

Zn deficiency

GFLV

Chimera

GFLV “Yellow Mosaic”

Application Methods

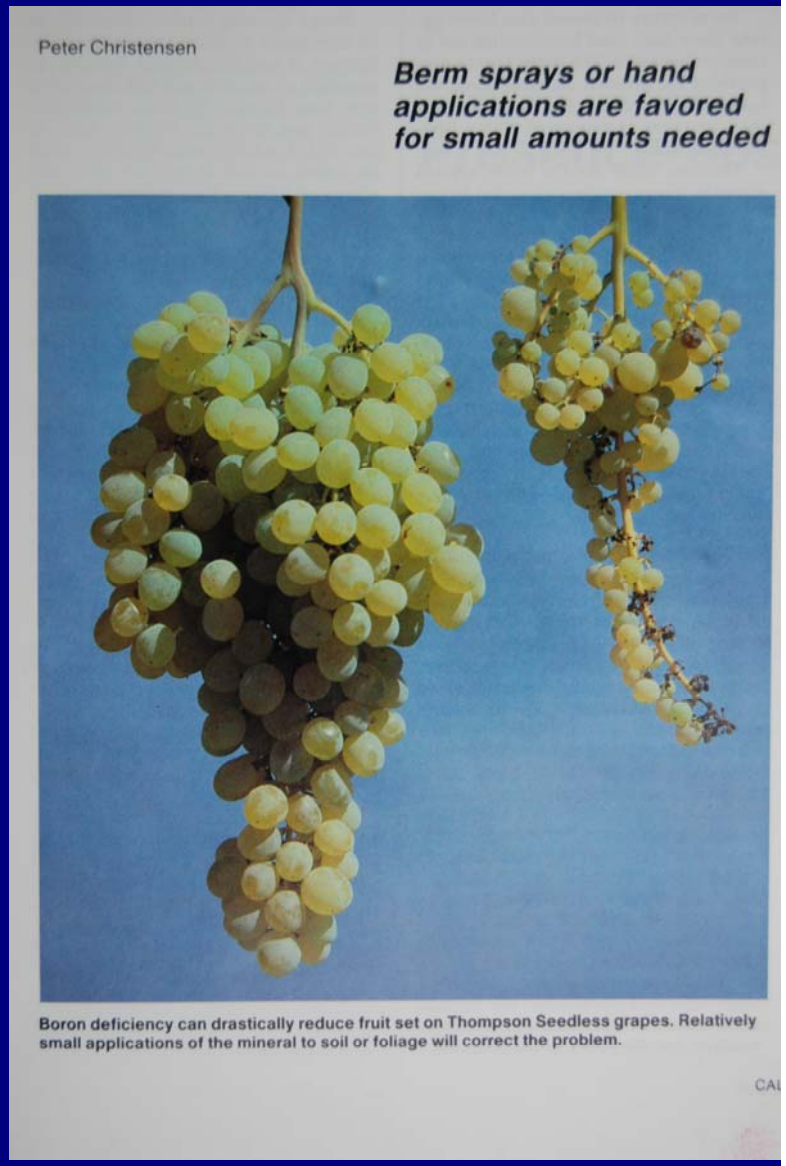
- Soil
- Irrigation
- Foliar

- Timing
- Formulation
- Organic

Soil

- Effective +
- Cost Efficient +
- Long term +
- Slower -

- Band
- Place near water/active roots
- Formulation
  - Salts $ZnSO_4$ ZnO
  - Chelates
  - Organic



Irrigation

- Effective +
- Less labor +
- Moderate term +
- Injector or solutionizer
- More management -

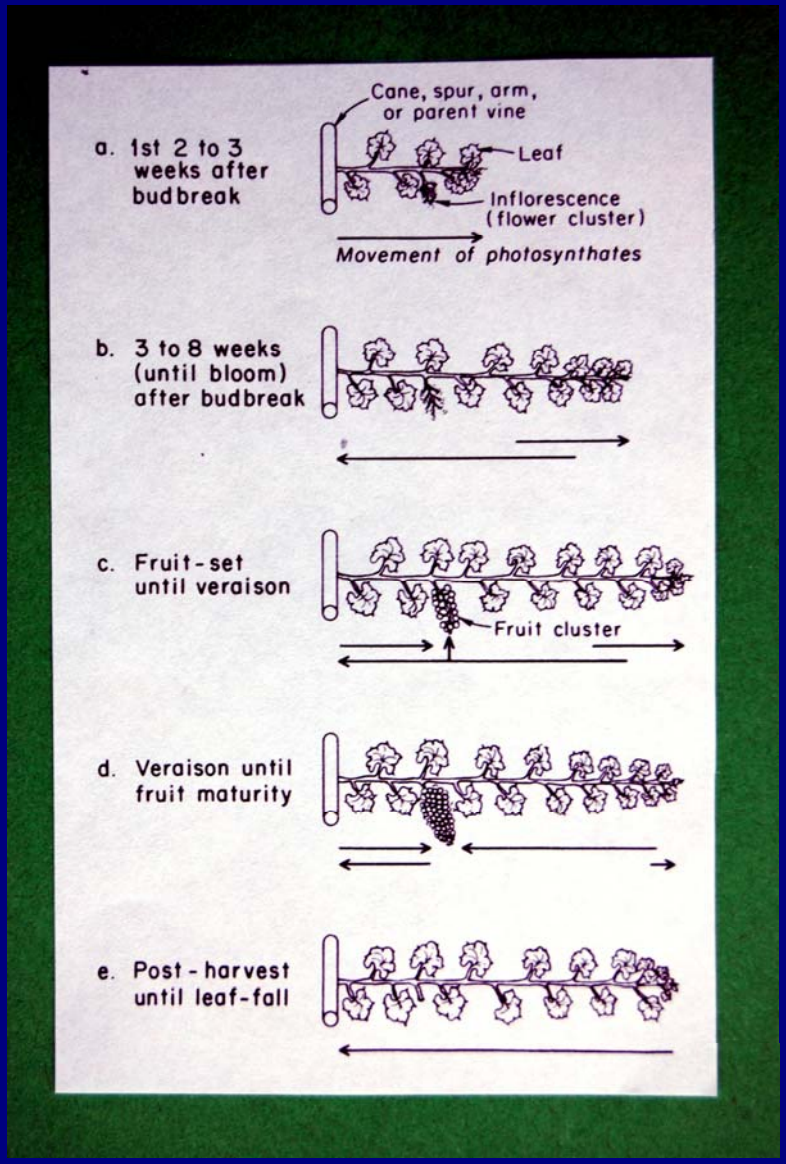
- Place near water/active roots
- Band

- Formulation
  - Salts $ZnSO_4$, $Zn(NH_4)PO_4$
  - Chelates
  - Mixture

Foliar Spray

- Convenient +
- Fast +
- Short term -
- More expensive -
- Timing important -

- Timing
  - Pre bloom
  - Post harvest
- Formulation
  - Salts
  - Basic
  - Oxides
  - Chelates
  - Organic ?



Foliar Application Factors

- Timing
  - Pre bloom
  - Post harvest
- Concentration – dilute better
- Spreader/Sticker
- Weather
  - Temperature
  - Relative Humidity
- Low biuret urea boost

- Formulation
  - Sulfate salt Cheaper $ZnSO_4$
  - Basic Safer $ZnCO_3$
  - Oxides Less soluble ZnO
  - Chelates Expensive
  - Organic ? Costly and less effective)

Foliar Spray Summary

- Timing — 2-3 weeks
- Formulations — Basic, chelates, salts, oxides
- Rates — low concentrations
- Conditions — Low Temps, High R.H., wind

Materials

• Solubor	$Na_2B_8O_{13} \cdot 4H_2O$	20.5%
• Borax	$Na_2B_4O_7 \cdot 10H_2O$	11
• Boric Acid	H_3BO_3	17
• Borate 48	$Na_2B_4O_7 \cdot 10H_2O$	14.9
• Colemanite	$Ca_2B_6O_{11} \cdot 5H_2O$	10

• Zinc Carbonate	$ZnCO_3$	52%
• Zinc Sulfate	$ZnSO_4$	36
• Zinc Oxide	ZnO	80
• Zinc Chelates	-	9-14
• Zinc lignosulfates	-	5-12
• Zinc polyflavonoids	-	7-20

Zinc Application Methods

	Material	*Rate/Acre*	*Actual/Ac*	*Timing*
Drip	ZnSO4	50-150 lbs	18 – 54 lb	Early
	Zn Chelate	3-9 gal	3 – 13.9	
Soil	ZnSO4	50 -150	18 – 54 lb	Winter/Spring
Foliar	ZnCO3	5 lbs	2.9 lb	PreBloom
	ZnSO4	1 -2 lb	0.4 -0.8 lb	
	Zn chelate	1 -2 gal	0.7 -1.4 lb	

Boron Application Methods

	Material	*Rate/Acre*	*Actual/Ac*	*Timing*
Drip	Solubor	0.5 lb	0.1 lb	Early
	2-4X	1-2 lbs	0.2-0.4 lb	
Soil	Solubor	5 lbs	1.0 lbs	Fall/Winter Broadcast
	maximum	20 lbs	4.0 lbs	per 4 year
	Solubor	5-10 lb	1-2 lbs	Fall/Winter Berm
Foliar	Solubor	1-2 lbs	0.2 -0.4 lb	PreBloom
	maximum	5 lbs	1.0 lbs	per year

Cost Comparison for Zinc

	Material	*Amount/Ac*	*Actual*	*Cost $*
Drip	ZnSo4 36%	100 lb	36	50
	Zn EDTA 6.5%	6 gal	4	72
Foliar	ZnCO3 52%	5 lb	2.6	20 *

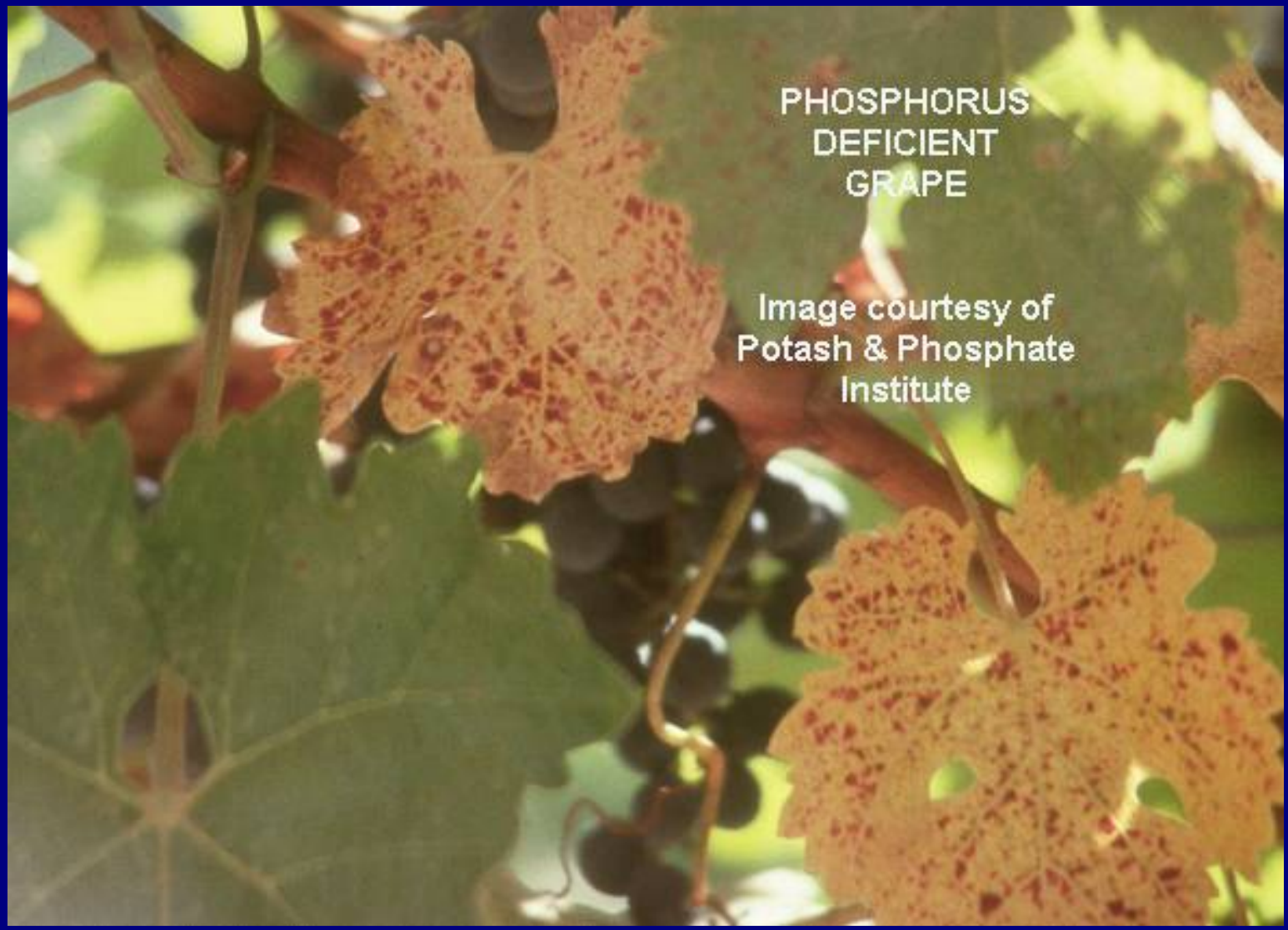
* Material $5

Application $15

Other Micro Nutrients

- Fe – almost always a pH relatedsoil problem
- Mn – similar to zinc, often in poorly drained areas & wet years
- Cu – similar to excess boron or nitrogen, rare
- Mo – poor set & berry growth, sandy soils, rare
  - Combination formulations helpful for long term, but… $
- S – mimics nitrogen
- Ca – serpentine soils, almost exclusively

Phosphorus


PHOSPHORUS
DEFICIENT
GRAPE
Image courtesy of
Potash & Phosphate
Institute

Phosphorus Deficiency in California

- New viticultural areas and soil sites
- ✓ Enabled by drip irrigation

- Mostly hillsides of north coast and Sierra Nevada
- Low pH
- High iron


Phosphorus Deficiency
Cabernet Sauvignon


Willamette Mite - Merlot


Leafroll Virus – Pinot noir

Phosphorus Critical Values

	Petiole Levels (% P)	
	Bloom	Veraison
Deficient	<0.10	<0.08
Questionable	0.10-0.15	0.08-0.12
Adequate	>0.15	>0.12
Cushion	>0.20	>0.15

Phosphorus Status and Rootstocks

HIGH	MEDIUM	LOW
110R	Harmony	420A
1103P	5C	101-14Mgt
Ramsey	5BB	3309C
Freedom	039-16	
	Schwarzmann	

Phosphorus Deficiency Correction

Rates:

0.33 lb. P/vine under drippers, 3 years
0.66 lb. P/vine unnecessary

Materials:

Single or Treble superphosphate
Ammonium phosphate

Summary

- Monitoring
  - Observe
  - Keep Records
  - Know soil type (map)
  - Tissue Analysis petioles at bloom (veraison) - blades B, Na, Cl as diagnostic
- Correction Method
  - Drip
  - Foliar
  - Soil
- Timing
- Formulations
- Rates
  - Dilute concentrations
- Conditions
  - Temperature
  - Relative Humidity
- Winery feedback from juice analysis - communication

"Best thing to put on your vineyard is your shadow" anonymous

Happy Harvest 2009