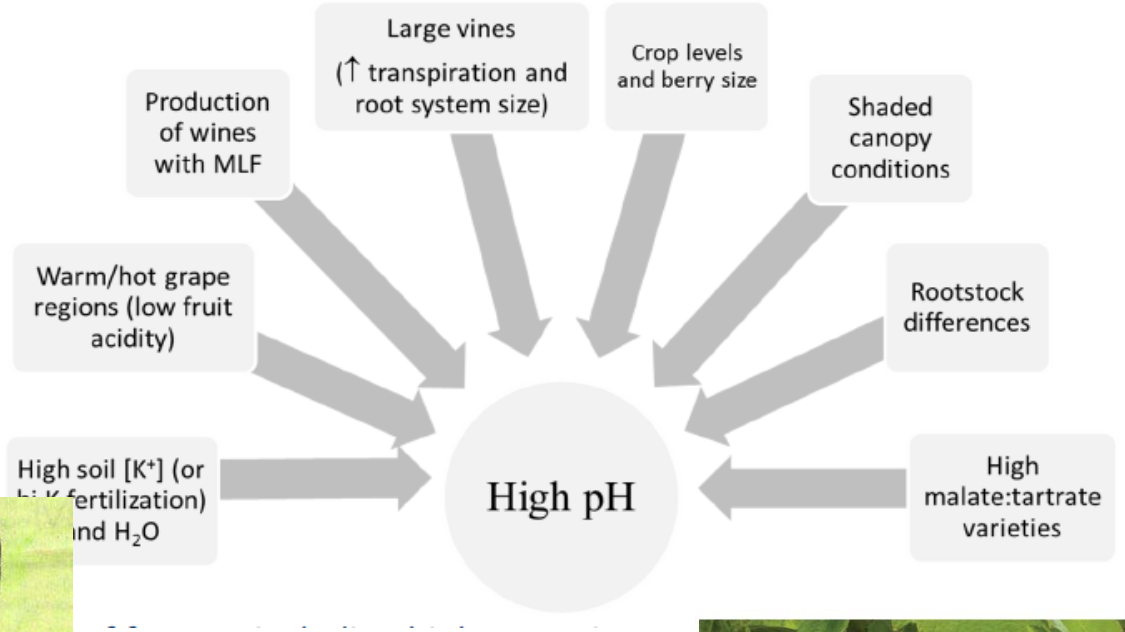
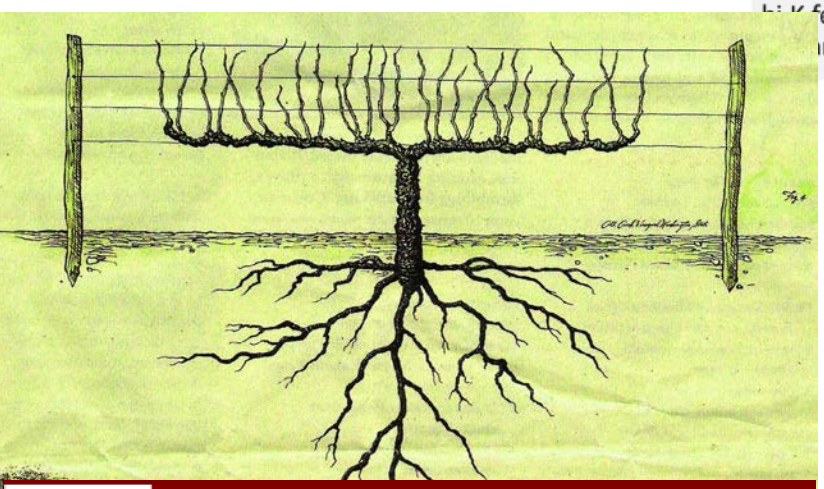
Potassium in the Vineyard and Winery


The faded chlorosis typical to potassium deficiency early in Malbec fruit development.

Rob Walker and Peter Clingeleffer,
Wines and Vines Nov. 2016





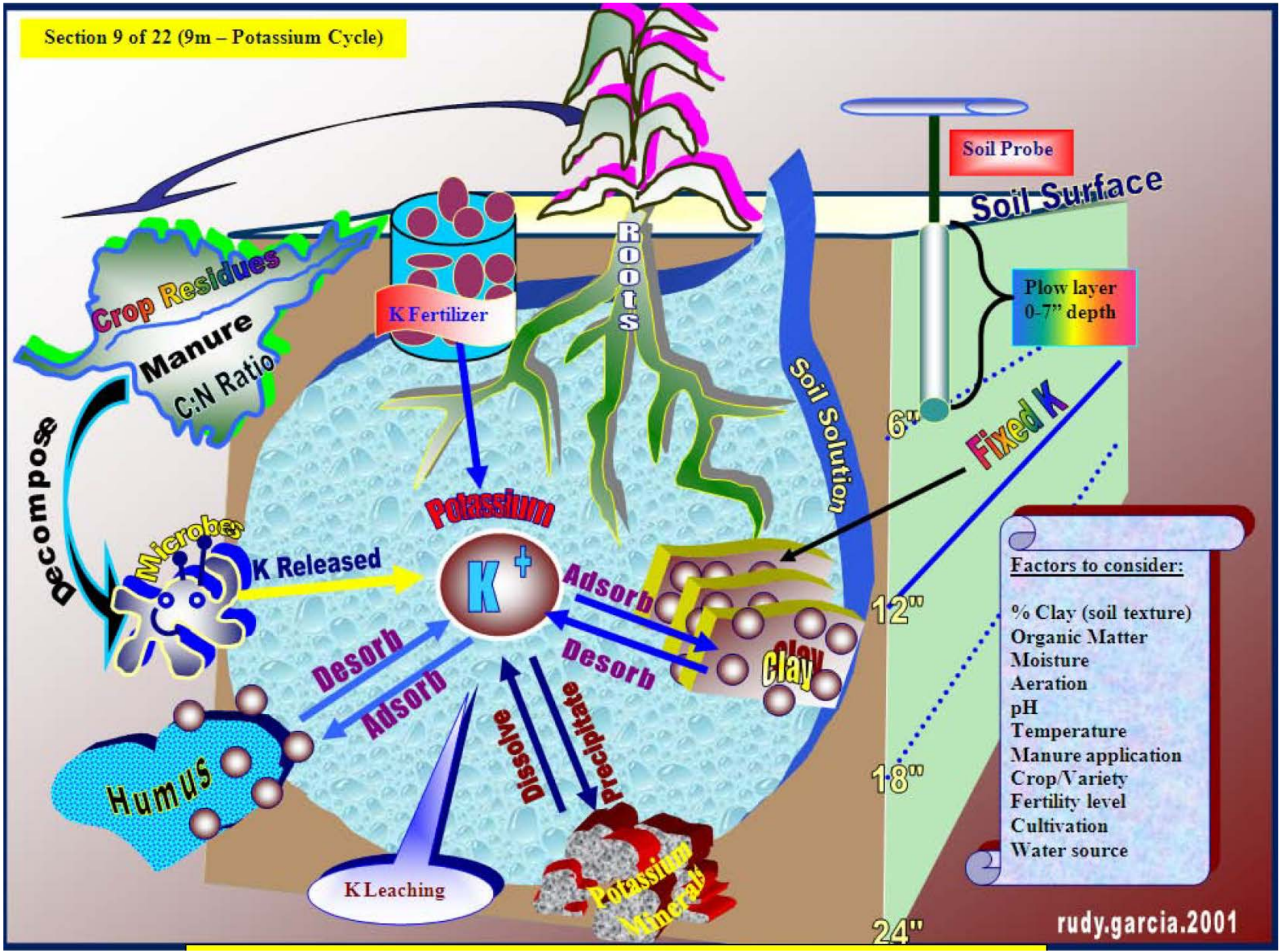

A Chardonnay leaf shows potassium deficiency symptoms during the set phase of fruit development on wet clay soils.

"I like to think we aren't so much anti-science as we are pro-myth."

Christopher Weyant/The New Yorker Collection/The Cartoon Bank.

K = potassium, a macronutrient

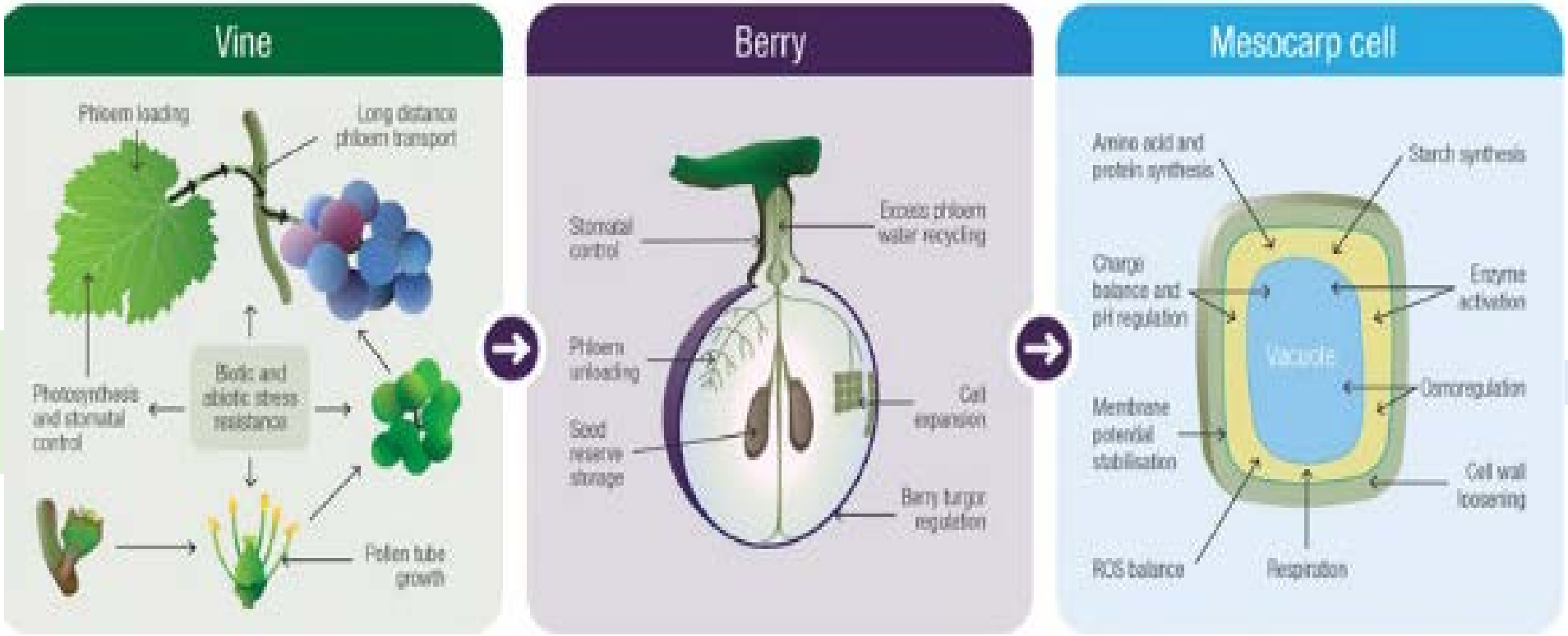
- General characteristics of K
  - K is high in some soils
  - Resistant to leaching
  - Tightly bound to soils
  - Highest amount in top soil
  - Often result of soil modification
  - Spotty in vineyards
  - Vines need high amounts
    - Most abundant cation in vine (cation = positively charged molecule)
    - 50% concentration compared to that of nitrogen


Section 9 of 22 (9m – Potassium Cycle)
Soil Probe
Soil Surface
Crop Residues
Manure
C:N Ratio
Decompose
K Fertilizer
Roots
Plow layer
0-7" depth
Soil Solution
6"
Fixed K
Microbes
K Released
Potassium
K+
Adsorb
Desorb
Desorb
Adsorb
Clay
12"
Humus
Dissolve
Precipitate
K Leaching
Potassium Mineral
18"
24"
Factors to consider:
% Clay (soil texture)
Organic Matter
Moisture
Aeration
pH
Temperature
Manure application
Crop/Variety
Fertility level
Cultivation
Water source
rudy.garcia.2001

K = potassium, in vine physiology

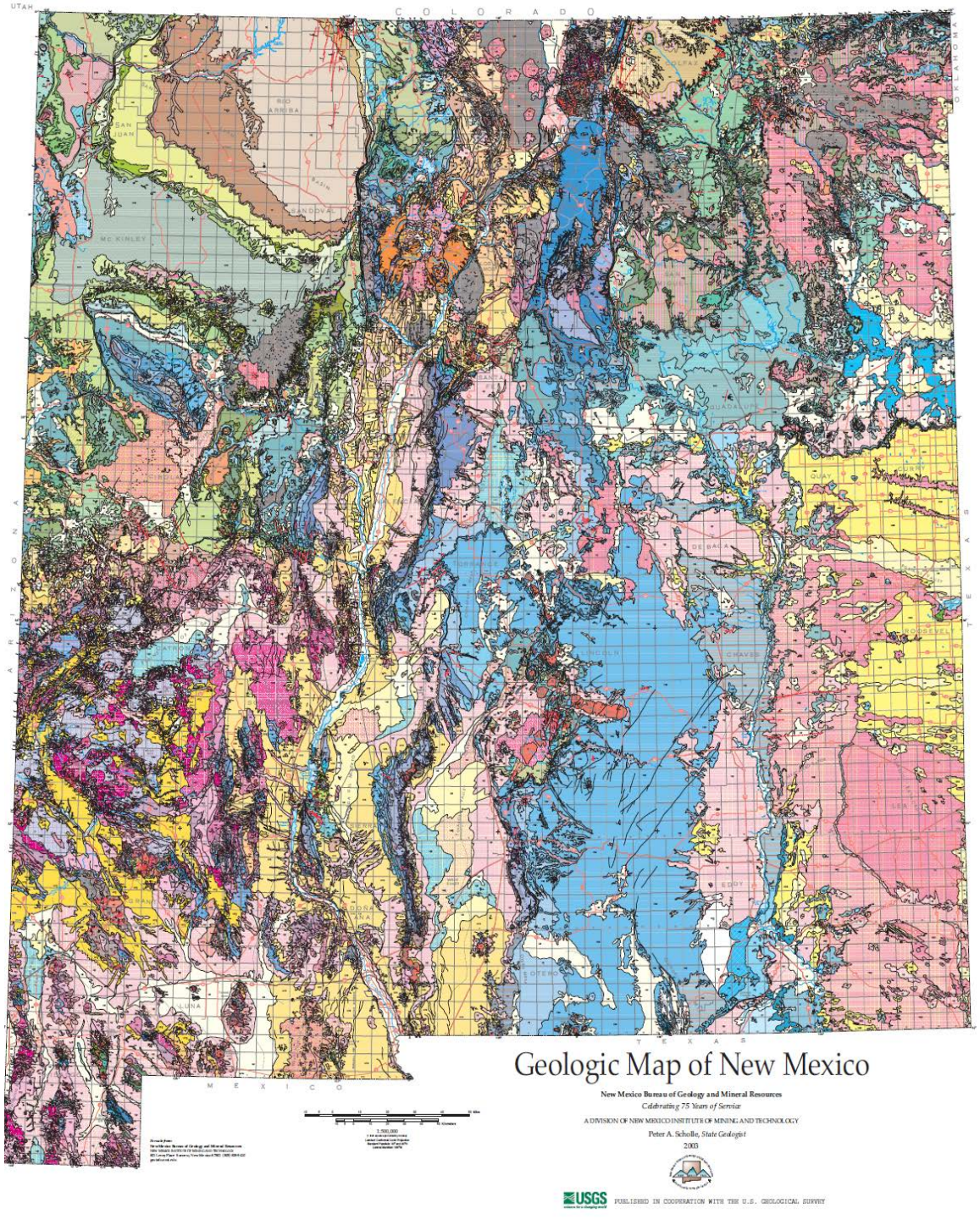
- As ion, it is a solute, osmotically active
  - Cell expansion, K required for rapid vine growth
  - Stomatal movement
  - Required for pollen hydration and germination
- Stimulates sucrose loading into phloem
- K gradient between soil solution and cell drives sap flow in vine…regulates water relationships
- Increases linearly: before bloom to about 2 weeks prior to leaf fall,
  - Greatest demand in mid to late summer
  - Contributes to cold hardiness

Role of K in vine, berry and cell function



Amount of nutrients in various organs of Chenin Blanc vines in sand culture per ton of fresh grapes

Element	Clusters (lb)	Permanent structure (lb)	Leaves (lb)	Shoots (lb)	Total (lb)
N	3.04	2.00	2.29	1.21	8.57
P	.55	.22	.64	.18	1.59
K	4.36	.42	1.04	.90	6.72
Ca	.37	.31	3.09	.66	4.43
Mg	.20	.18	.71	.24	1.32



Geologic Map of New Mexico, New Mexico Bureau of Geology and Mineral Resources, 2003, Scale 1:500,000.

Potassium – Deficiency

- 5 ton crop can remove 18 pounds of K per acre per year
- Distinctive symptoms
- Occurs in the mid-shoot area
- Common in mid-late summer

Symptoms of K deficiency

- “Spring fever” = older leaves
- Rootstocks differ in ability to take up K

Potassium Deficiency

UC Davis file photo

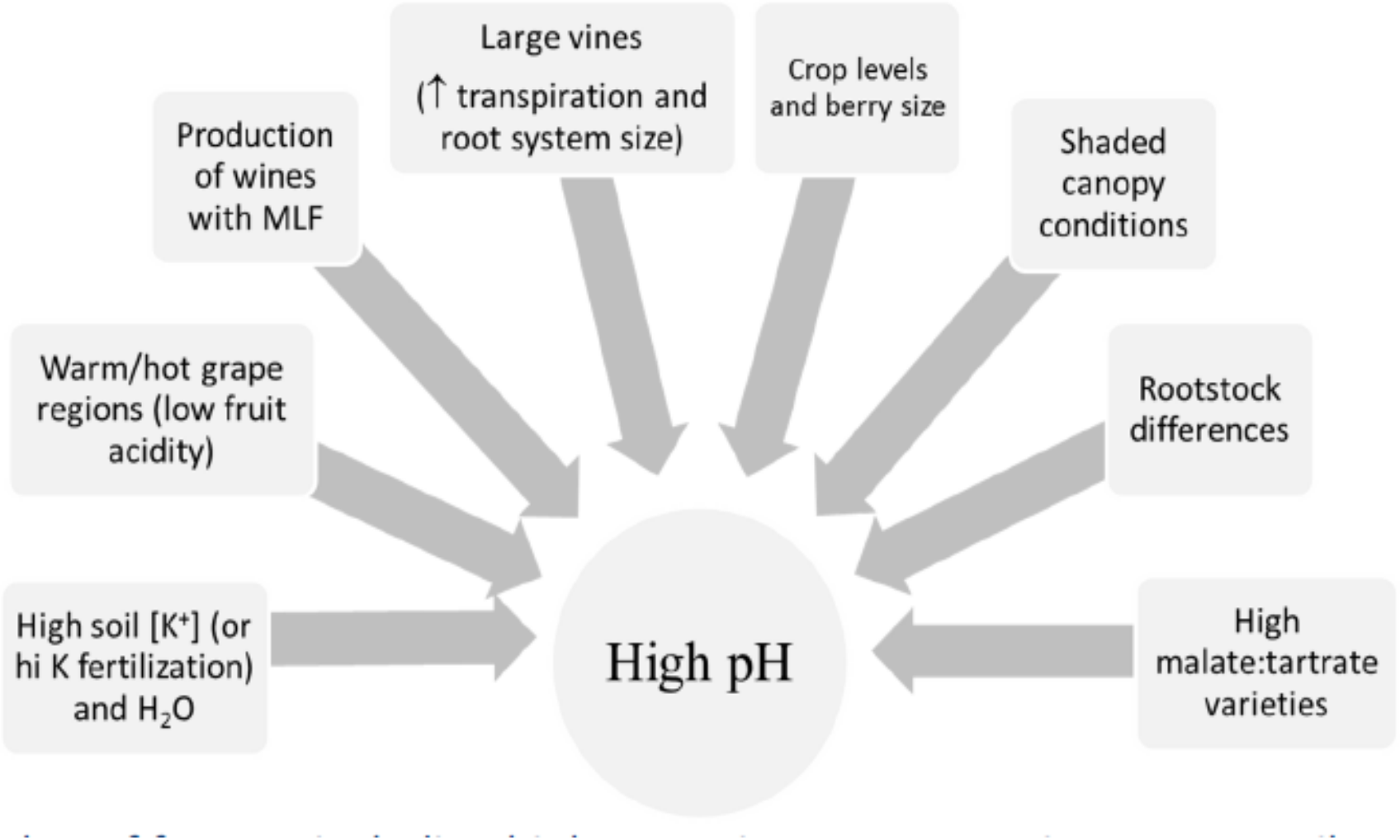
Consequences of K deficiency

- Inadequate K
  - Less sap flow =
    - less plant growth
    - more prone to drought stress
    - suppressed sugar transport
  - Deficient K in roots =
    - root growth stops
    - photosynthesis inhibited, sucrose trapped in leaves = negative impact on fruit ripening
    - K moves to younger leaves and permanent vine structure

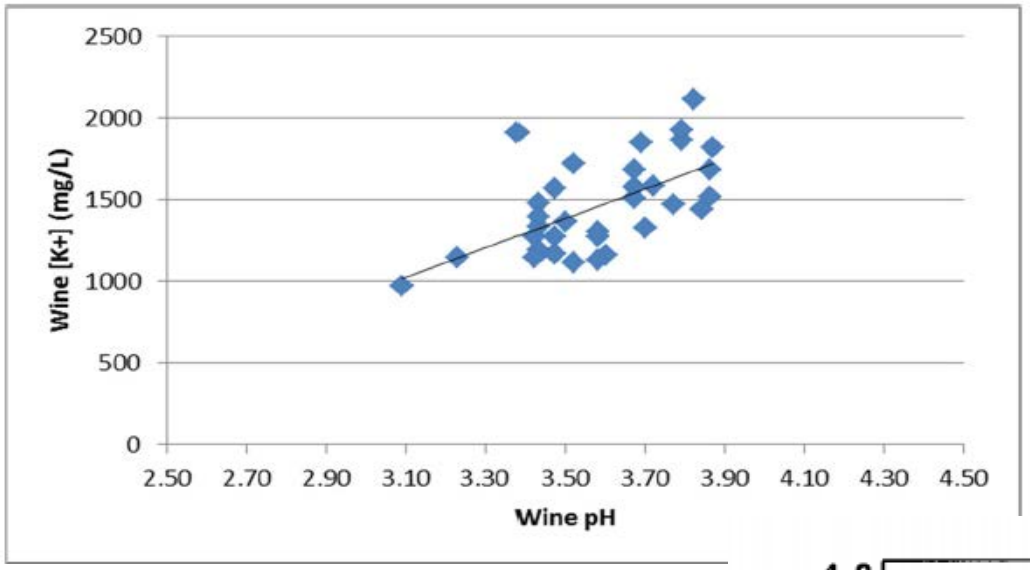
Too much or not enough?

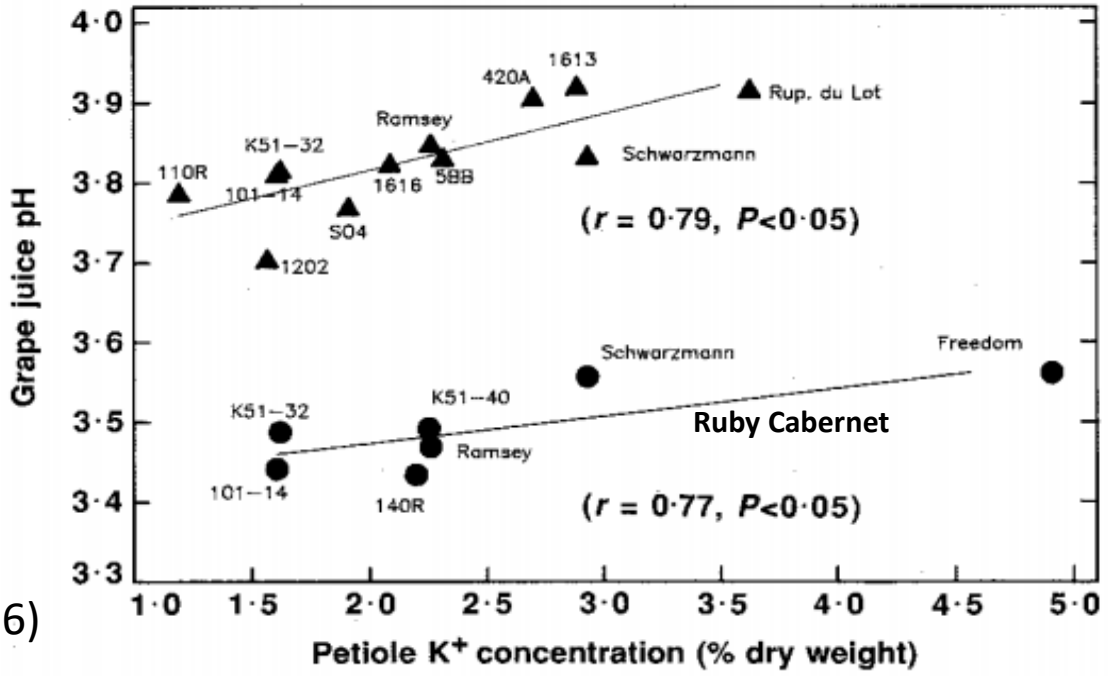
- Excess K can increase juice pH as well as decrease color quality and stability of musts
  - White wine becomes brown
  - Red wine color becomes instable
- HOW MUCH was excessive?
  4.00% compared to 2.35% in the control

High pH: Too much K is not the only reason…



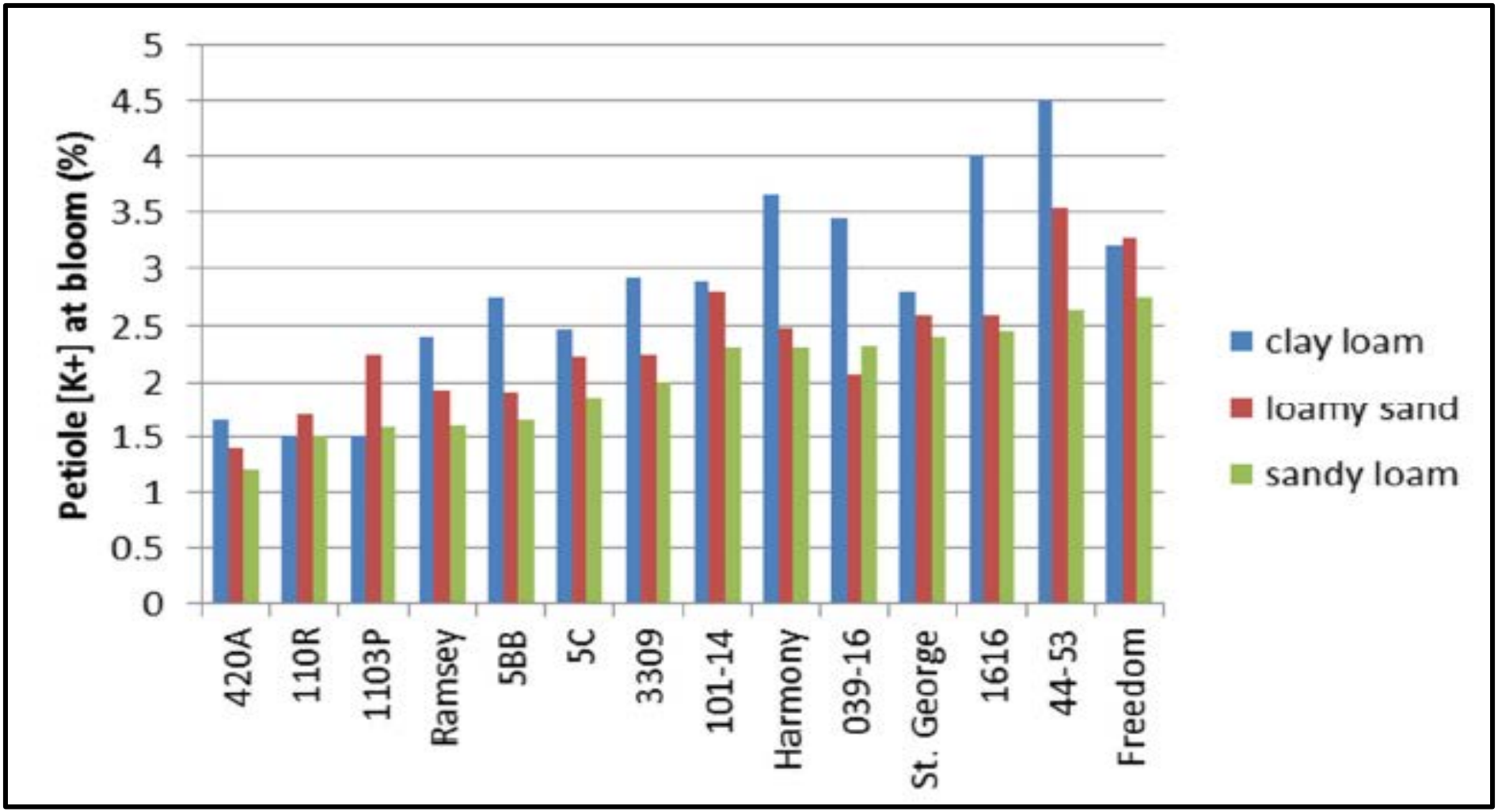
pH imbalance in Cabernet Sauvignon wines

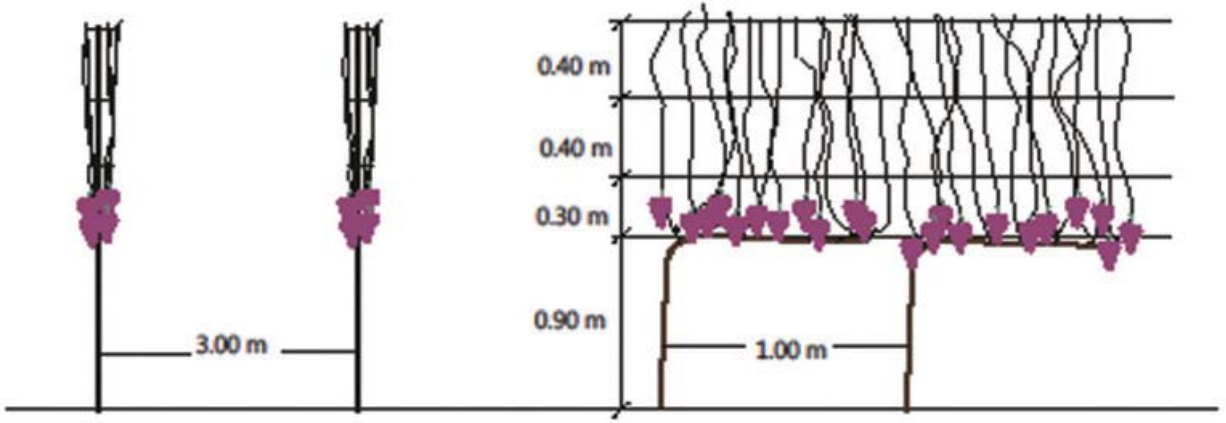




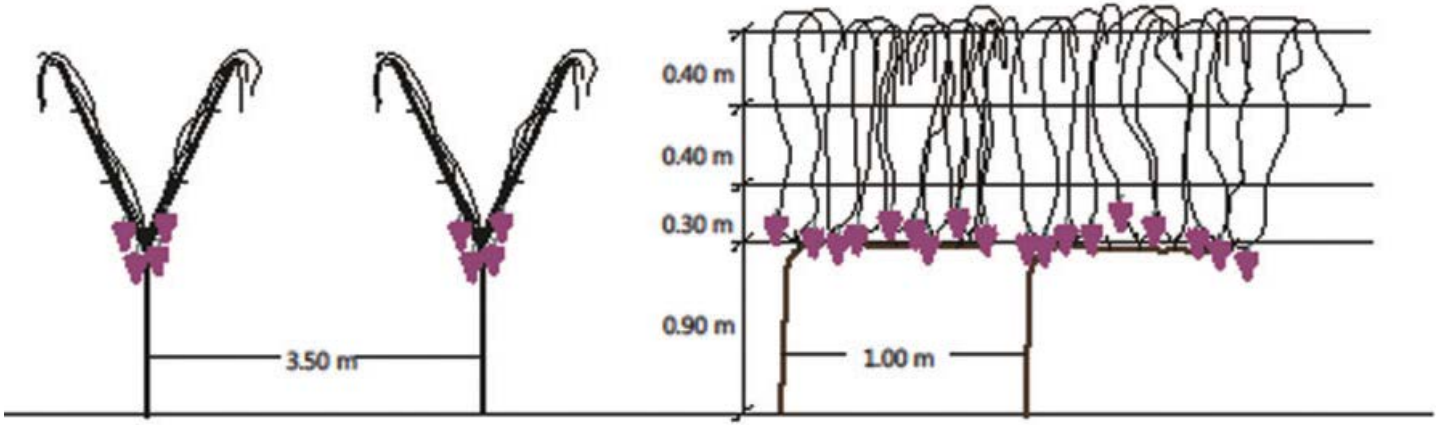
Relationship between
petiole K+ concentration
and grape juice pH of Chardonnay
and Ruby Cabernet
(From: Ruhl, 1989, as cited in Moss 2016)

Impact of rootstock on petiole K^+ at bloom showing a reduced uptake of K with rootstocks with *V. berlandieri* parentage





VSP



SAYM

Light and leaves and shade…

Petiole analysis guidelines for potassium

	Deficient	Marginal	Adequate	Excessive
Wine Grape Production Guide				
Petioles/bloom	< 1.00	1.00 - 1.50	1.50 – 2.50	> 2.50
Petioles/véraison	< 0.80	< 1.20	1.20 – 2.00	> 2.00
SJV, California				
Petioles/bloom	< 1.00	1.00 - 1.50	≥ 1.50	
Petioles/véraison	< 0.50		≥ 0.80	
Australia				
Petioles/bloom	< 1.00	1.00 - 1.50	≥ 1.50	1.80 – 3.00
Petioles/véraison	< 0.60	1.00	≥ 1.20	

Potassium fertilization

- Potassium chloride
- Potassium nitrate
- Potassium sulfate

all have been effective in correcting deficiencies either as

- Potassium application
  - on low K soils K can increase vine size and yields
  - At low pH excess K may limit uptake of Mg
  - At high pH excess Mg may limit uptake of K

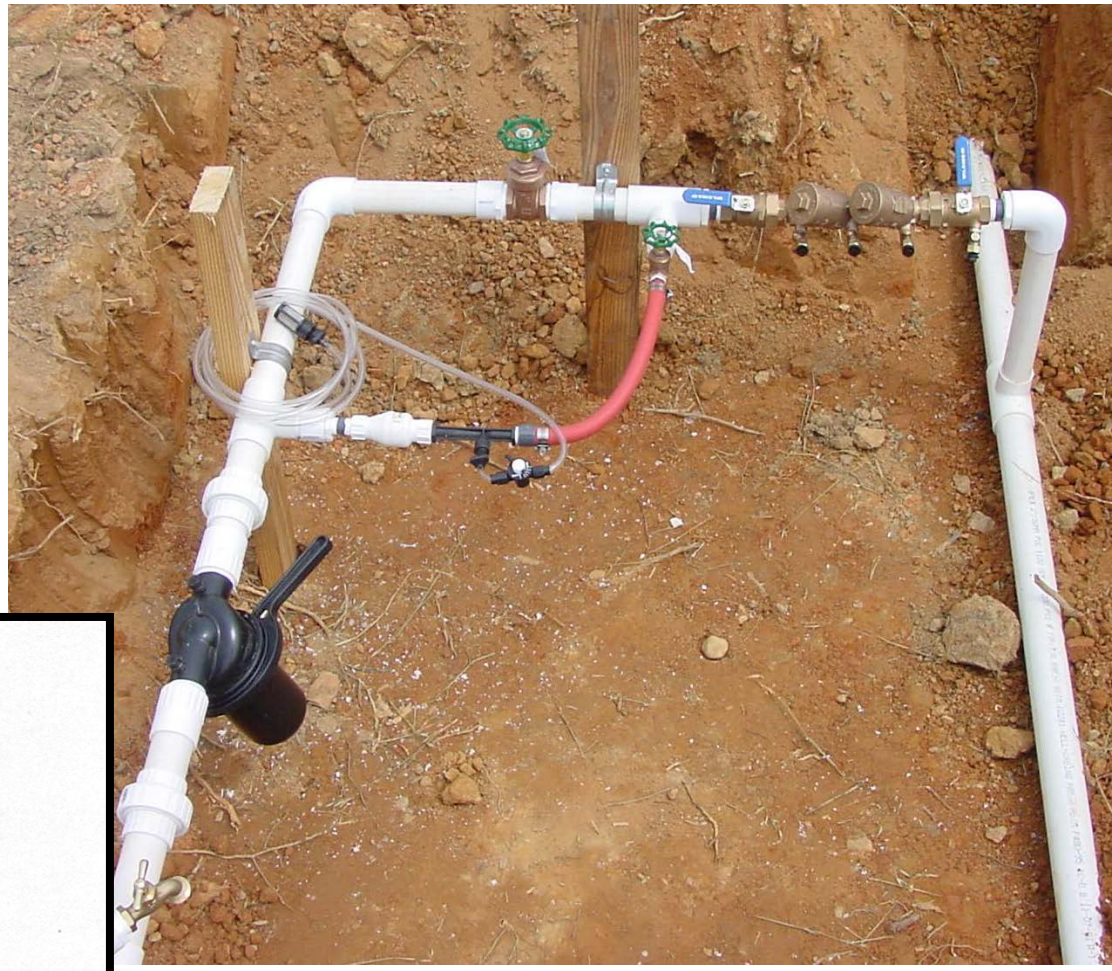
Fertilizer application

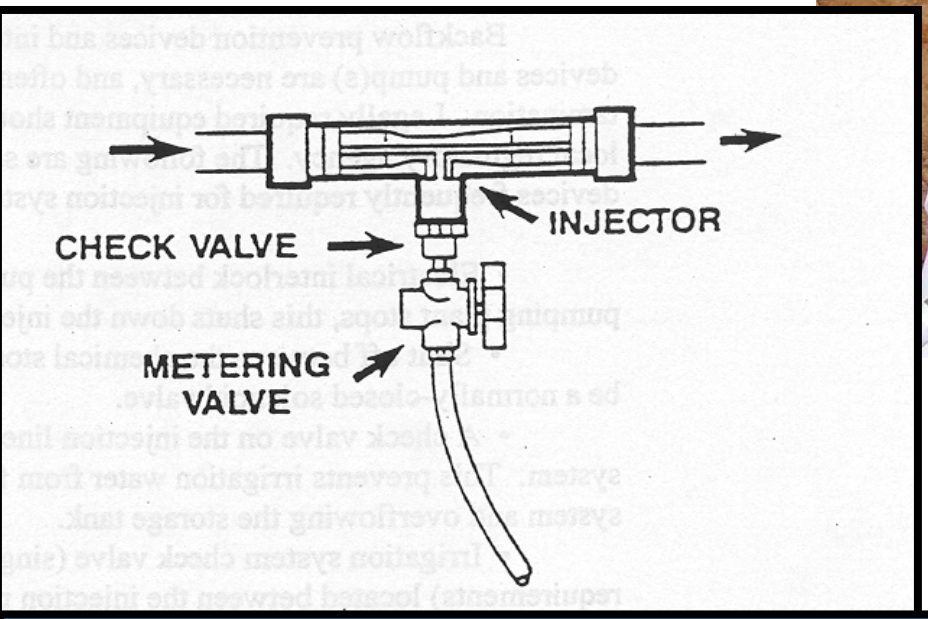
- Broadcast: over the entire vineyard
- Banded: restricted to either side of rows
  - saturates fixation sites in the soil = may allow more rapid movement into root zone
- Fertigation: water and fertilizer
- Foliar

Fertigation

- Factors to consider
  - Uniform delivery of water/fertilizer
  - Increased costs of equipment, maintenance
  - Soil texture (impacts distribution in profile)
  - Quality of water
- Benefits
  - Material savings, > 50% possible
  - In solution, not dependent on rainfall to move materials
  - Reduced leaching, tends to stay in zone wetted by drip irrigation emitters
  - Less machinery in field
  - Easier for split applications

Injection equipment

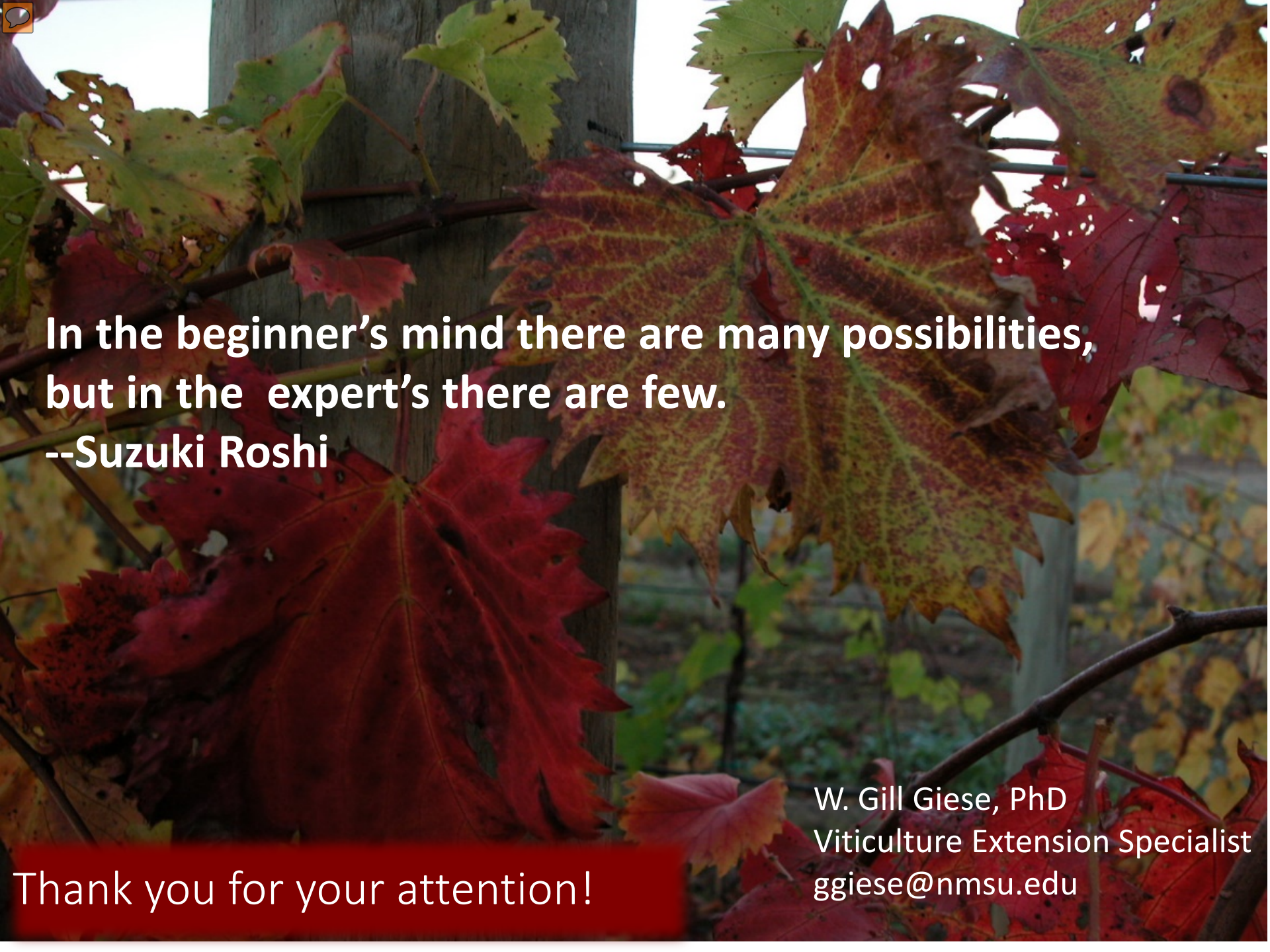




Venturi injector no power source required, inaccurate, inexpensive, limited flow rate range

Foliar application

- Combine with pesticides? Safer to apply fertilizers separately, avoid incompatibility or mixing problems
- Pay attention to recommendations
- Prevent or correct deficiencies where small amounts are needed since leaves are not efficient absorbing organs
- Thorough coverage is essential
- **CAUTION:** do not exceed recommended rates or foliar burn may result



Thank you for your attention!

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