To apply or not to apply fertilizers: Mineral nutrient uptake by grapevines and interpretation of tissue analyses.

Larry E. Williams

Department of Viticulture and Enology

Kearney Ag Center

Parlier, CA

Topics for discussion at the 2012 Foothill Grape Day

"Because of our clay soils, I have not seen much N deficiency here. We typically see P, K and boron deficiency. Anything you can comment on K foliar sprays (do they work) would be appreciated."

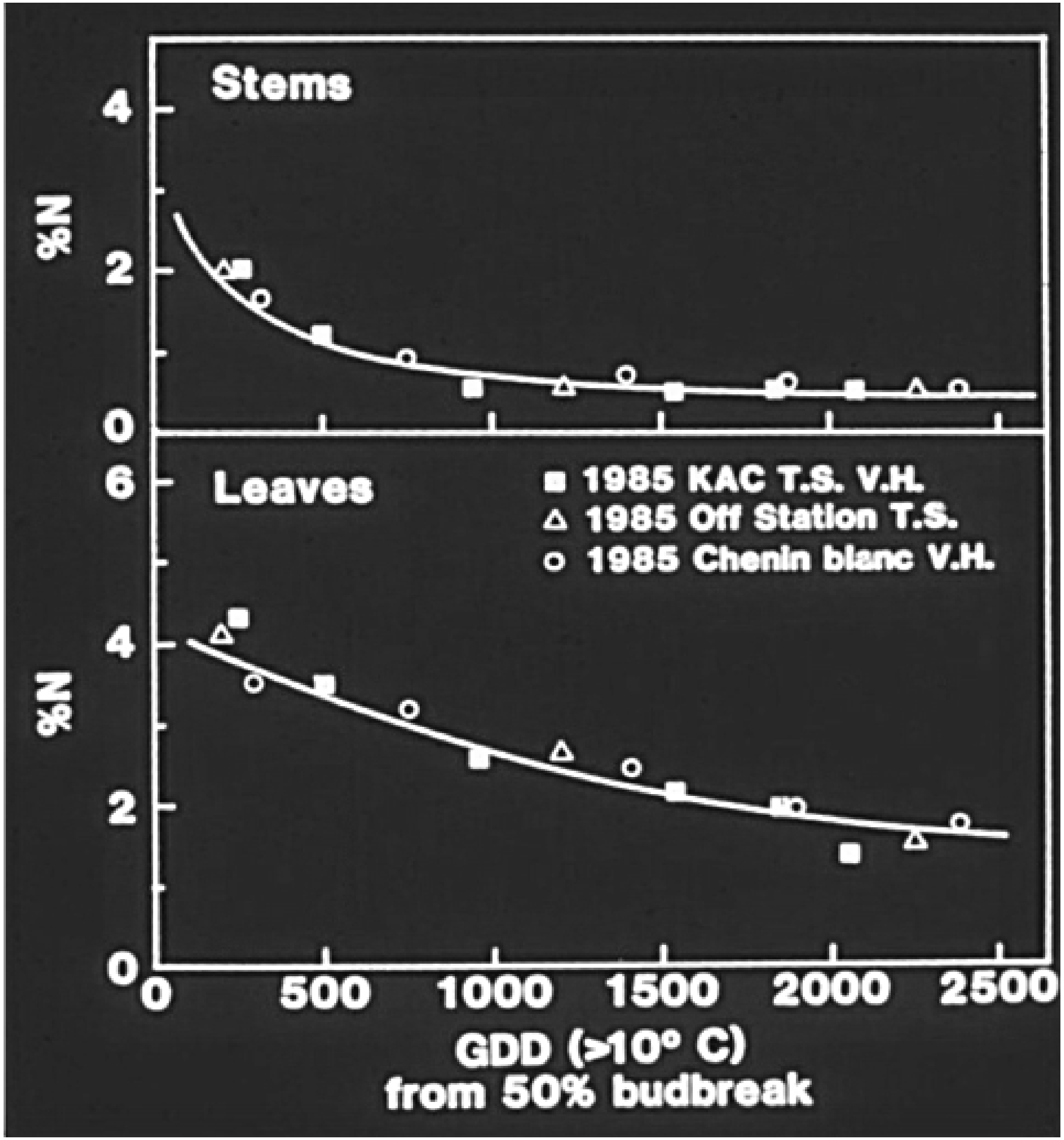
Lynn Wunderlich

Farm Advisor – Central Sierra

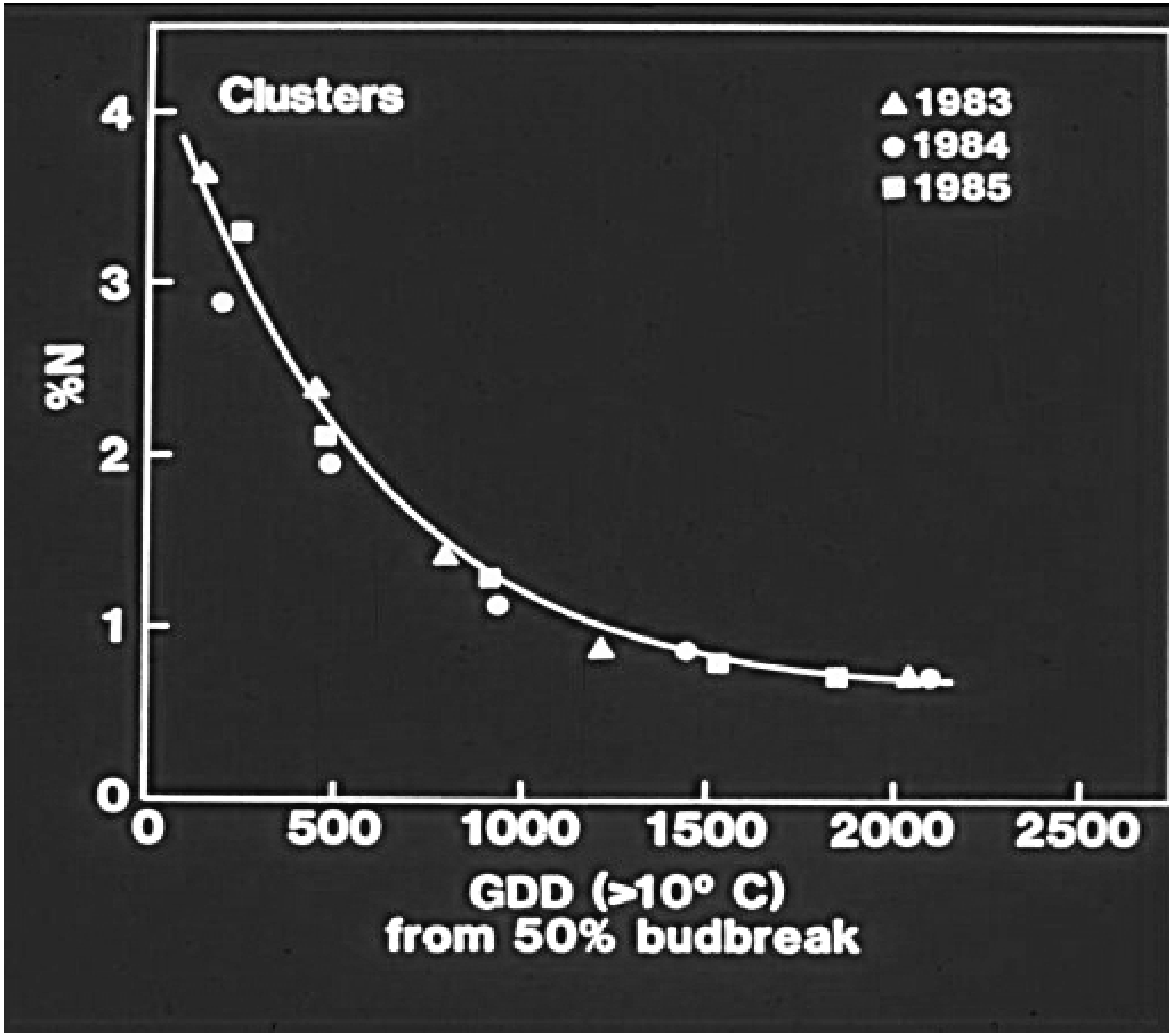
Basics of mineral nutrient uptake in grapevines and their relationship to fertilization of vineyards.

Effects of time of year, location and cultivar on the concentration of N in various organs of the grapevine.

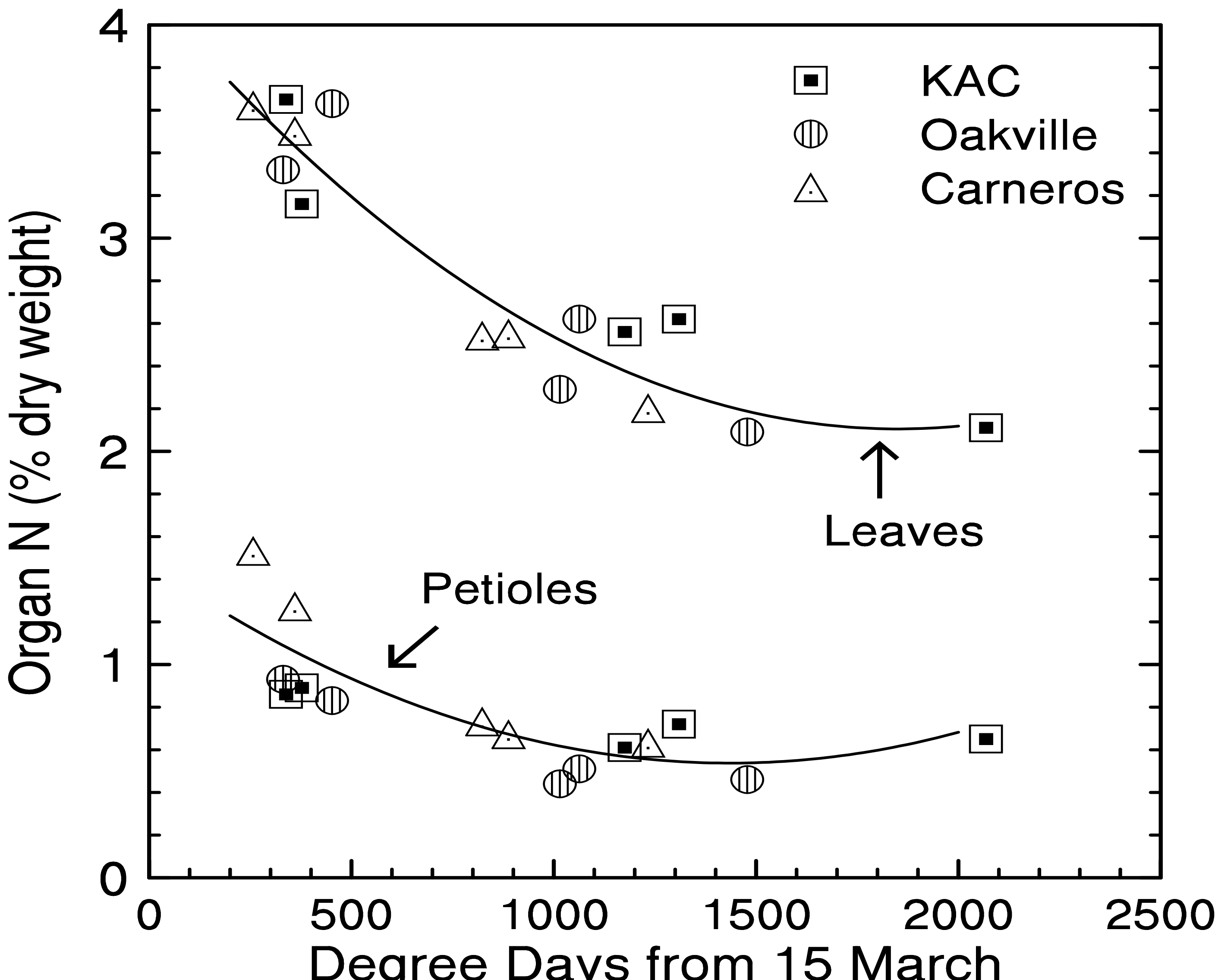
The concentration of N within the leaves and stems decreases throughout the season.



The concentration of N within the cluster decreases throughout the season.



KAC is Thompson Seedless, Oakville is Cabernet Sauvignon and Carneros is Chardonnay.



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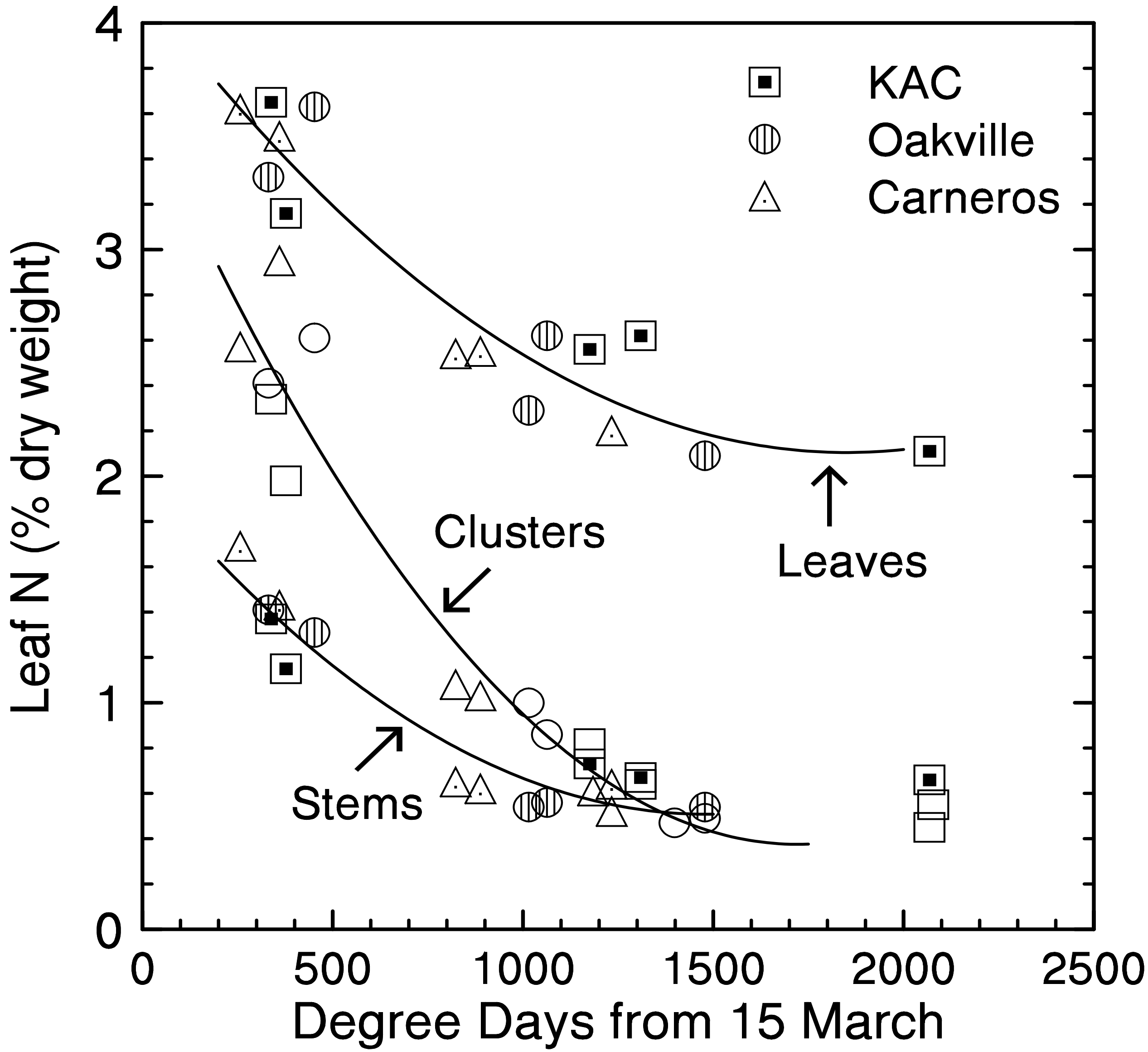


Conclusions:

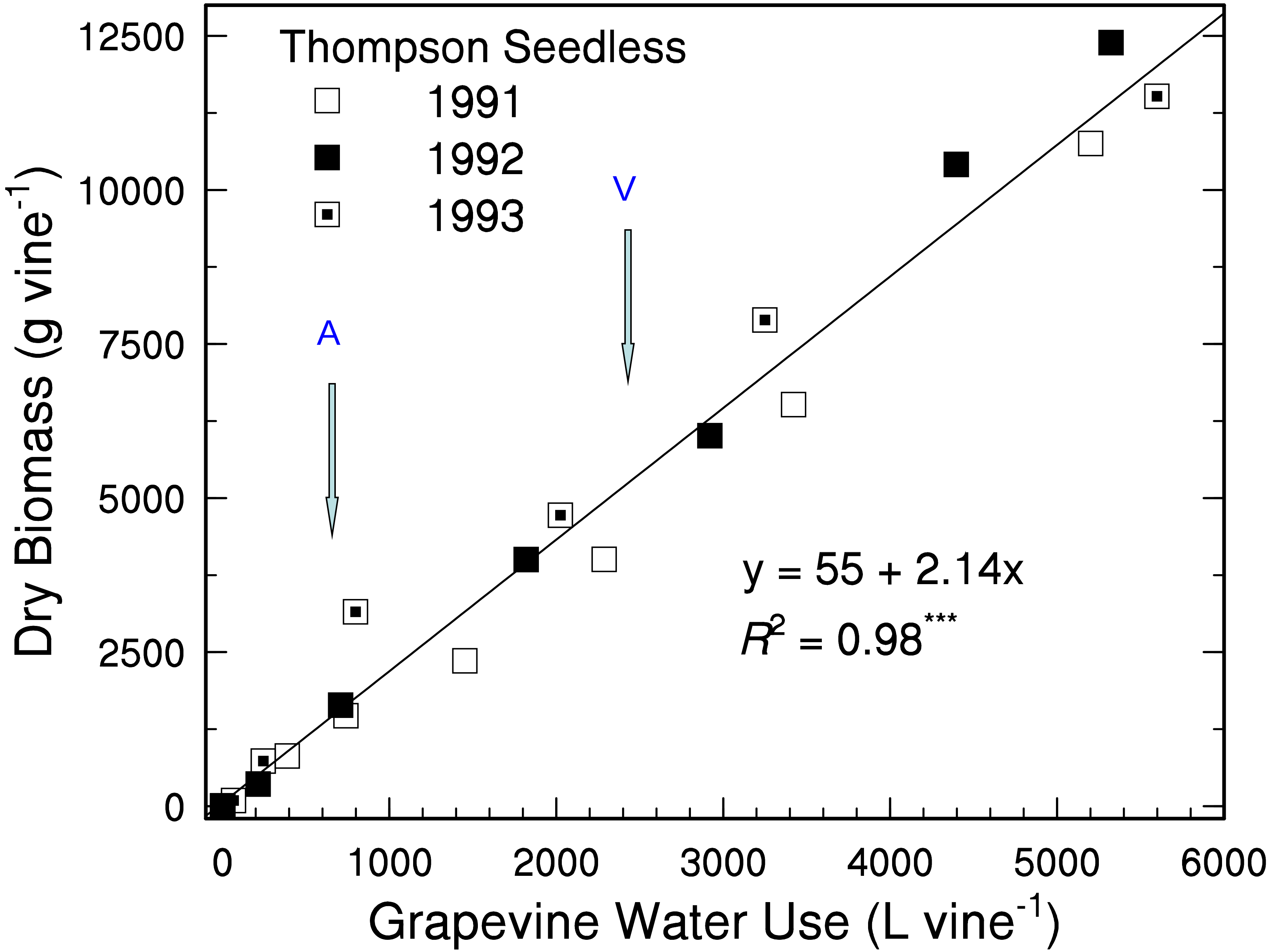
- The N concentration in the organs of grapevines generally decreases as the season progresses probably due to a dilution effect (increase in biomass greater than that of N).
- The N concentration follows similar patterns across years, locations and cultivars when expressed as a function of degree days.
- Such patterns may be useful in a fertilization management program to assess vine nutrient status.

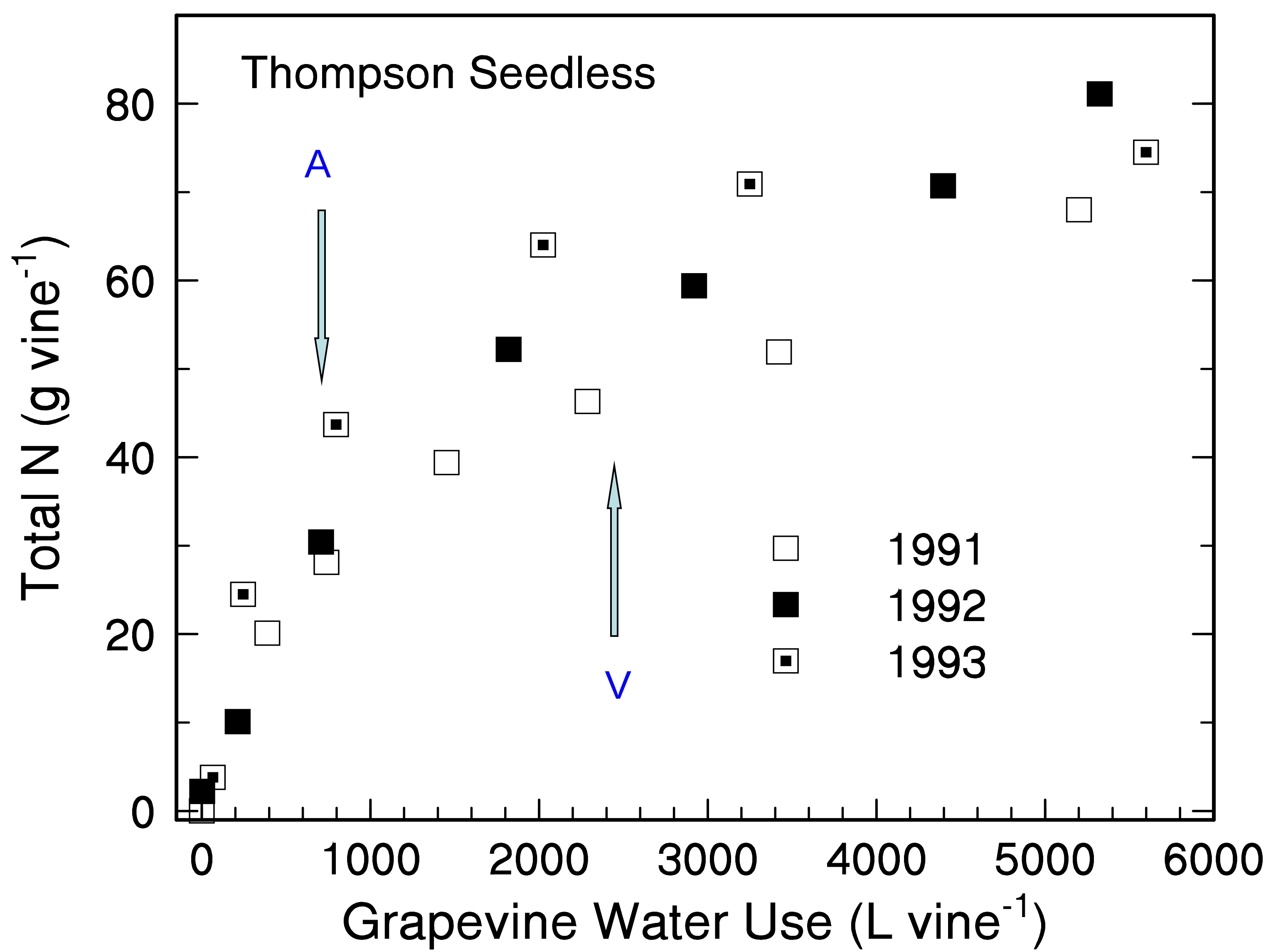
What drives the uptake of mineral nutrients in grapevines?

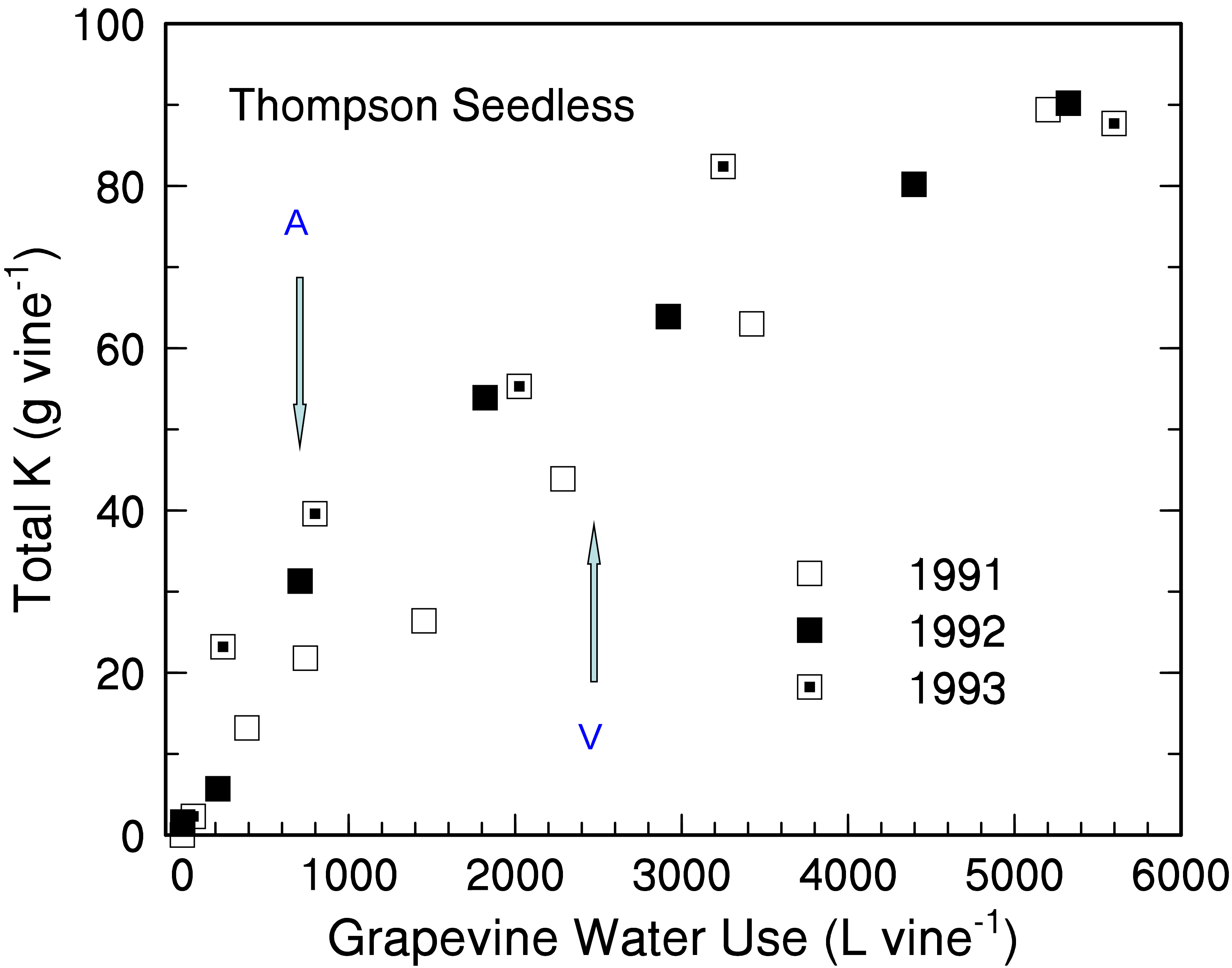
Background

- Many have shown that there is a linear relationship between transpiration of plants and dry biomass production on a seasonal basis.
- Several plant growth models have assumed that N uptake by plants is a linear function of transpiration. This would indicate that ion movement in the soil, ion uptake by the roots and distribution within the plant was due to mass flow.
- Others have assumed that N (and perhaps K) uptake by plants is driven by growth under non-stress conditions.

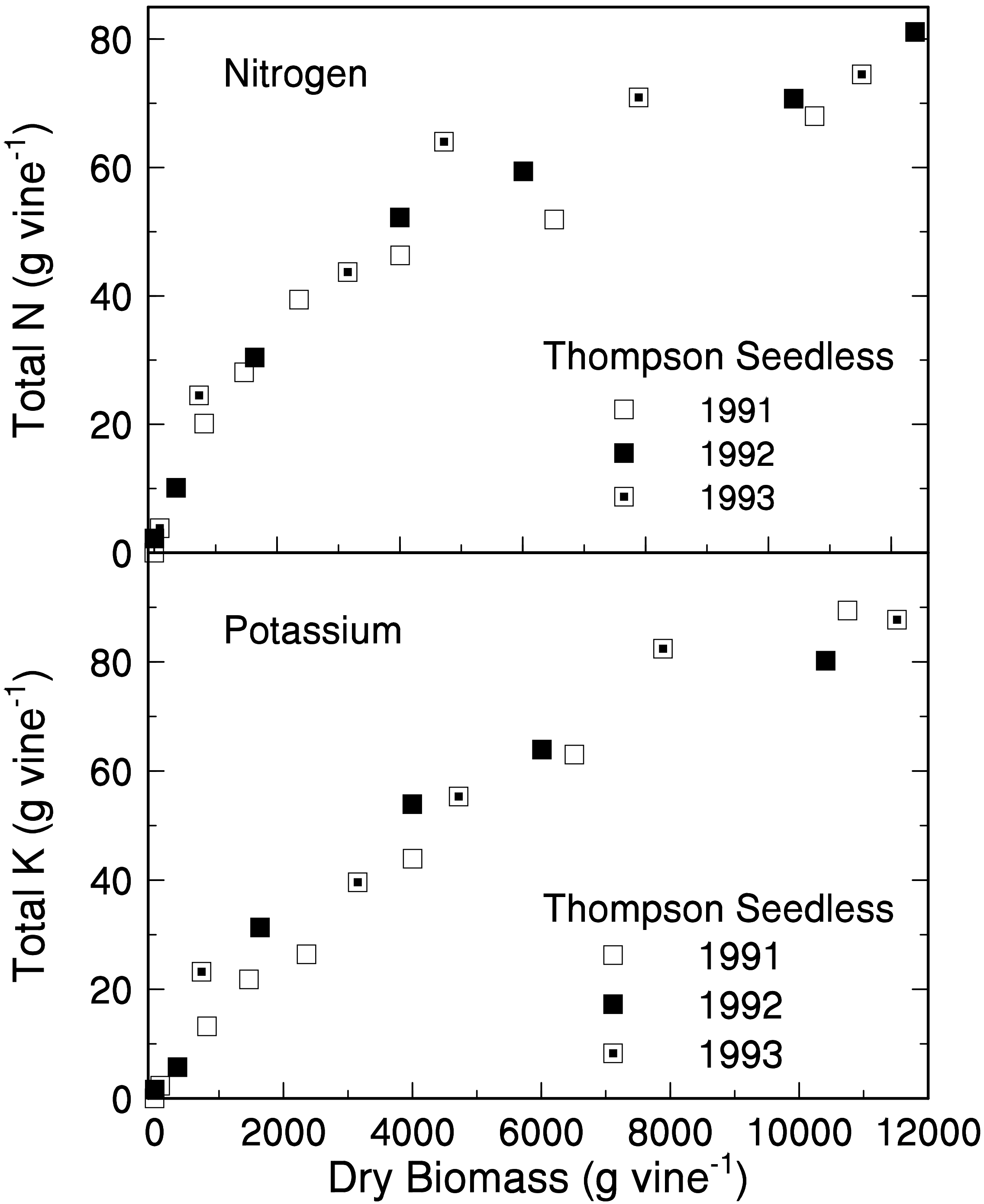
5,500 L = 728 mm or 28.6 inches of water

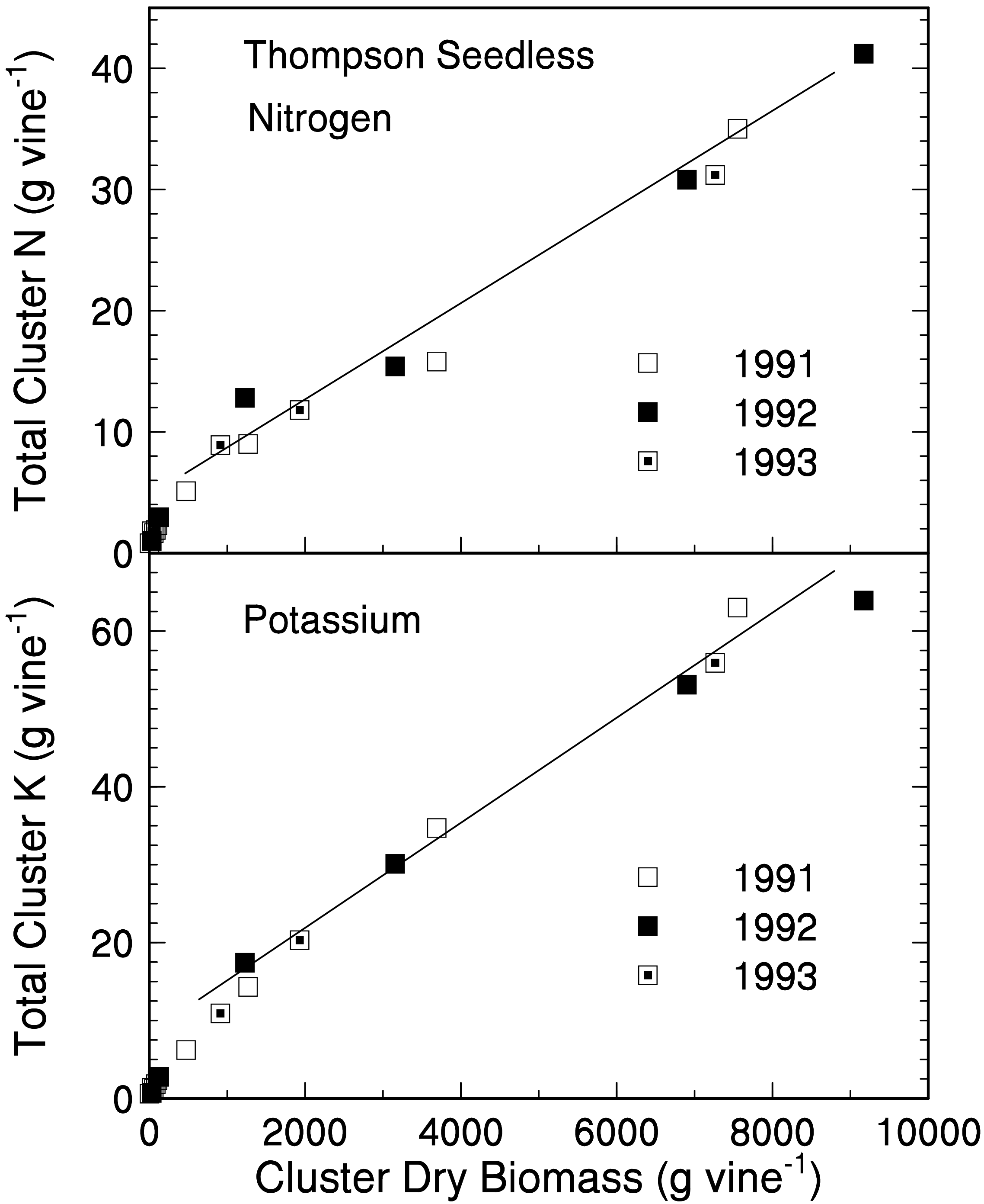



Thompson Seedless
A
V
1991
1992
1993
0
20
40
60
80
Total N (g vine-1)
0
1000
2000
3000
4000
5000
6000
Grapevine Water Use (L vine-1)



Thompson Seedless
A
V
1991
1992
1993
Total K (g vine-1)
Grapevine Water Use (L vine-1)
0
20
40
60
80
100
0
1000
2000
3000
4000
5000
6000


Nitrogen
Total N (g vine-1)
Thompson Seedless
1991
1992
1993
Potassium
Total K (g vine-1)
Thompson Seedless
1991
1992
1993
Dry Biomass (g vine-1)
0
20
40
60
80
0
2000
4000
6000
8000
10000
12000



Thompson Seedless
Nitrogen
Potassium
1991
1992
1993
Total Cluster N (g vine^{-1})
Total Cluster K (g vine^{-1})
Cluster Dry Biomass (g vine^{-1})
0
10
20
30
40
0
20
40
60
0
2000
4000
6000
8000
10000

Summary:

- Nitrogen and K uptake by the vines were curvilinearly related to both seasonal vine water use and biomass accumulation of Thompson Seedless grapevines.
- The curvilinear relationship was due to the separation of vegetative and reproductive growth demands of N and K during the season.
- It is unknown whether the greater N and K uptake during the early portion of the growing season was due to an active uptake of both mineral nutrients or redistribution of N and K from the permanent structures of the vine.

Background

Irrigation has for some time been known to influence the K status of grapevines. The concentration of petiole and blade K during several sampling times (anthesis, veraison and at harvest) increased when normally non-irrigated vineyards were irrigated (Vaadia and Kasimatis, 1961; Freeman and Kliewer, 1983). Based upon the movement of K in the soil (it has been shown to be directly proportional to the soil water content) both soil and fertilizer K may be improved by maintaining higher soil water content. More recent data supporting such observations have been obtained in M. A. Matthews' lab.

Effects of Irrigation treatment and time during the 3rd growing season on total N of clusters, leaves and stems

	Irrigation	---------------- N (% dry wt) --------------		
Date	Treatment	Clusters	Leaves	Stems
August 12	0.2	0.58	2.07	0.80
	0.6	0.48	2.02	0.57
	1.0	0.51	2.08	0.61
	1.4	0.54	2.28	0.45
Sept. 7	0.2	0.64	1.99	0.78 a
	0.6	0.54	1.92	0.61 ab
	1.0	0.61	1.94	0.47 b
	1.4	0.58	1.93	0.47 b

Effects of Irrigation treatment and time during the 3rd growing season on total K of clusters, leaves and stems

	Irrigation	--------------- K (% dry wt) -------------		
Date	Treatment	Clusters	Leaves	Stems
August 12	0.2	0.88 ab	0.59 c	0.62 c
	0.6	0.80 c	0.76 b	0.75 b
	1.0	0.82 bc	0.82 b	0.81 b
	1.4	0.92 a	0.96 a	0.94 a
Sept. 7	0.2	0.89 b	0.44 c	0.42 c
	0.6	0.69 c	0.45 c	0.45 c
	1.0	0.86 b	0.72 b	0.69 b
	1.4	1.06 a	0.96 a	1.04 a

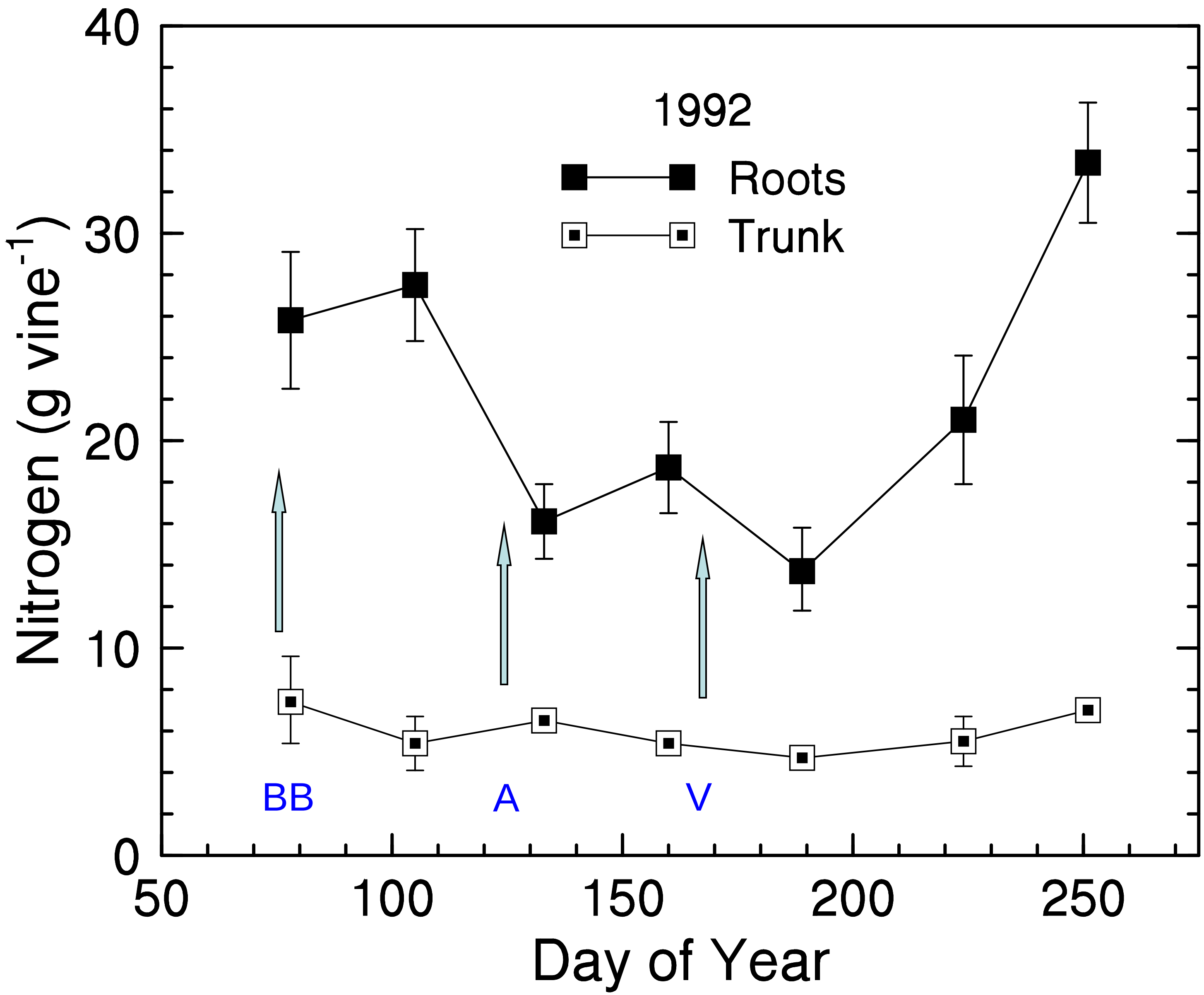
Effects of Irrigation treatment on total vine % N and K and the amounts of those two nutrients per unit area at harvest the 3rd year of the study.

	Irrigation treatment (fraction of applied H_2O amts)			
Total vine	0.2	0.6	1.0	1.4
N (% dry wt)	0.81 a	0.70 b	0.75 ab	0.73 ab
K (% dry wt)	0.72 bc	0.63 c	0.82 b	0.95 a
kg N ha^{-1}	57.8	89.2	107.3	108.3
kg K ha^{-1}	51.5	80.5	116.8	140.4
lbs. N/acre	52	79	95	97
lbs. K/acre	46	72	104	125

Conclusions

- The irrigation treatments significantly affected K in the leaves, clusters and stems. As applied water amounts increased (especially at 1.4 ET_c) the concentration of K in those organs increased.
- The effects of the irrigation treatments on biomass production was mainly responsible for the reduced N needed to support the deficit irrigated vines as there was little difference in total vine % N among treatments.
- Increased biomass and increased uptake of K were both responsible for the greater demand of this mineral nutrient under the conditions of this study.

Dynamics of N reserves in the grapevine: implications for N management practices



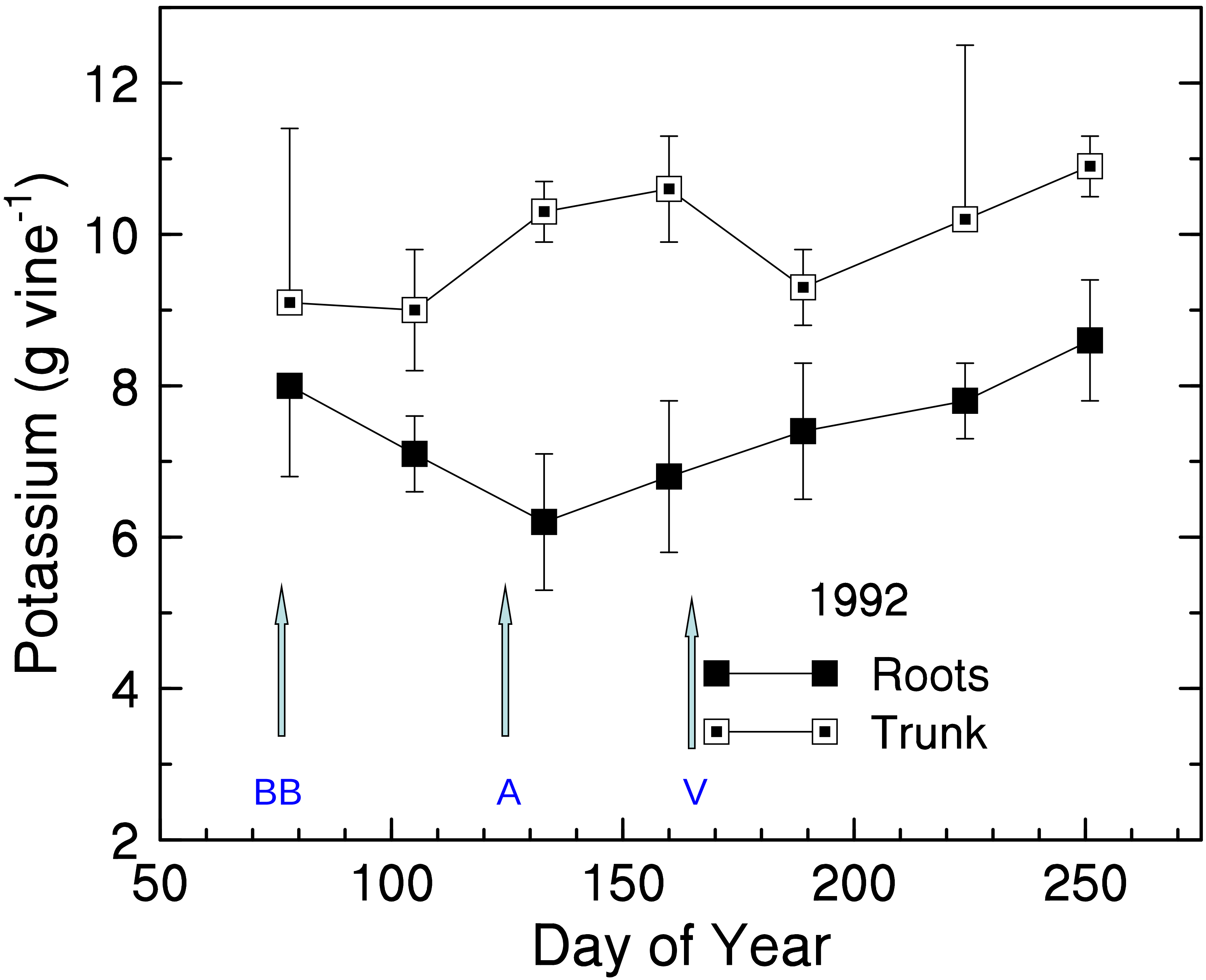
1992
Roots
Trunk
BB
A
V
Nitrogen (g vine^{-1})
Day of Year
0
10
20
30
40
50
100
150
200
250

The amount of N in the vine at harvest (9/5) and that at the end of the growing season (all leaves have fallen from the vine). The bottom row is the change in N from harvest to the end of the season. EOS stands for end of season.

Date	Clusters	Leaves	Stems	New Total	Fruiting canes	Trunk	Roots
	-------------------	-------------------	-------------------	(g N / vine)	-------------------	-------------------	-------------------
9/5	32.0	30.0	11.1	73.1	2.2	7.0	18.8
EOS	31.1	15.6	12.1		2.5	11.1	31.7
Δ 9/5	---	**-14.4**	+1.0		+0.3	**+4.1**	**+12.9**

Values above are equivalent to lbs per acre.

The loss of N from the leaves between harvest and EOS account for 85% of the N accumulated in the trunk and roots after harvest.



Potassium (g vine-1)
Day of Year
1992
Roots
Trunk
BB
A
V
12
10
8
6
4
2
50
100
150
200
250

Utilization of Nitrogenous and Potassium Reserves

- N may be translocated from the permanent structures of the vine (the trunk early on and roots later) to the shoots early in the season. The reserves may supply 10 to 25% of the total N needed for shoot and fruit growth.
- The vine's N reserves are primarily restored with N from the leaves as they senesce. This occurs from harvest through the end of leaf fall.
- Potassium is primarily derived from the soil with little coming from the permanent organs.

N BUDGET OF THOMPSON SEEDLESS GRAPEVINES

Growth Period

Leaves	~35 g/vine
Shoots	~10 g/vine
Clusters	~30 g/vine
	75 g/vine

After Harvest

Fallen leaves	~20 g/vine
Prunings	~15 g/vine
Remolilization	~15 g/vine
	50 g/vine

g per vine are equivalent to lbs per acre with these vine and row spacings

Potassium Budget of Thompson Seedless Grapevines (g/vine)

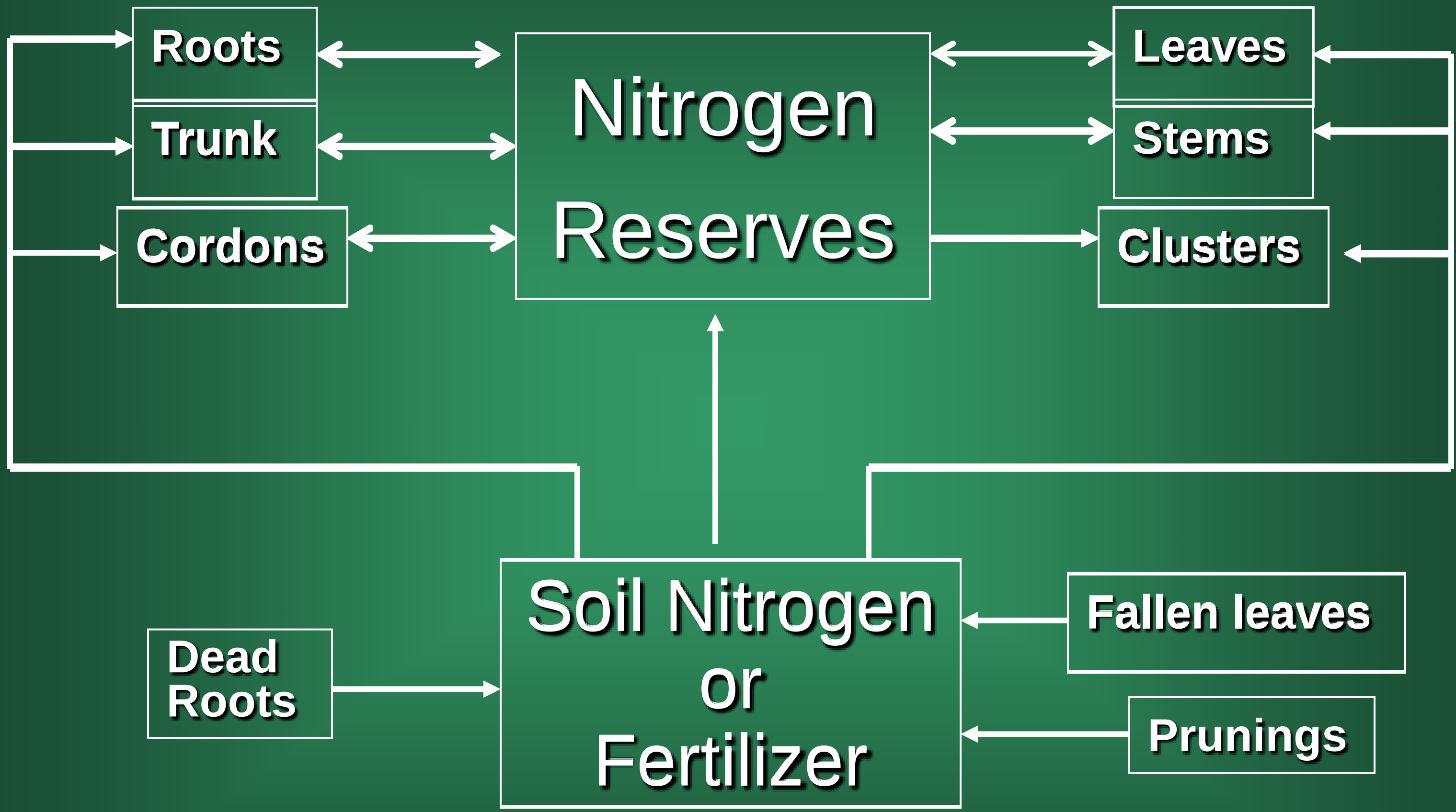
Requirements	Leaves		~12
	Stems		~26
	Clusters		~43
		Total	83
Losses	Shoot trimming		~5
	Fallen leaves		~8
	Prunings		~11
	Fruit harvest		~45
		Total	69

g per vine are equivalent to lbs per acre with these vine and row spacings

The average and high and low amounts of several mineral nutrients in one ton of fruit from grapevines.

Mineral Nutrient	Average	High	Low
	----------------	(lbs / t)	----------------
N	2.80	3.95	1.73
P	0.54	0.46	0.42
K	4.73	7.08	3.05
Ca	0.96	1.78	0.52
Mg	0.19	0.31	0.09

Nitrogen Cycling within a Vineyard



Grapevine N Fertilizer Program

1.) Assessing vineyard/vine N status
2.) Determination of N fertilizer amounts
3.) Kinds of N fertilizers
4.) Timing of fertilization events
5.) Effects of N on vegetative and reproductive growth

1.) Assessing vine nutrient status

a.) deficiency symptoms

b.) soil analysis

c.) tissue analysis

1.) Assessing vine nutrient status

a.) deficiency symptoms –
by the time this is observed
vine growth may already be
adversely affected.

1.) Assessing vine nutrient status

b) Soil analysis

"Soil Analysis is of no value in determining N needs. This is due to the transient nature of its main available form (NO_3) in the soil profile and the unavailability of organic-N fraction until it is mineralized."

L.P. Christensen, UCCE Specialist
Raisin Production Manual

Boron toxicity symptoms on Crimson Seedless.

This vineyard was fertilized with a boron product. It didn't need it and as a result the grower ended up with boron toxicity.

1.) Assessing vine nutrient status

c.) Tissue Analysis – criteria for usefulness

- The tissue used and the mineral nutrient measured should be related to the mineral nutrient status or its concentration in other organs of the vine.
- The tissue used and the mineral nutrient measured should be related to vegetative and reproductive growth of the vine.
- A critical value or its range for the mineral nutrient in the organ measured should be robust enough to cover a wide range of vineyard or grapevine situations.

1.) Assessing vine nutrient status

c.) Tissue Analysis

- Time of Sampling
- Type of Tissue Sampled
- Form of Nitrogen

Time of Sampling

Bloom and/or Veraison

- Definite Growth Stage
- Repeatable
- Convenient

Type of Tissue Sampled

- Petioles opposite the cluster at bloom
- Petioles of mature leaves at veraison
- Leaf blades
- Fruit at harvest
- Canes during dormancy

Form of Nitrogen

Petioles – NO_3-N, NH_4-N, total N

Leaf Blades – total N

Fruit – total N, arginine

Canes – total N, arginine

Must – ammonia, NOPA (amino acids) and YANC

What do most growers use in CA?

Most grape growers use either petioles collected at bloom and/or petiole samples collected at veraison to assess vineyard nutrient status. They will have the petioles analyzed for NO_3-N and/or total N. A few growers may have the leaf blades analyzed for total N.

NITRATE-NITROGEN Bloom Petiole Levels (ppm)

	Nitrate-Nitrogen (ppm)
Deficient	Less than 350
Questionable	350 - 500
Adequate	500 – 1,200
Excessive	Over 2,000
Possibly toxic	Over 3,000

What factors may influence petiole values when analyzed for N or NO_3?

A. **Time of day petioles are sampled** – I have found that time of day <u>may</u> influence the concentrations of NO_3 and K in the petioles. <u>I recommend that petioles should only be collected between 10 a.m. and 2 p.m. to minimize the effects of time of day on measured nutrient values.</u>

What factors may influence petiole values when analyzed for N or NO_3?

B. **Location of the leaves where petioles are collected** – I conducted a study where petioles were collected from leaves opposite a cluster, leaves in full sunlight and leaves growing in the shade. There were some minor differences, depending upon nutrient analyzed, among the leaf types selected. <u>I am of the opinion that the leaf selected makes little difference as long as it is a mature, fully expanded leaf.</u>

What factors may influence petiole values when analyzed for N or NO_3?

A. Cultivar
B. Rootstock
C. Time petioles sampled (during growing season)
D. Irrigation/rainfall prior to sample
E. Type of irrigation (flood or drip)
F. Environment just prior to or the day of sample collection
G. When last fertilized or fertility of soil in the vineyard

A few points:

1.) Most studies have failed to correlate petiole nutrient status with nutrient status of other vegetative or reproductive organs within the vine at that time or at other phenological stages to <u>derive and/or validate critical values</u> of mineral nutrients.

2.) It has always been assumed that rootstocks differ in their ability to take up mineral nutrients from the soil profile based solely upon petiole nutrient values.

3.) What does variability in petiole N (NO_3) values from one year to the next indicate.

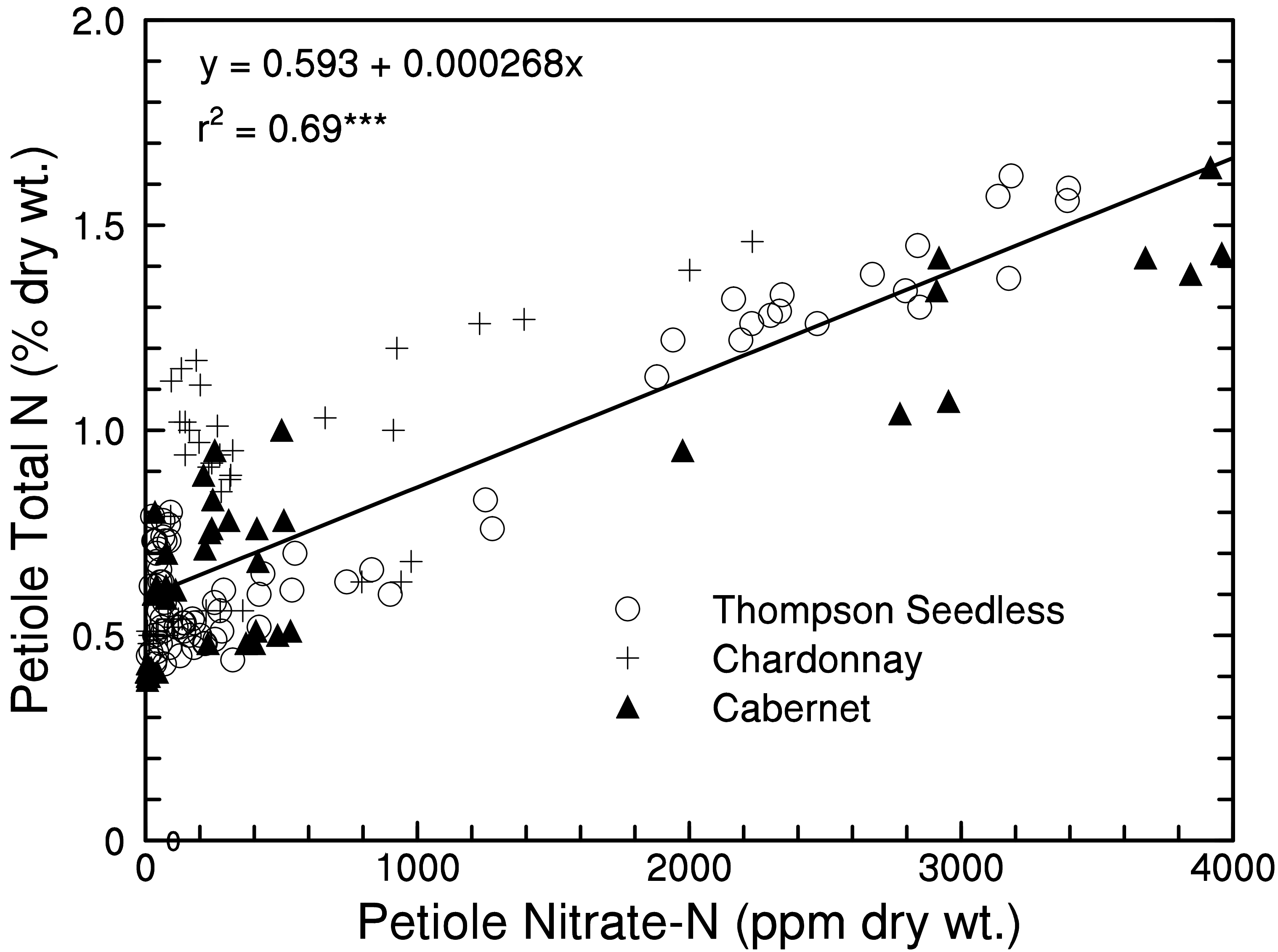
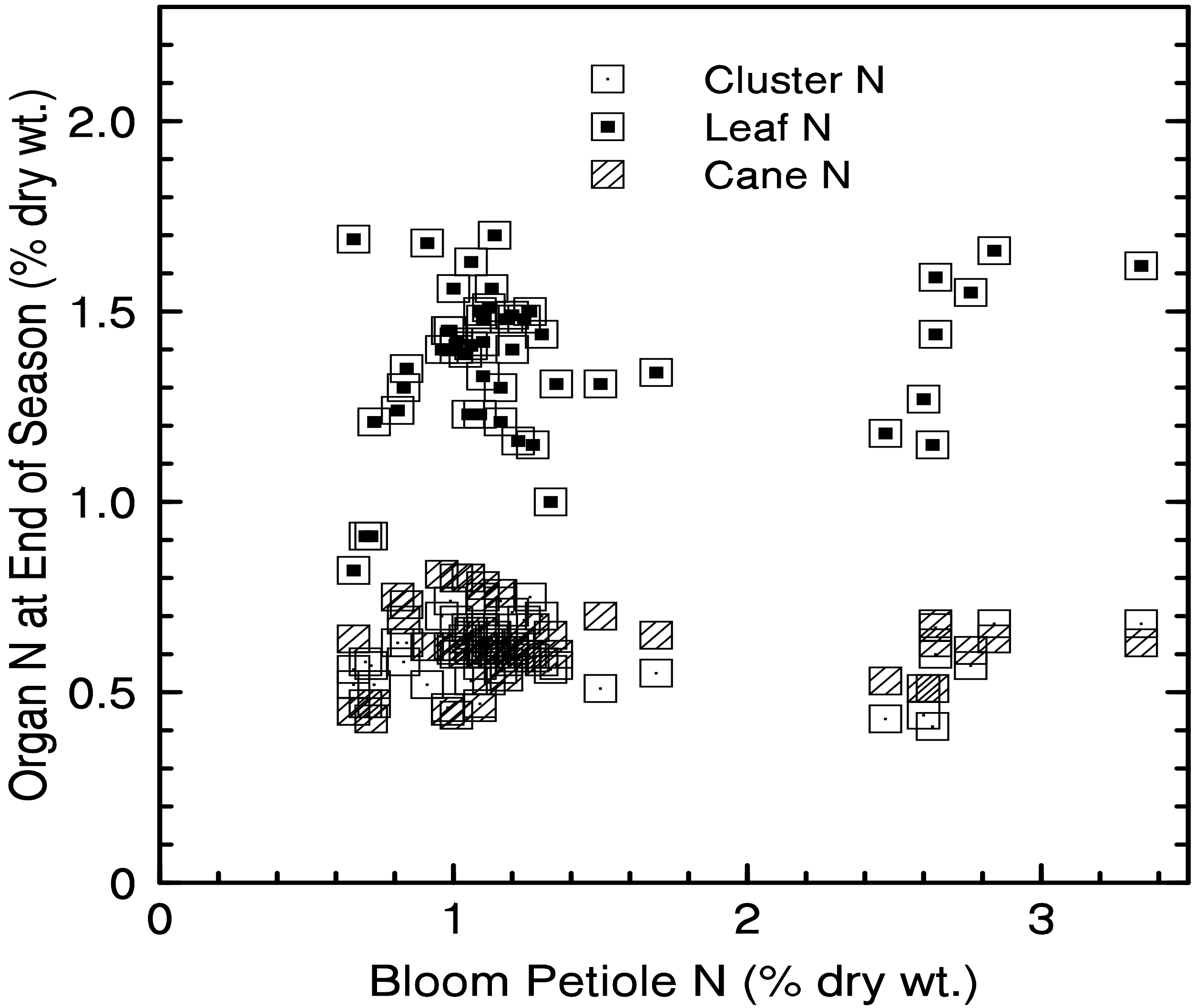
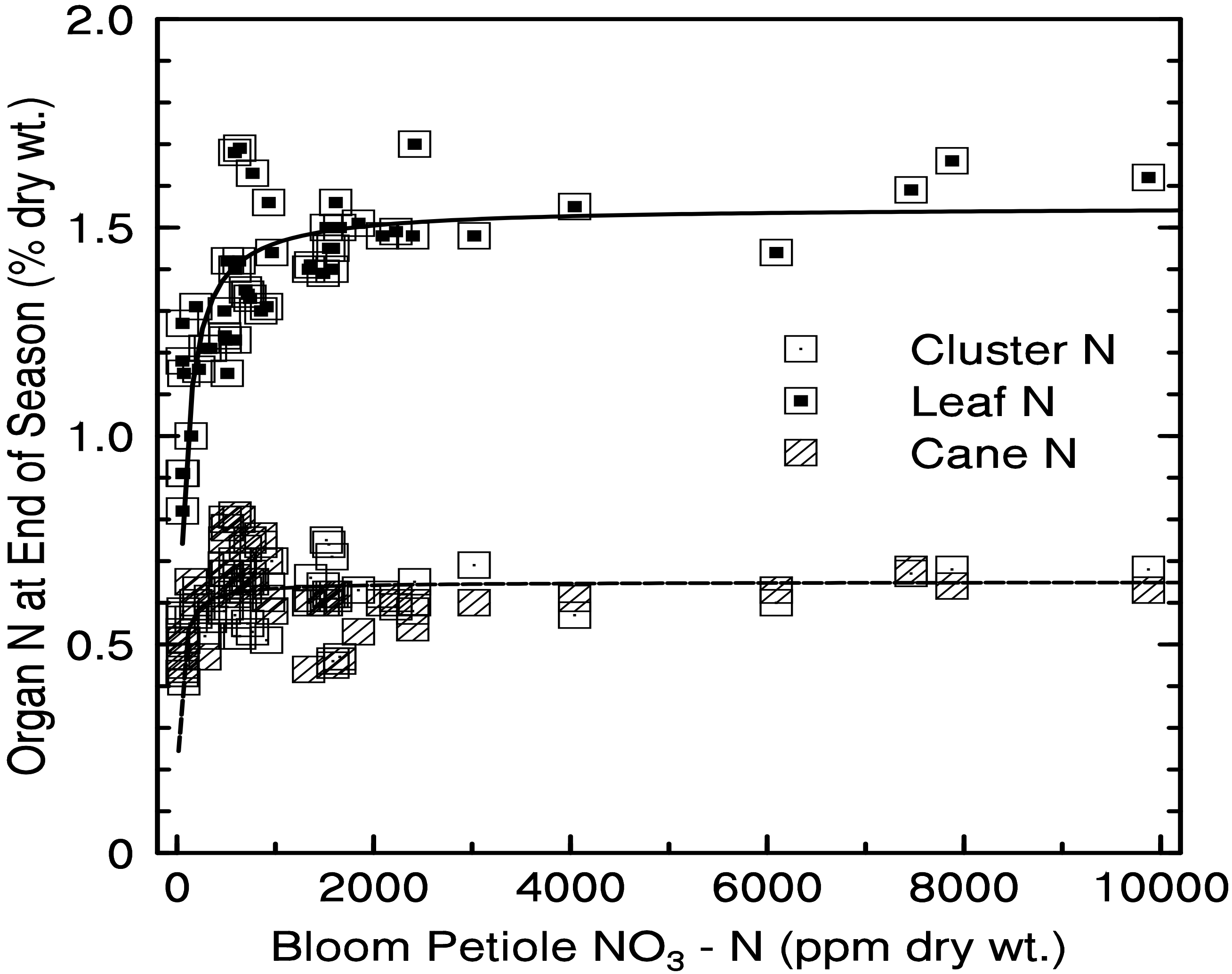


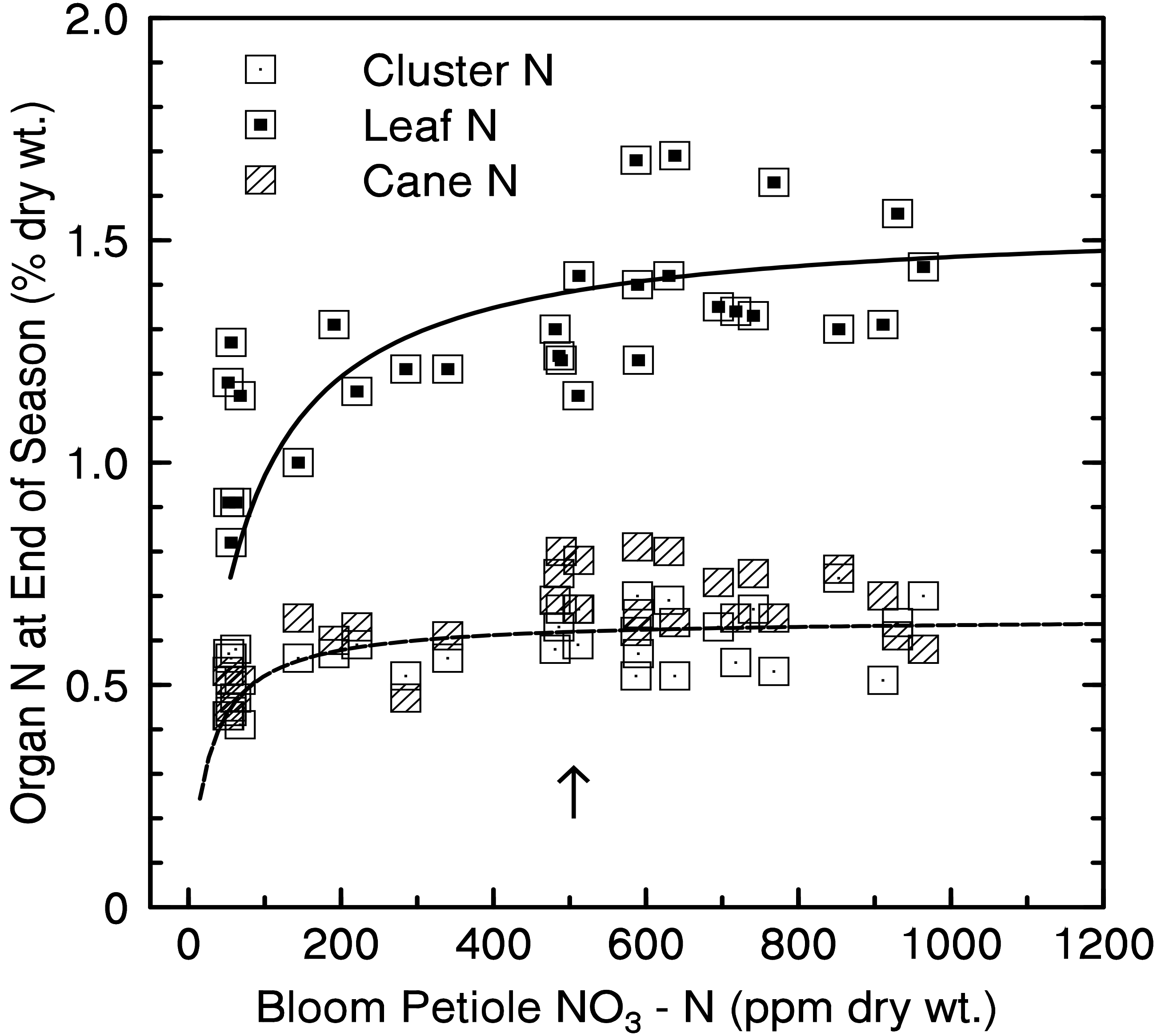
Figure 1. The relationship between petiole nitrate-N and petiole total N for three cultivars.

Data of Chardonnay and Cabernet Sauvignon at different locations and on different rootstocks.

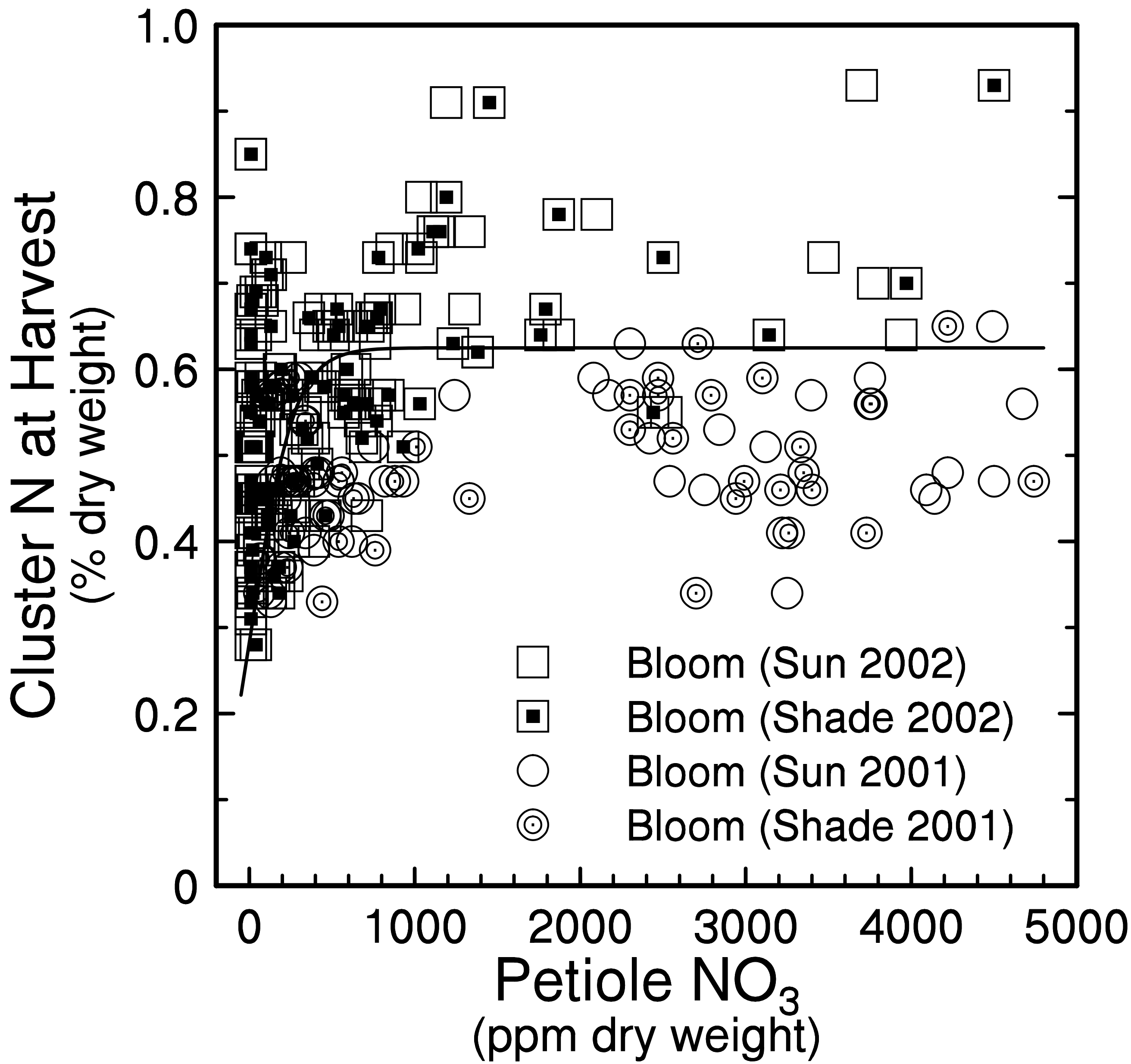


Data of Chardonnay and Cabernet Sauvignon at different locations and on different rootstocks.

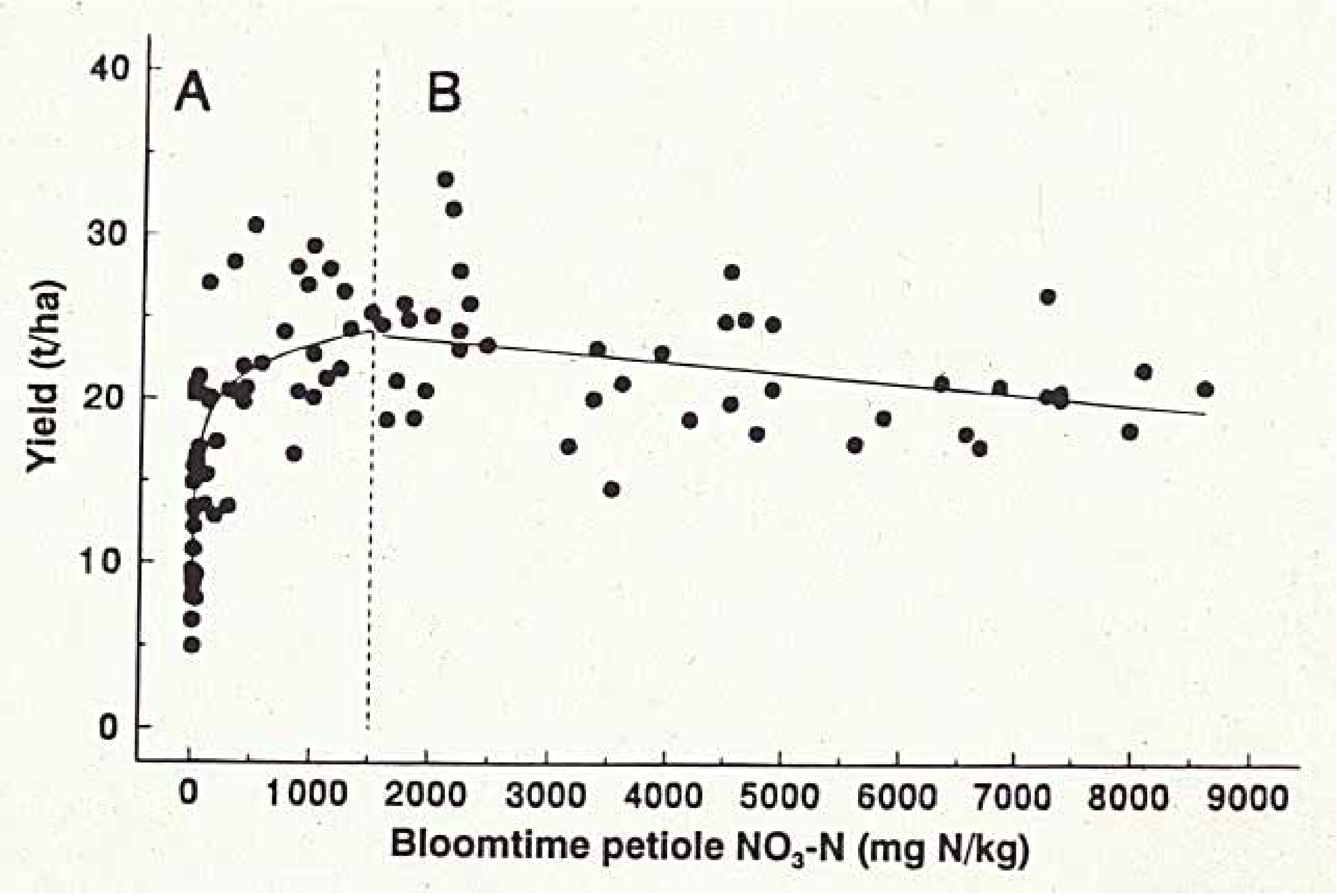



2.0
1.5
1.0
0.5
0
Cluster N
Leaf N
Cane N
Organ N at End of Season (% dry wt.)
0
200
400
600
800
1000
1200
Bloom Petiole NO3 - N (ppm dry wt.)

Data of numerous wine grape cultivars grown at different locations on many different rootstocks.



Data of White Riesling grown in Washington state..



Bloom-time petiole nitrate concentration at four locations and rootstock/scion combinations for three years.

		----NO_3 (ppm dry wt)----		
Location	Rootstock	1997	1998	1999
Carneros	5C	911	500	484
	110R	718	340	396
Gonzalez	5C	768	486	650
	110R	638	481	555
	Freedom	587	695	599
Oakville	5C	68	1655	47
	110R	56	1338	57
	3309C	52	1586	55
P. Robles	5C	6191	1359	2754
	110R	4042	964	1358
	Freedom	9876	1486	1387
	140Ru	7462	1518	1947
	1103P	7878	1575	1562

Cultivar/Site: Cabernet at Paso Robles
Data: ^{15}N, Total N and biomass for three years
Applied Fertilizer: 17g N vine^{-1}

Rootstock	Total ^{15}N	Total N	Total Dry Wt.	%N
	------------------(g/vine $^{-1}$)	----------------		
5C	0.035 c	65.3	8261	0.79 c
110R	0.049 b	67.5	8394	0.80 bc
Freedom	0.074a	69.7	8701	0.80 bc
1103P	0.072a	74.0	8949	0.83 b
140Ru	0.051 b	79.7	9171	0.87a

Conclusions:

- Bloom petiole analysis of N does not indicate that one rootstock is more efficient at taking up N than another under the conditions of this study.

- The relationship between petiole nitrate-nitrogen and N concentration in the leaves, fruit and canes in this study indicates that a bloom-time petiole value of 200 ppm NO_3 would be “adequate.” Nitrate values in the petioles at bloom below 100 ppm decreased percent N in those organs only slightly.

Grapevine Fertilization Program

2.) **Determination of fertilizer amounts**

It will depend upon whether it is a maintenance program or one to correct a deficiency

a.) for a maintenance program one needs to determine how much of the mineral nutrient is removed from the vineyard (i.e. develop a N budget)

b.) determine the efficiency with which fertilizer is taken up.

The average and high and low amounts of several mineral nutrients in one ton of fruit from grapevines.

Mineral Nutrient	Average	High	Low
	----------------	(lbs / t)	----------------
N	2.80	3.95	1.73
P	0.54	0.46	0.42
K	4.73	7.08	3.05
Ca	0.96	1.78	0.52
Mg	0.19	0.31	0.09

Grapevine Fertilization Program

3.) Kinds of N fertilizers

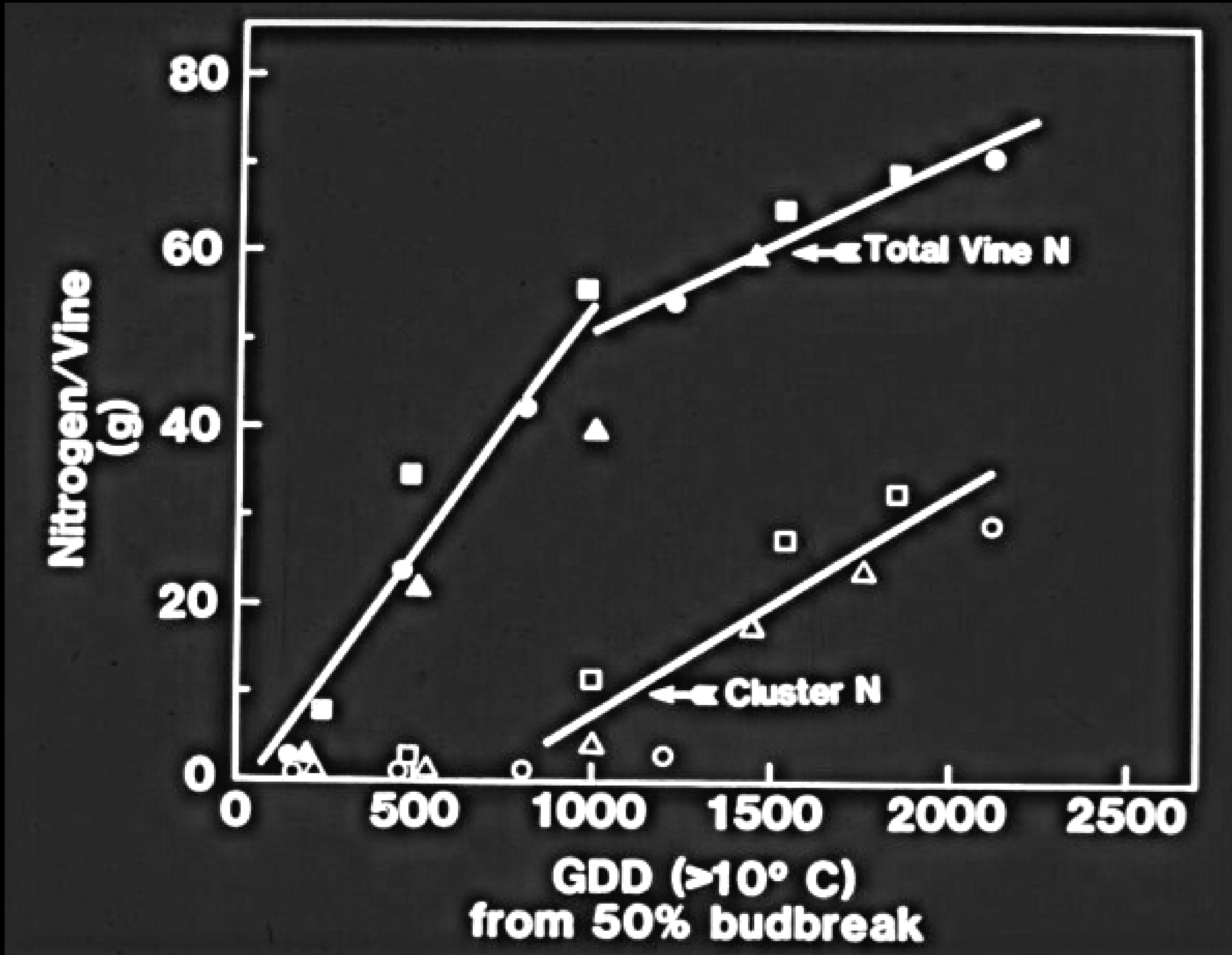
"Generally the choice of the formulation of nitrogen can be based mostly upon cost."

L.P. Christensen, UCCE Specialist

Grapevine Fertilization Program

4.) Timing of fertilization events

One must know when the N is being utilized by the vine to choose the appropriate date to apply the fertilizer.



Nitrogen/Vine (g)
80
60
40
20
0
Total Vine N
Cluster N
0
500
1000
1500
2000
2500
GDD (>10° C)
from 50% budbreak

When do vines require the most N during the growing season?

1.) Approximately two thirds of the current season’s above ground requirement goes to the leaves and stems (main axis of the shoot), the other third goes to the fruit.

2.) Approximately two thirds of the current season’s N requirement is taken up between budbreak and sometime between berry set and veraison.

3.) Some of the nitrogen required by the current season’s above ground growth may be obtained from N in the trunk (or cordons if present) and the root system

L.E. Williams' recommendation for N fertilization application timing

Split applications[a]

1st application – one month after BB
2nd application – just after berry set.

[a] apply one half the total fertilizer to be used each time.

When do you not want to apply a nitrogen fertilizer?

1.) Avoid applying N in winter/early spring if the fertilizer is susceptible to leaching during this season.

2.) An application of N fertilizer just prior to or at bloom will increase the amount of berries that fail to set.

3.) A post-harvest application of an N fertilizer is probably not as efficient as some thought. For one to consider this time as appropriate, one needs to assess vine health, length of season remaining and soil type.

Effect of irrigation type and form of nitrogen of fertilizer use efficiency (FUE).

Treatment	FUE [1]
Drip NO_3	42%
Drip NH_4^+	37%
Furrow (NO_3)	14%
Furrow (NH_4^+)	10%
Drip (cont)	38%

[1] FUE = Total Fert. N on Vine/Total Fert. N Applied.

Distribution of fertilizer N in individual vine organs

Treat-ment	Year Harvested	Clusters	Leaves	Stems[2]	Trunk	Roots	Total
		--------------Vine organs--------------					
		-------------(g N vine^{-1})---------------					
Drip (cont)	1989	3.23	1.81	0.86	1.14	2.47	9.51
Drip (cont)	1990	1.78	1.40	0.78	0.58	2.32	6.86

[1] Vines fertilized with 15 N every two weeks during 1989 growing season for a total of 27.6 g N vine^{-1}.

[2] Stems include main axis of shoot and fruiting canes.

Inefficient use of nitrogen:

1.) Contributes to greater use of energy reserves
2.) Increased production cost
3.) Possible environmental pollution of nitrates in water

Grapevine Fertilization Program

5.) Effects of N on vegetative and reproductive growth

Effects of N Fertilization on Growth, Yield and Fruit Characteristics

Parameter	Deficient Vineyards	Non-deficient vineyards
Vegetative growth	↑	↑
Yield	↑	*
Berry Sugar	?	? or ↓
N Compounds in Fruit	↑	↑

↑ ↓ - increase and decrease respectively; ***** - no effect; ? :- may or may not have effect

San Joaquin Valley N and K Fertilizer Study: Objectives

- Determine the correlations among the various means to assess vine N nutrient status with nitrogenous compounds found the the fruit at harvest of Merlot and Thompson Seedless grapevines grown in the San Joaquin Valley.
- The nitrogenous compounds measured in the fruit are those used by yeast during fermentation. They include ammonia and α-amino acids.
- Determine the effects of K fertilizer on juice characteristics and correlations with vine K nutrient status.

Critical values of YANC in grapes for wine production

Various studies have attempted to estimate the minimum concentration of juice N needed to achieve a satisfactory completion of fermentation as judged by low residual sugar, i.e. minimum concentration of N in juice at which the risk of slow or stuck fermentation is low. Estimates range from 70 – 267 mg/L YANC, with a value of ~ 140 mg N/L for clarified musts of moderate sugar concentration being considered a practical minimal limit.

Effects of applied **N** fertilizer at berry set (BS) or veraison (V) in 2004 on must characteristics of **Merlot** grapevines grown in Madera County.

N Treatment	Soluble Solids (°Brix)	pH	TA (g L^{-1})	NH_4^+	NOPA	YANC
				---------------- (mg L^{-1})	-------------	
2004						
N 0	25.5	3.66	5.35 a	50 c	98 b	144 b
N 75 BS	26.0	3.67	5.32 a	67 b	123 a	181 ab
N 150 BS	25.5	3.63	5.45 a	79 a	115 a	184 a
N 75 V	25.3	3.71	4.65 b	63 b	118 a	188 a
2005						
N 0	22.4	3.46	3.47	62 b	143 b	205 b
N 75 BS	22.3	3.44	4.04	81 a	140 b	220 ab
N 150 BS	21.9	3.45	3.85	82 a	156 a	238 a
N 75 V	21.7	3.42	4.06	86 a	149 ab	235 a

Effects of applied **N**/**K** fertilizer at berry set (BS) or veraison (V) in 2004 on must/wine nitrogenous compounds of **Merlot**.

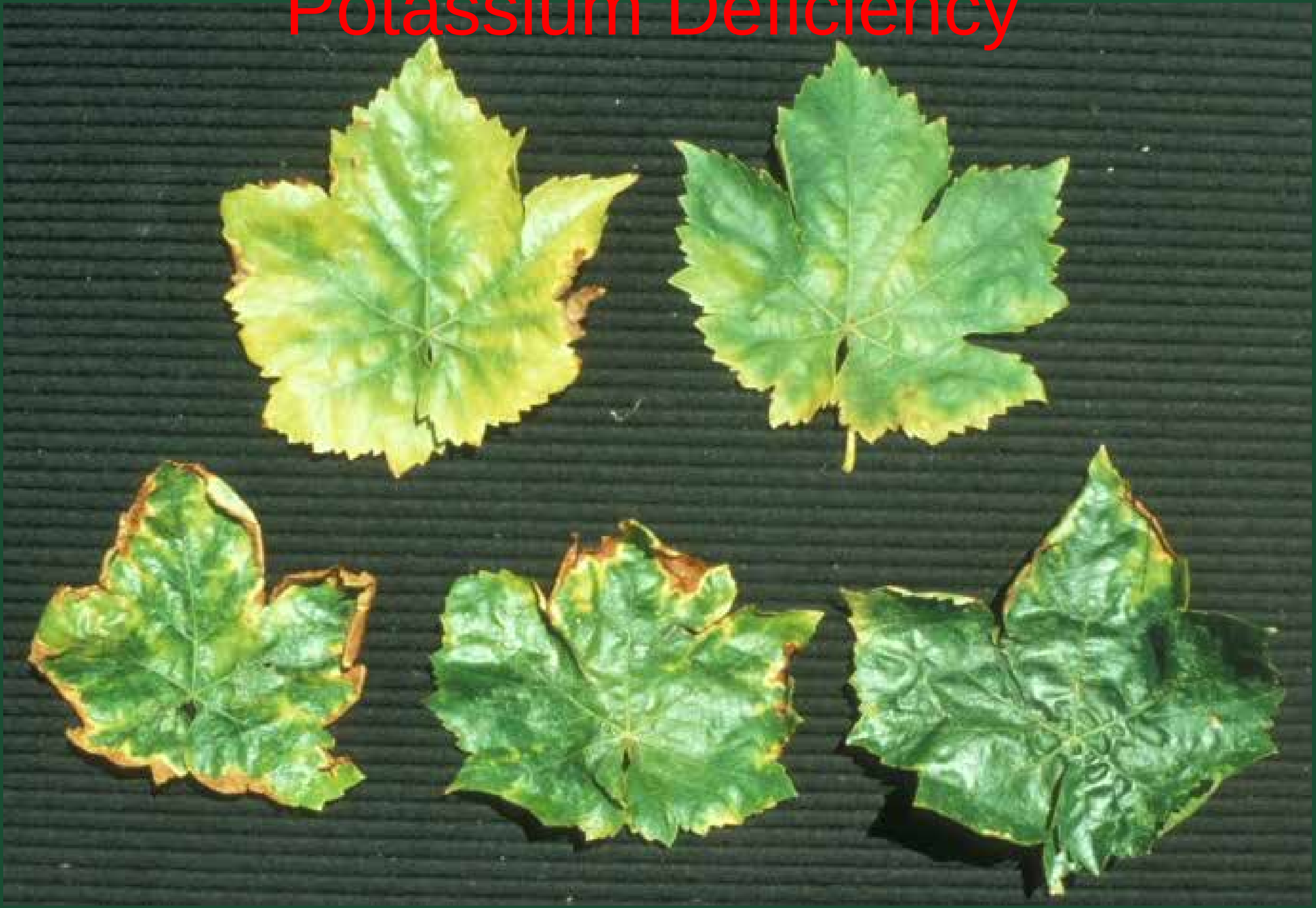
N/K	----- Merlot Must -----			---- Merlot Wine ----		
Treatment	**NH_4^+**	**NOPA**	**YANC**	**NH_4^+**	**NOPA**	**YANC**
2004	----- (mg L^{-1}) -----					
N 0	50	98	**144**	5.9	34	**40**
N 75 BS	67	123	**181**	4.5	40	**44**
N 150 BS	79	115	**184**	6.7	39	**46**
N 75 V	63	118	**188**	9.4	40	**49**
2004						
K 0	59	108	**166**	7.1	36	**43**
K 75 BS	62	106	**178**	9.8	39	**49**
K 150 BS	57	87	**141**	6.8	35	**42**
K 75 V	53	92	**149**	6.4	34	**40**

Grapevine K Fertilization Program

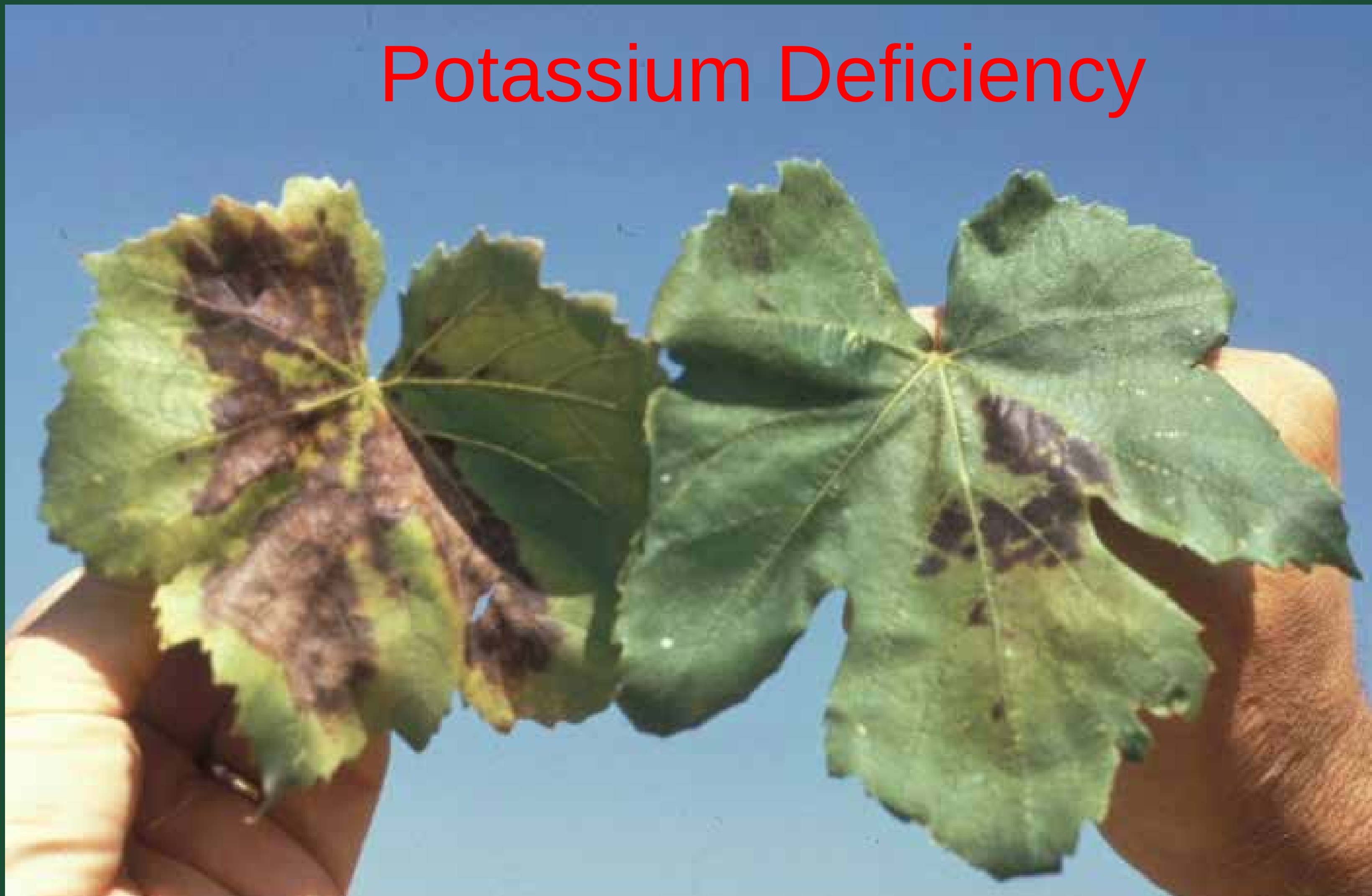
1.) Assessing vineyard/vine nutrient status
2.) Determination of fertilizer amounts
3.) Kinds of fertilizers
4.) Timing of fertilization events
5.) Effects of mineral nutrients on vegetative and reproductive growth.

Potassium Deficiency

Potassium Deficiency

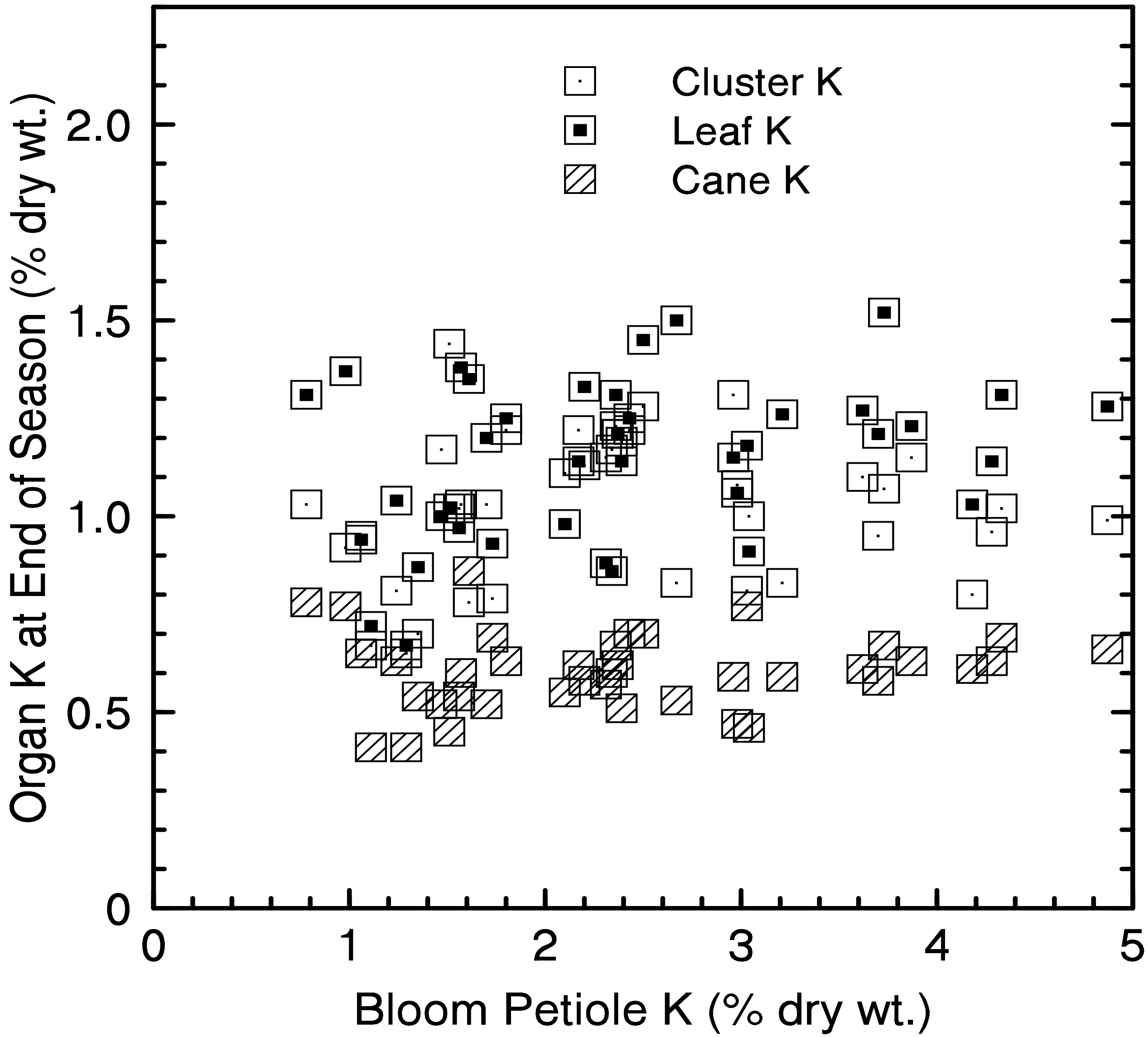


Potassium Deficiency



POTASSIUM

	Potassium (%)
Bloom Petiole Levels	
Deficient	Less than 1.0
Questionable	1.0 to 1.5
Adequate	Over 1.5
Midsummer Petiole Levels	
Deficient	Below 0.5
Adequate	Above 0.8


Cluster K
Leaf K
Cane K
Organ K at End of Season (% dry wt.)
Bloom Petiole K (% dry wt.)
0
0.5
1.0
1.5
2.0
0
1
2
3
4
5

Effects of applied **K** fertilizer at berry set (BS) or veraison (V) in 2004 on must characteristics of **Merlot** grapevines grown in Madera County.

K Treatment	Soluble Solids (°Brix)	pH	TA (g L^{-1})	NH_4^+	NOPA	YANC
				---------------- (mg L^{-1})	-------------	
2004						
K 0	25.1	3.64	4.70	59 ab	108 a	166
K 75 BS	25.6	3.64	4.72	62 a	106 a	178
K 150 BS	25.3	3.68	4.87	57 ab	87 b	141
K 75 V	25.5	3.69	4.65	53 b	92 ab	149
2005						
K 0	22.0	3.46	3.68	103	158 b	261
K 75 BS	22.1	3.44	3.74	108	157 b	264
K 150 BS	22.0	3.45	3.67	139	159 b	299
K 75 V	22.3	3.42	3.50	116	178 a	293

Effects of applied **N**/**K** fertilizer at berry set (BS) or veraison (V) in 2004 on wine characteristics of **Merlot** grapevines grown in Madera County.

N/K Treatment	**Ethanol** (% v/v)	pH	**TA** (g L^{-1})	**NH_4^+**	**NOPA** (mg L^{-1})	**YANC**
2004						
N 0	14.1	3.98 b	5.63 a	5.9 b	34 b	40
N 75 BS	14.3	4.04 b	5.33 ab	4.5 b	40 a	44
N 150 BS	14.0	4.04 b	5.10 b	6.7 ab	39 a	46
N 75 V	13.9	4.11 a	4.93 b	9.4 a	40 a	49
2004						
K 0	14.4 a	4.02	5.60	7.1	36	43
K 75 BS	14.0 ab	3.98	5.74	9.8	39	49
K 150 BS	14.3 ab	3.99	5.78	6.8	35	42
K 75 V	13.7 b	4.00	5.46	6.4	34	40

Effects of applied N and K fertilizers at berry set (BS) or veraison (V) in 2004 on juice or wine K status of Merlot grapevines grown in Madera County

Treatment	--------- K (mg L^{-1}) ----------		Treatment	-- K (mg L^{-1}) --
2004	Juice	Wine	**2005**	Juice
N 0	1922 ab	1694 c	**N 0**	1432
N 75 BS	2001 a	1951 b	**N 75 BS**	1409
N 150 BS	1727 b	2503 a	**N 150 BS**	1442
N 75 V	2006 a	1922 b	**N 75 V**	1353
2004			**2005**	
K 0	1913 b	1972	**K 0**	1406 b
K 75 BS	1908 b	1989	**K 75 BS**	1474 ab
K 150 BS	2364 a	2008	**K 150 BS**	1620 a
K 75 V	1887 b	1985	**K 75 V**	1363 b

Do potassium foliar/cluster sprays late in the growing season hasten the ripening of berries?

Influence of cluster directed applications of calcium salts and other compounds before harvest on postharvest quality and decay of table grapes.

Dr. Joseph L. Smilanick

USDA-ARS

San Joaquin Valley Agrcult. Sci. Center

Parlier, CA

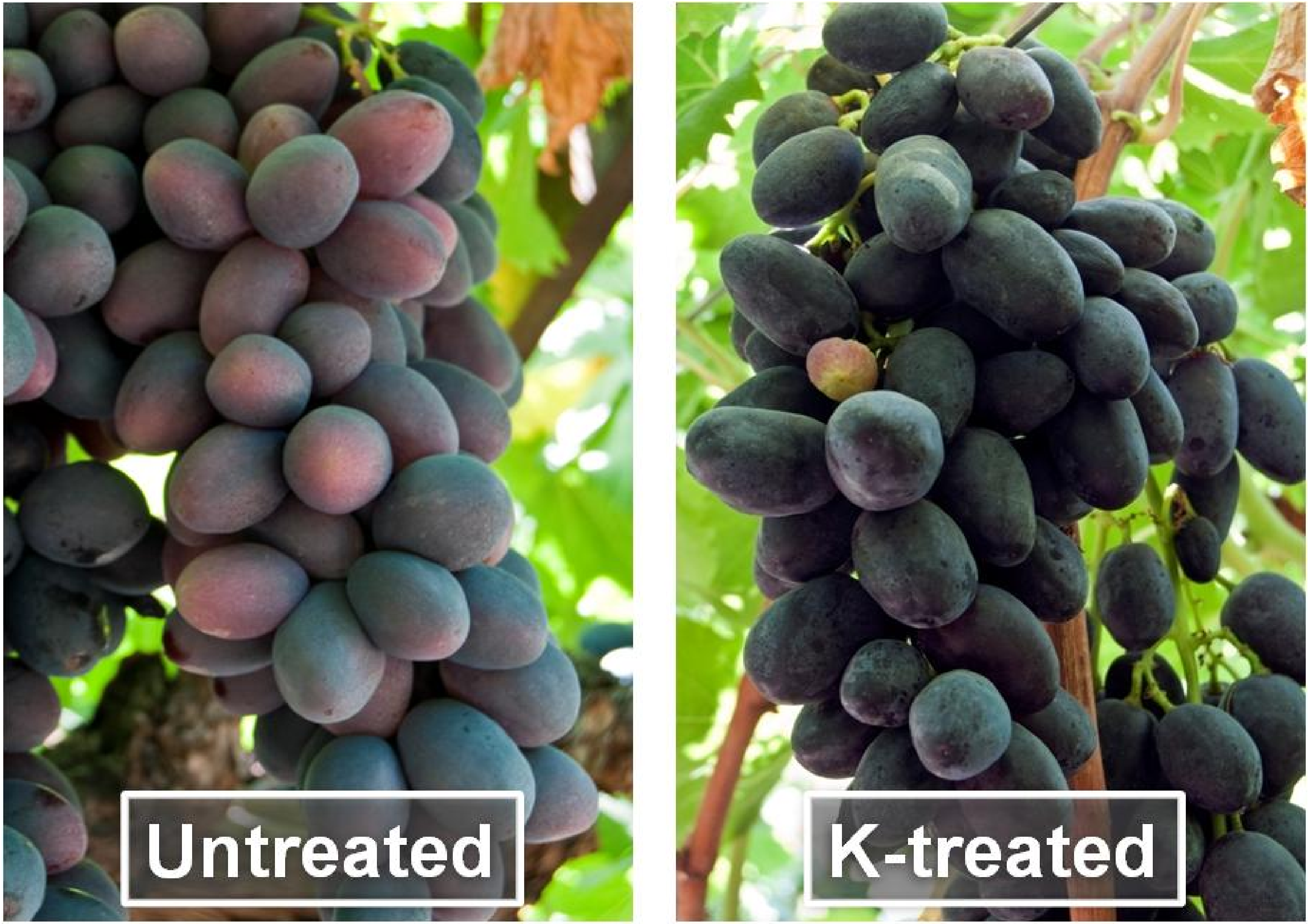
Influence of potassium cluster directed sprays applied at the onset of veraision and later on enhancing sugar accumulation

- Spray solution contained 1.3 g of K metalosate per liter of water and sprayed to runoff. Also used 0.35 ml of B1956 surfactant per liter of water.
- Also used K sorbate and K bicarbonate in some trials.
- Small hand-held sprayer used with solution directed on clusters only.

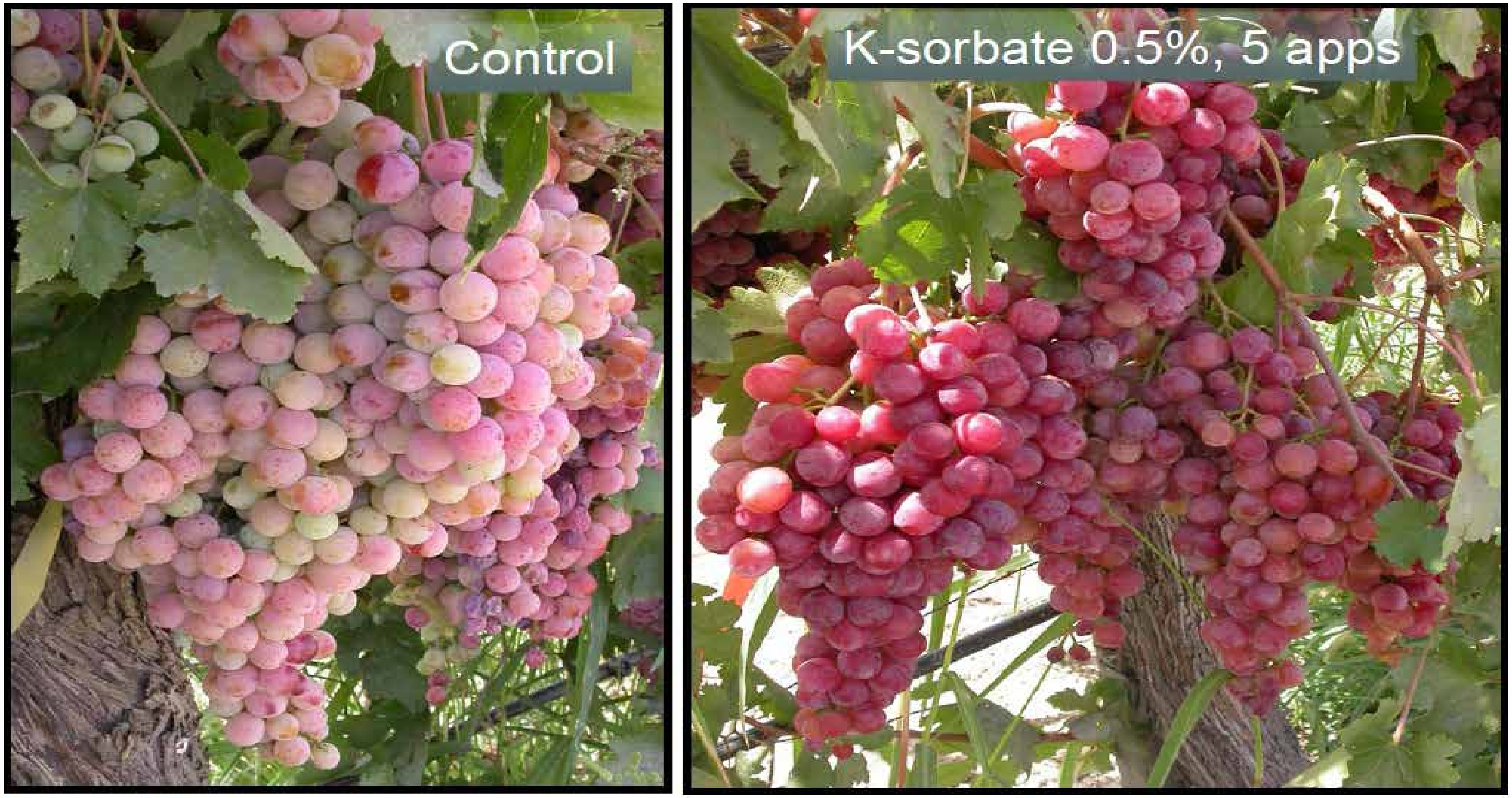
Results:

- The application of those compounds enhanced the accumulation of sugar in the fruit of six different cultuvars (across 3 years).
- Change from control to experimental product ranged from +1.0 to +4.8 Brix.
- Most products increased color of the fruit.
- In one trial sugar and color of the control caught up with the experimental treatment when sugar reached 20 Brix.

Appearance of ‘Sweet Scarlet’ table grapes at harvest on Aug 5, 2009, after four applications of potassium metalosate. Soluble solids untreated were 16.0% and those potassium-treated were 19.5%.



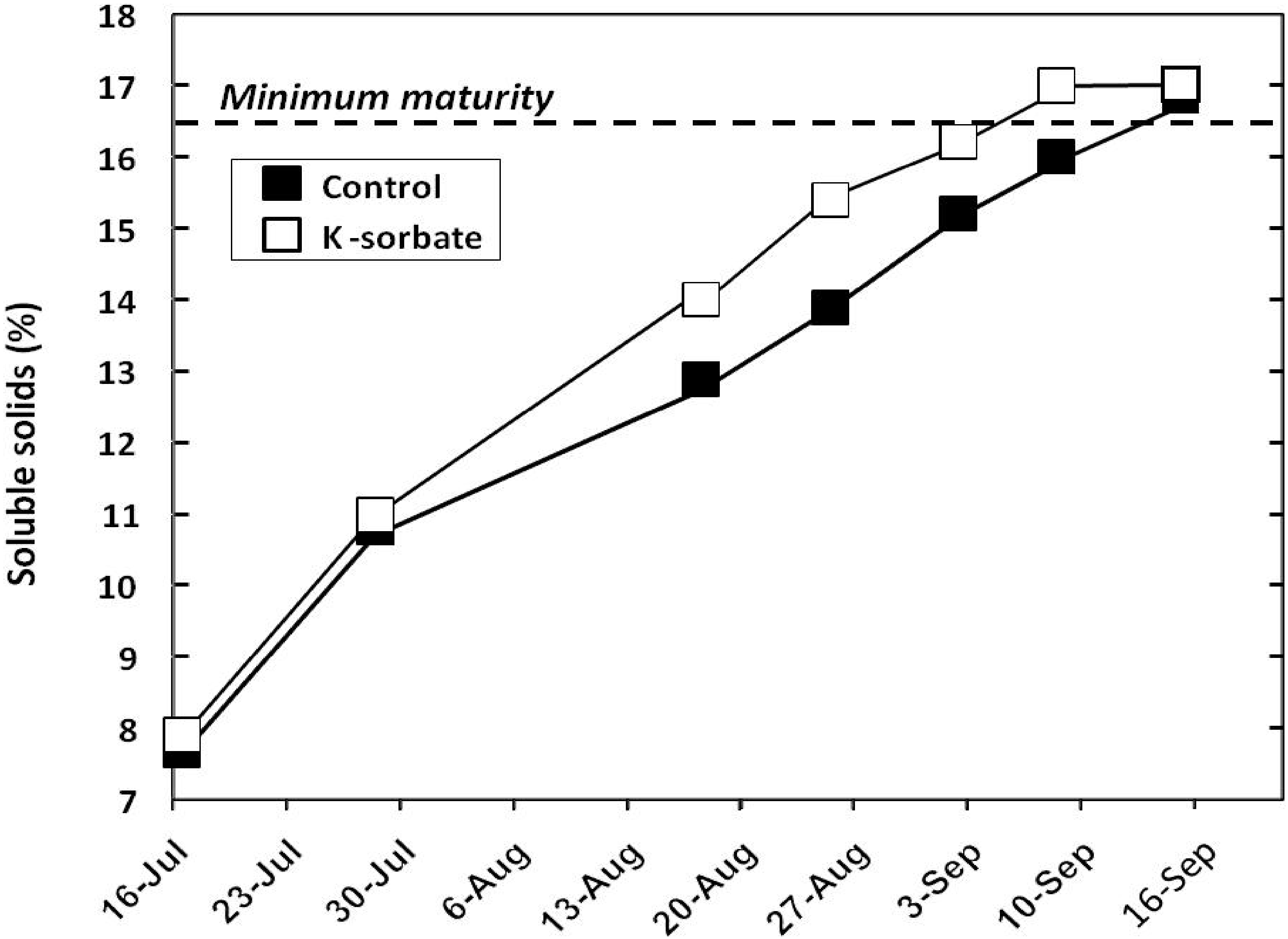
Appearance of ‘Autumn Royal’ table grapes on Aug 18, 2009, after three applications of potassium metalosate. Soluble solids of the untreated grapes were 15.2% and those of the potassium-treated grapes were 20.2%.



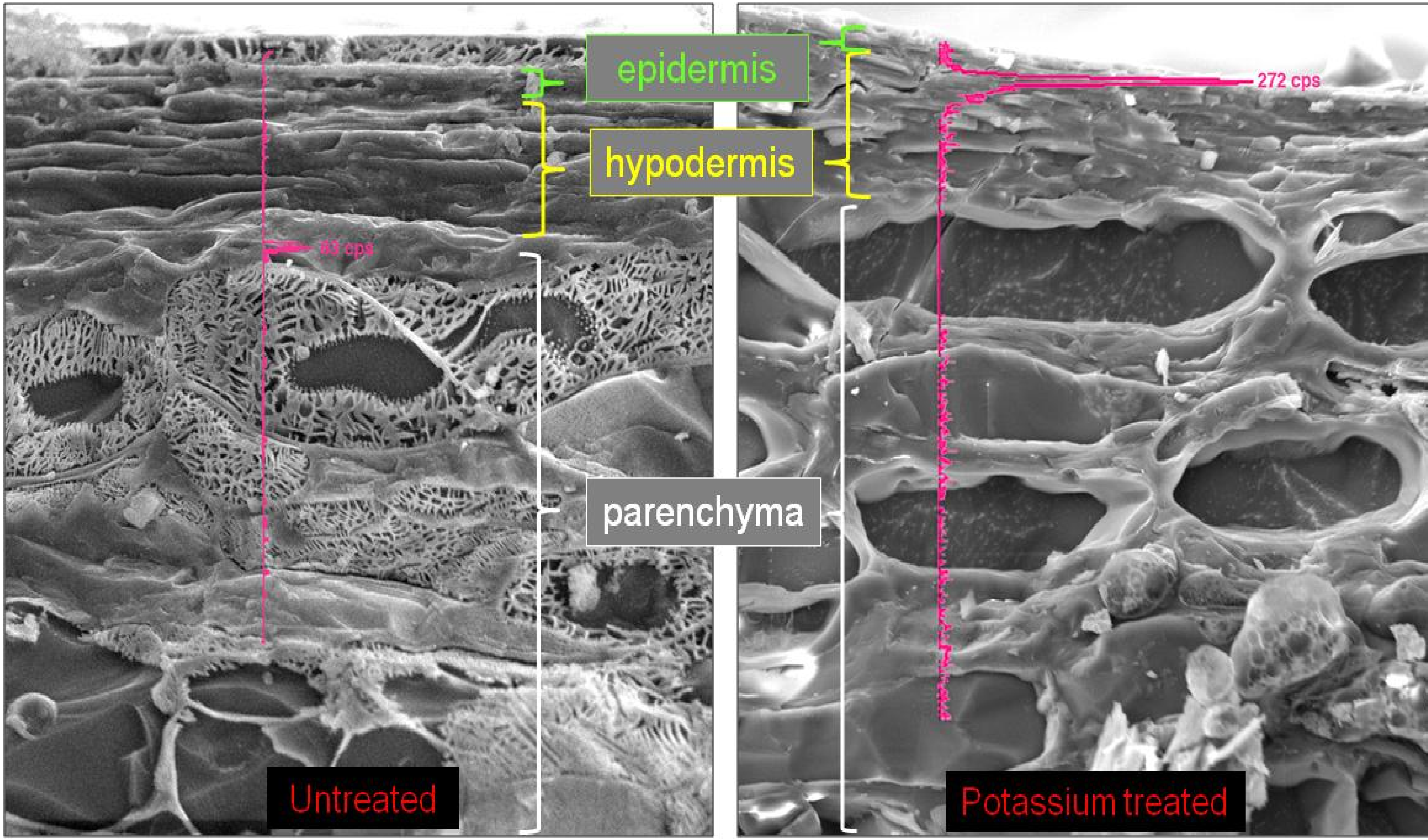
SS = 14.1% $\pm$ 0.6
Hue = 27.42^{o}
Firmness = 336.2 g of Force

SS = 17.6% $\pm$ 0.8
Hue = 9.96^{o}
Firmness = 389.2 g of Force

Appearance of ‘Redglobe’ table grapes at harvest on August 19, 2008, after four applications of potassium sorbate at Kearney Agricultural Center.



Soluble solids content of ‘Redglobe’ table grapes after the onset of veraison. Potassium sorbate (‘K-sorbate; 0.5% wt/vol) was sprayed into clusters on June 2, June 23, July 28, and August 19, 2009.



Potassium distribution within ‘Redglobe’ table grapes after the onset of veraison. .

Advancing maturity of raisin grapes (Thompson Seedless, Fiesta and Selma Pete) with foliar potassium applied during fruit ripening.

Williams L. Peacock
UC Cooperative Extension
Viticulture Farm Advisor, emeritus
Tulare County, Visalia, CA

Bill Peacock's trials

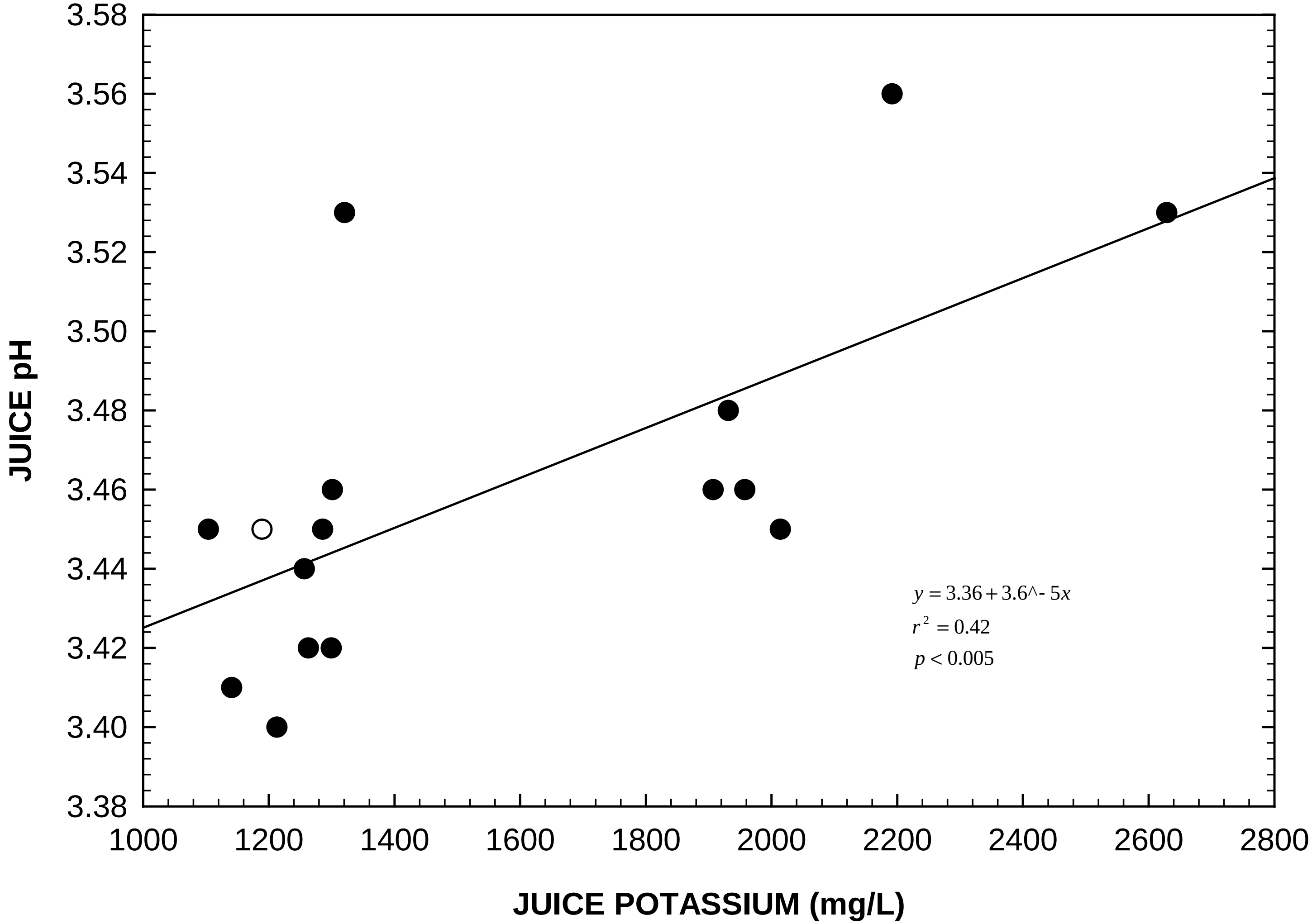
- Will foliar K applied during ripening advance fruit maturity?
- When should foliar K be applied to maximize repsonse.
- How much foliar K is needed?
- Which material works best?
- Can it be applied with both concentrate and dilute sprays?

Results:

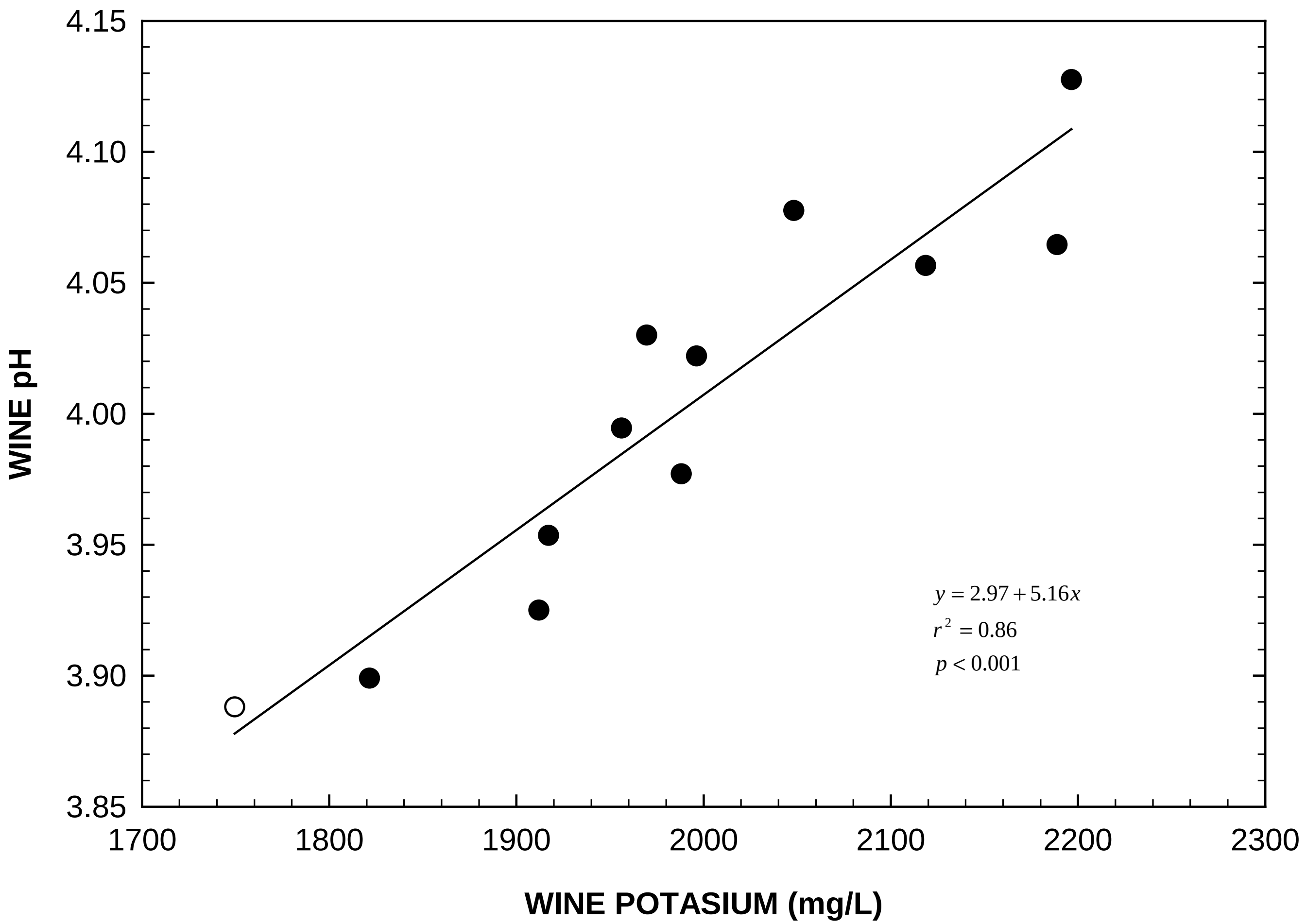
- K was shown to advance maturity by 1 to 2 Brix over the control.
- Foliar K should be applied late during ripening (from 14 to 18 Brix).
- K sprays should be applied at 1 to 1.5 lbs per acre. Applying less than 1 lb did not work, more than 1.5 lbs had no further effect.
- There were no differences in maturity between K metalosate, sorbate, phosphate or phosphite.
- Both concentrate and dilute spay rigs worked but it is important that clusters contact the material.

Possible effects on wine grapes:

- It should be pointed out that maturity standards are certainly different for table grapes (raisins?) as opposed to wine grapes.
- As far as I know, no such work has been done on wine grapes.
- Foliar K applications would be risky on wine grapes as the added K may increase insoluble K tartrate crystals in the juice which may cloud wine, reduce wine acid content and raise pH.



The relationship between juice potassium and juice pH



The relationship between wine potassium and wine pH

Deficiencies in California

Common	***Less Common***	***Not Observed***
Nitrogen	Iron	Copper
Potassium	Magnesium	Molybdenum
Zinc	Manganese	Chlorine
Boron	Phosphorus	Calcium
		Sulfur

Excesses in California

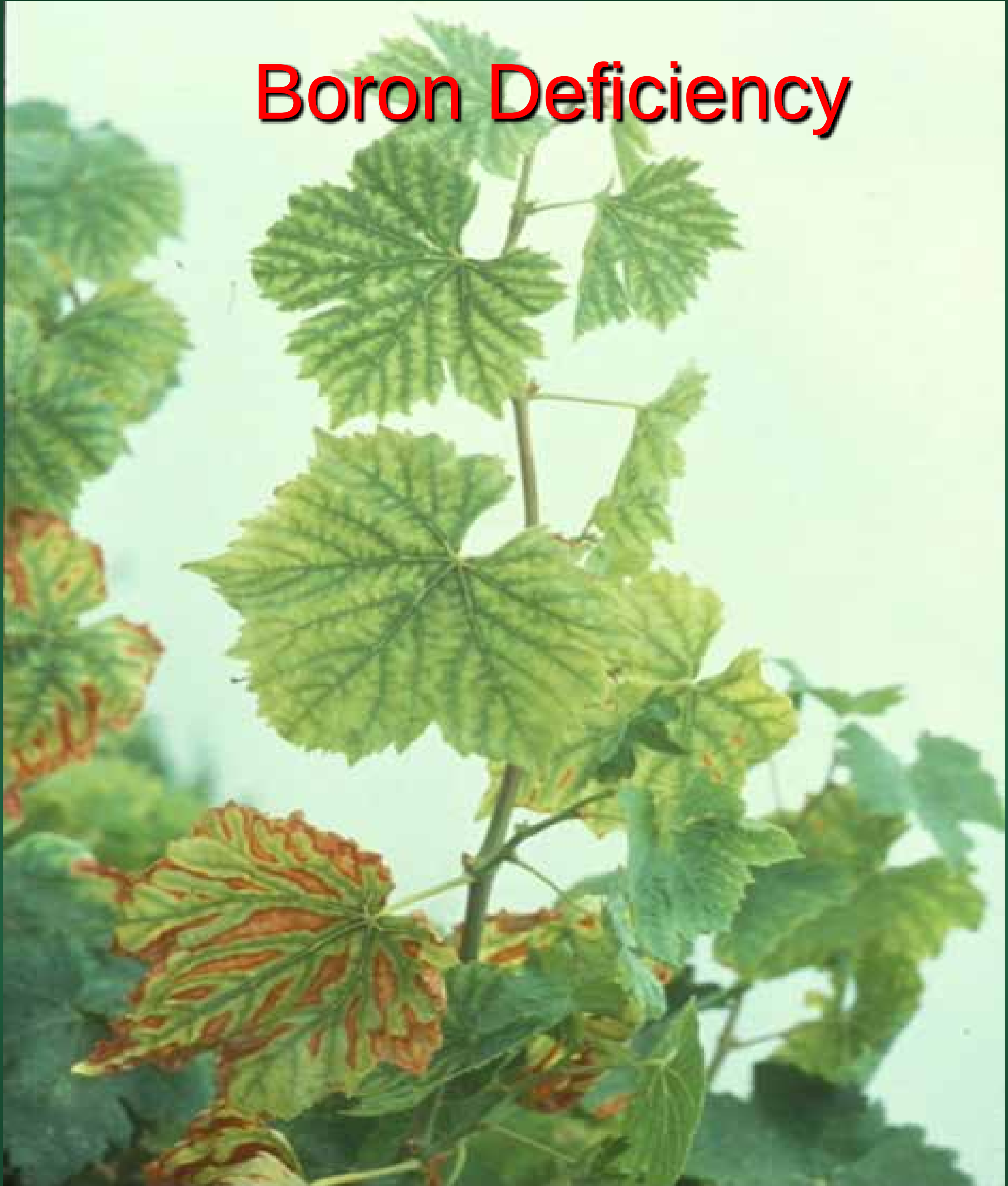
Nitrogen

Chloride

Boron

Boron Deficiency

Boron Deficiency



Boron Deficiency

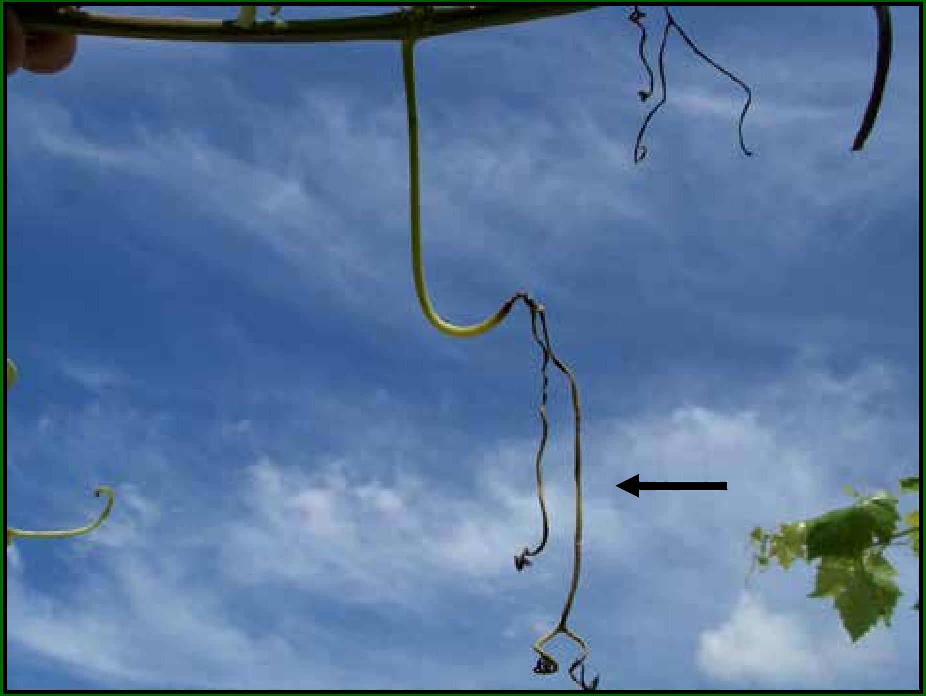
Boron Deficiency


Boron Deficiency

- Esca, Black Measles

External symptoms

Shoot tips and tendrils dieback

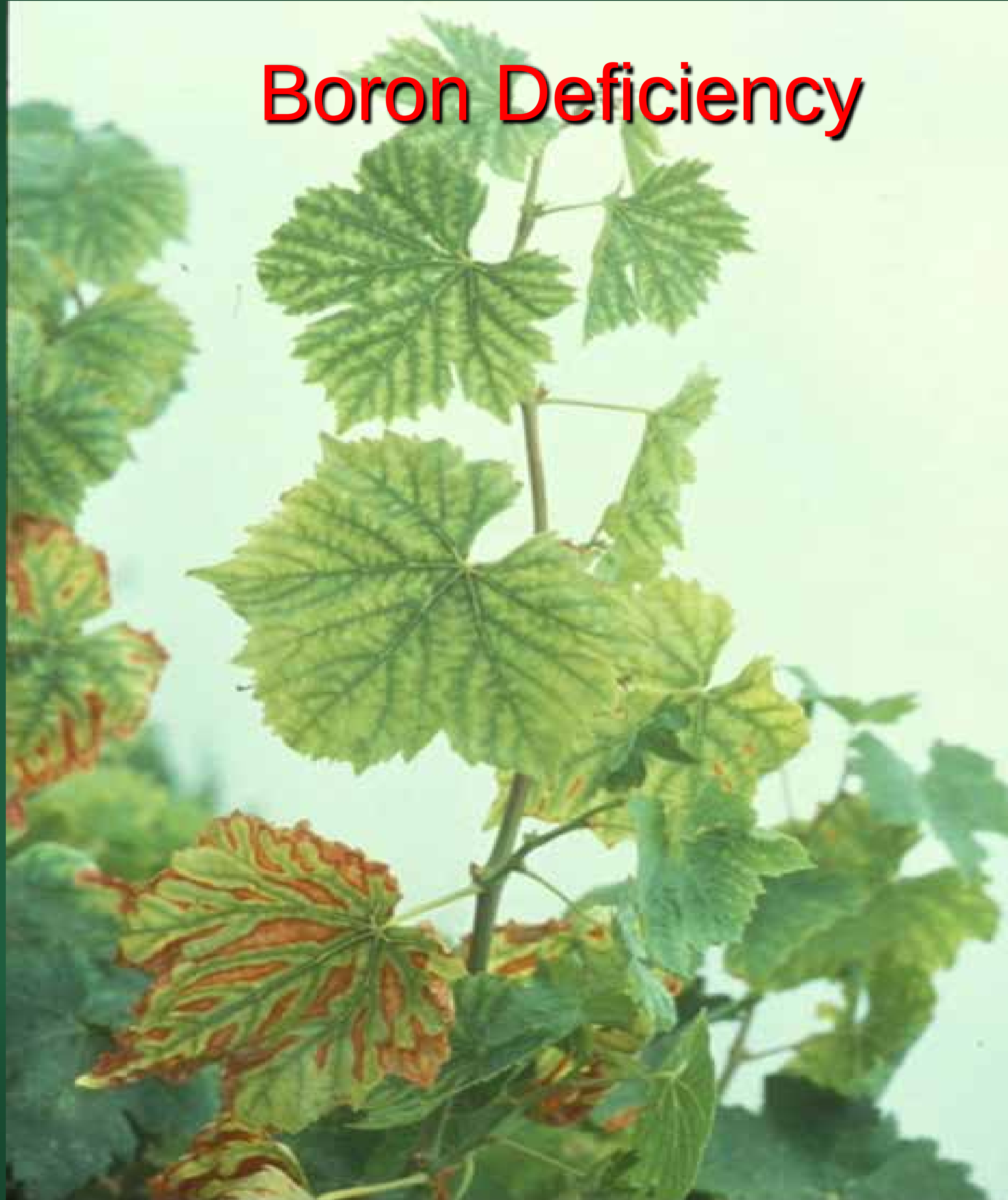


Boron Deficiency

Early measles leaf symptoms

Photo by Jack Kelly Clark

Boron Deficiency



- Esca, Black Measles
  Leaf symptoms

BORON
Petiole Levels (ppm)

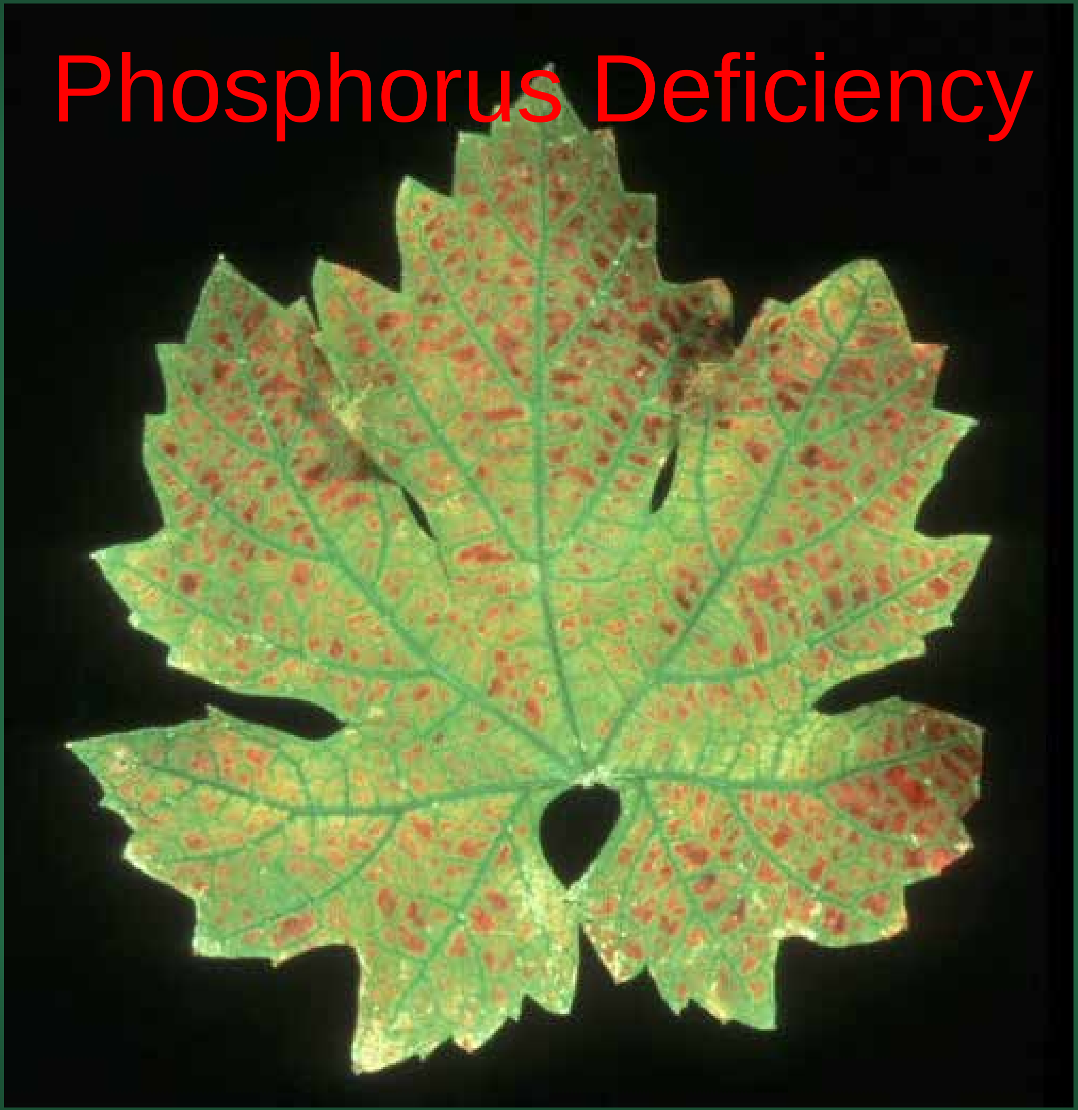
	Total Boron (ppm)
Deficient	Less than 25
Questionable	26-30
Adequate	Over 30
Possibly toxic	100-150 and above
Toxic	Over 300 in blades

BORON
FOLIAR SPRAY

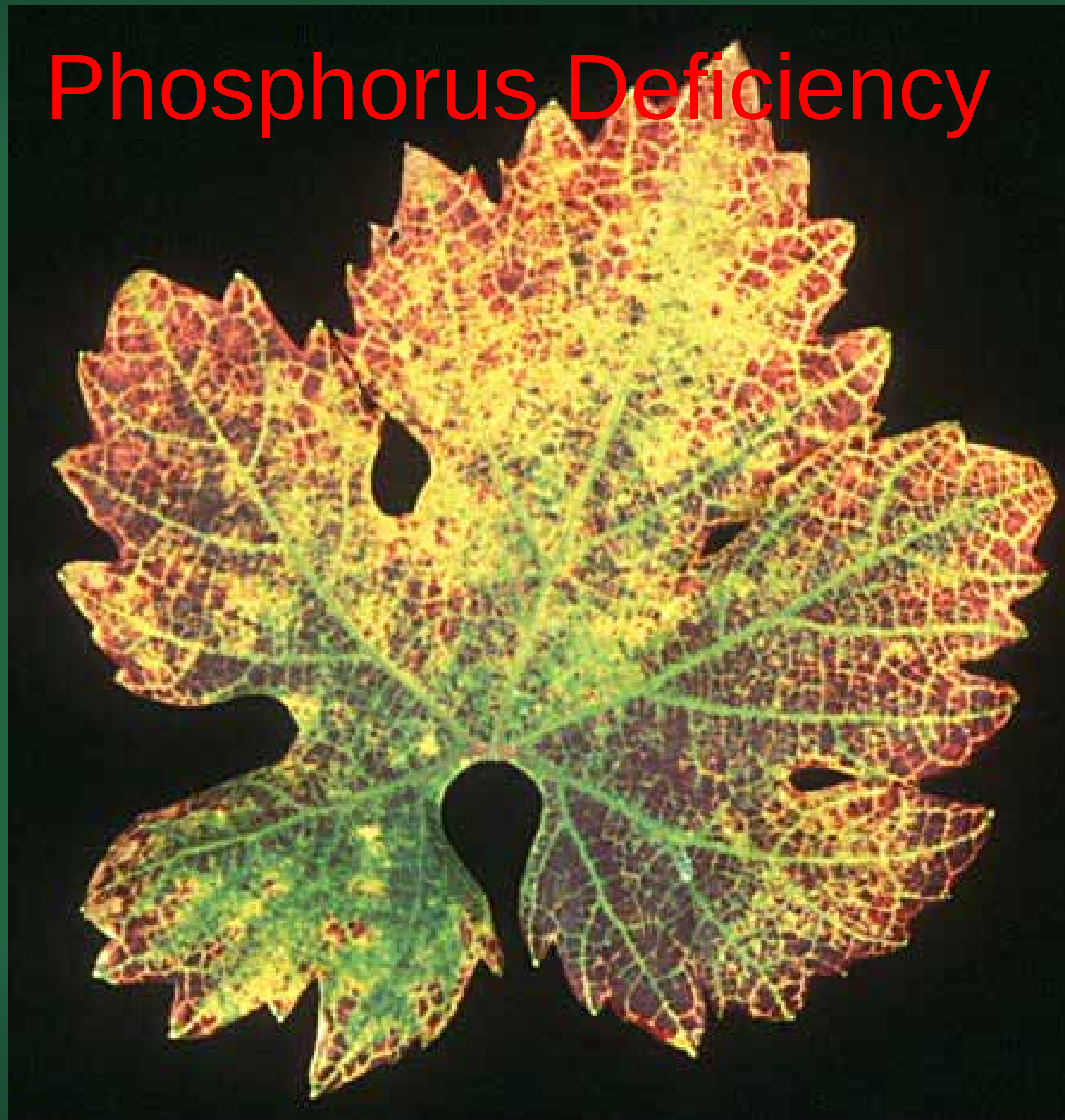
2 – 3 lbs/acre (2.2 – 3.4 kg/ha)

of

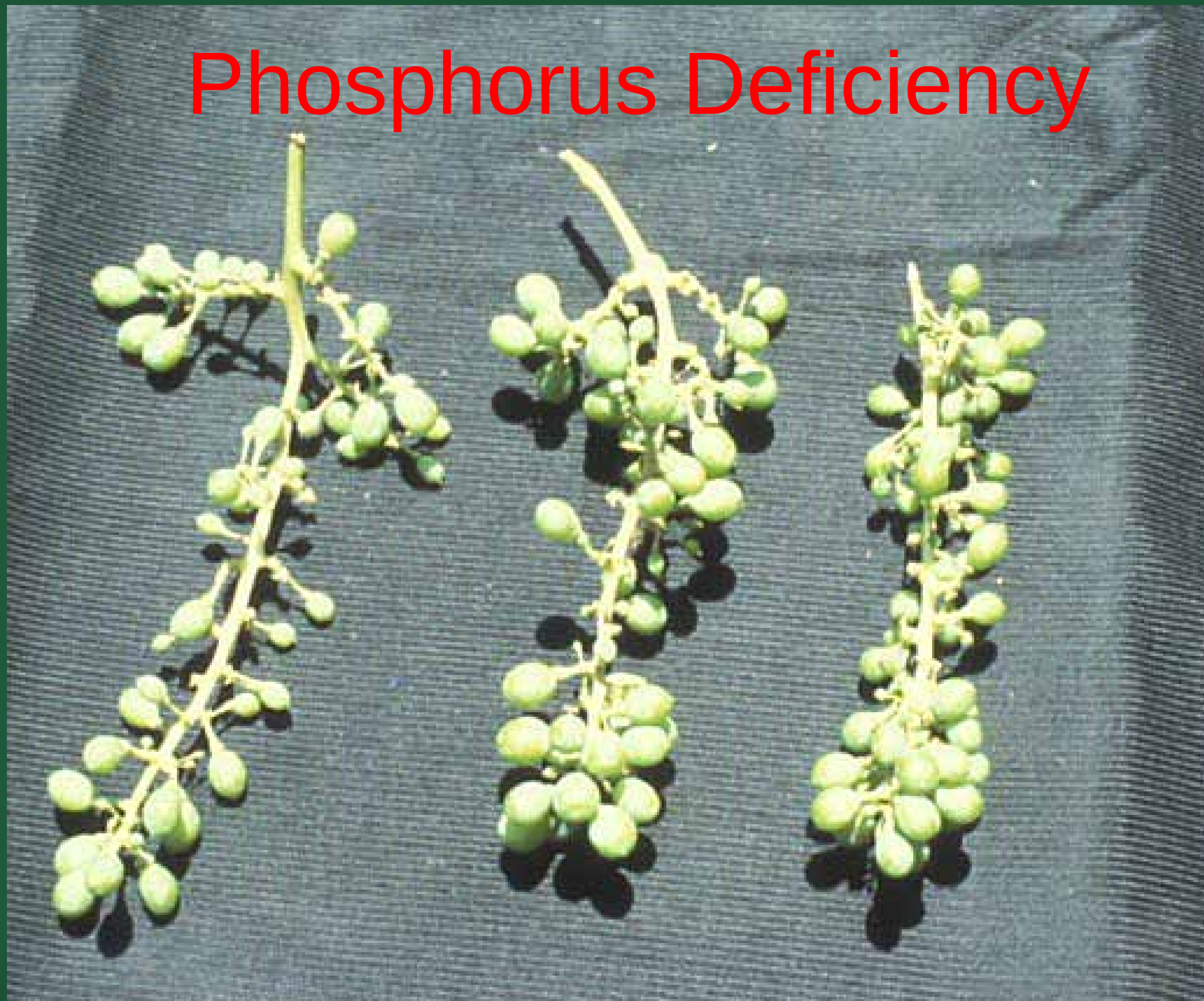
20% B spray product


Phosphorus Deficiency

Phosphorus Deficiency


Phosphorus Deficiency

Phosphorus Deficiency



PHOSPHORUS
Petiole Levels (%)

	Total P (%)
Bloom Petiole Levels	
Possibly deficient	<0.10
Questionable	0.10 – 0.15
Adequate	>0.15
Midsummer Petiole Levels	
Possibly deficient	<0.08
Adequate	>0.12