Grape Vine Nutrition

Agronomic, Economic and Environmental Concerns

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PRECISION AG INCORPORATED

A Bit About Me and Precision Ag

- Precision Ag is an agricultural consulting company based in Templeton CA.
  - Focused on Soil – Plant – Water effects on crop growth and development
- Me – Ph.D. in Soil Science from UC Davis
  - Farm Advisor – Fresno County
  - Ag Consultant – SJV
  - National Agronomist – Delta & Pine Land Co.

Four Fundamental Questions

- Which (nutrients should be applied)?
- What (formulation should be used)?
- When (should it be applied)?
- How much (should be applied)?

- Each of these questions have agronomic, economic and environmental components

Historically

- In the past – Agronomic (viticultural) concerns were what drove fertilization decisions
- Recently (last year) the price of fertilizer has increased dramatically – bringing up more economic concerns
- Also – there is increased concern about the environment, some of which is now legally required (Ag Waiver)

Which Nutrient?

- There are 16 essential nutrients
- Only 4 are commonly required to be added

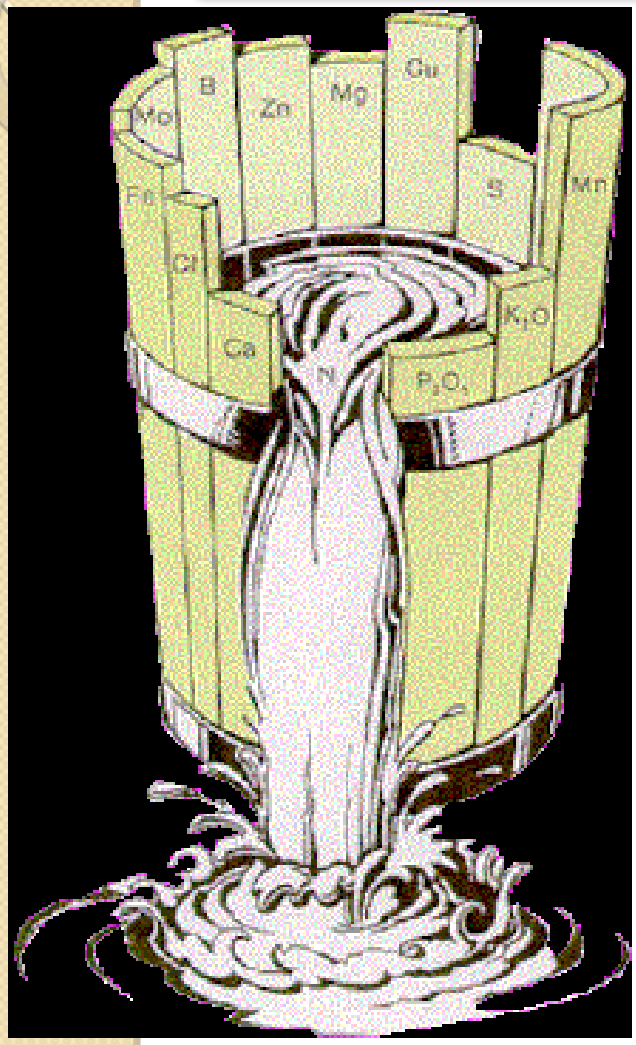
  Required means that you will most likely see an increase in yield/quality by an addition of the nutrient

- How do you decide if a nutrient is needed?
  - Tissue analysis
    - Petiole
    - Blade
  - Soil analysis
  - Deficiency Symptoms

Nutrients commonly deficient

- Nitrogen
  - Petiole Range 250 – 1500 ppm
  - Standard fertilizer rate: 25 to 50 lbs N / ac
- Potassium
  - Petiole Range 1.5 - 3.0%
    - Maybe to low for some varieties
  - Standard fertilizer rate: .25 - .50 lbs K_2O per vine
- Zinc
  - Petiole Range 25 - 50 ppm
  - Standard fertilizer rate: 2 – 2.5 lbs Zn / ac
- Iron
  - Petiole Range 50 – 300 ppm
  - Standard fertilizer rate: 1 – 2 lbs Fe / ac

Liebig's Law of the Minimum



Like a barrel's capacity is limited by the length of the shortest stave

Yields/Quality are limited by the nutrient in shortest supply

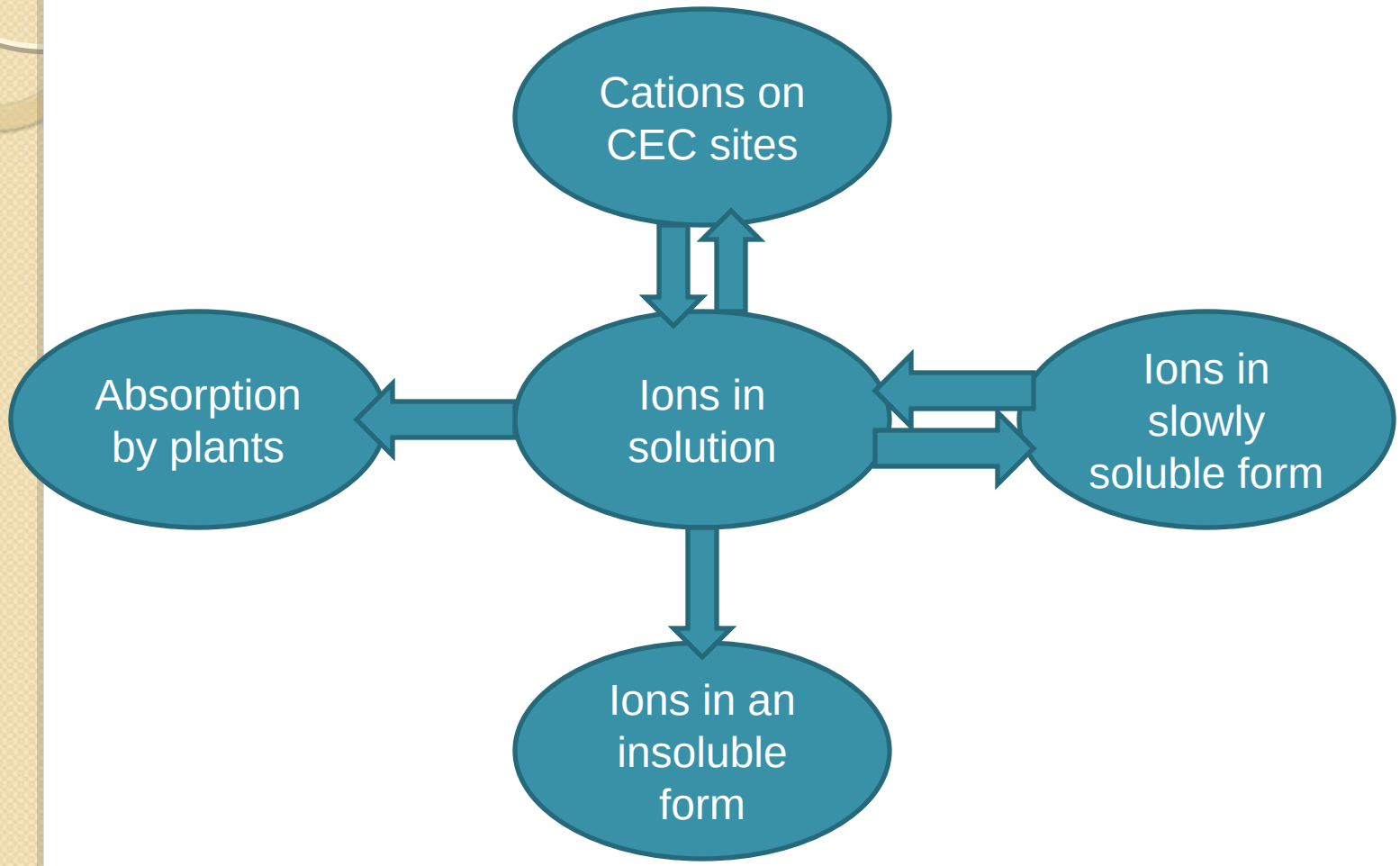
Additionally, it doesn't do any good to add other nutrients until the most limiting one is corrected

Remember – Root stock can affect nutrient deficiency
Left 3309 – Right 5C

What Formulation? – BUT FIRST

- To understand this area we need a bit of soil fertility background
- All nutrients are taken up as ion's dissolved in the soil solution
  - Solubility of fertilizer is critical
- Nutrient ions are in equilibrium with other forms in the soil
- Positively charged ions (cations) are also in equilibrium with a property of the soil called cation exchange capacity (CEC)
- Some nutrients (esp nitrogen) change forms in the soil

Nutrients in the Soil



Common Forms of the 4 Nutrients

- Nitrogen
  - Nitrate forms (NO_3^-)
  - Ammonium forms (NH_4^+)
- Potassium – only as K^+ ion
- Iron – only as Fe^{+2} ion
- Zinc – only as Zn^{+2} ion

What Formulations?

- Formulation also refers to what other elements are associated with the primary nutrient
- If the nutrient ion is positively charged then other molecule needs to be negatively charged
- Frequently, sulfate (SO_4^-) is the other ion
  - Generally good solubility and sulfate is potentially beneficial
- Chelates (organic molecules) are frequently used for micronutrients
  - They maintain solubility longer

Common Formulations

- Nitrogen
  - Ammonium sulfate
  - UN-32
  - CAN-17 (Calcium ammonium nitrate)
  - Custom formulations – usually the nitrogen part comes from UN-32 or CAN-17
- Potassium
  - KTS – (Potassium thiosulfate)
    - In many custom blends
  - Potassium Sulfate
  - Potassium Chloride
  - Potassium Nitrate

Common Formulations

- Iron
  - Iron Sulfate
  - Iron Oxide
  - Iron Chelate (EDTA)
- Zinc
  - Zinc Sulfate
  - Zinc Oxide
  - Zinc Chelate (EDTA)

What About Organic Fertilizer?

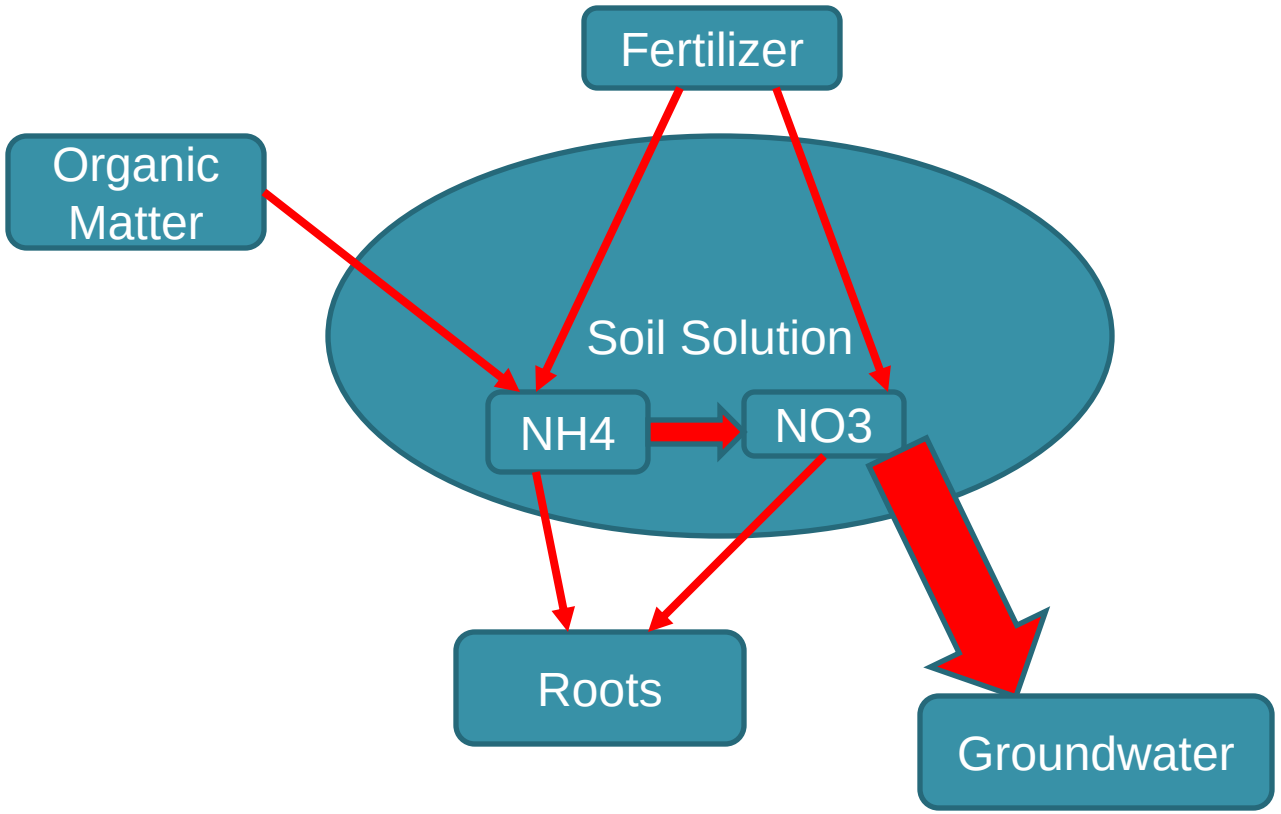
- In the most basic sense – plants don't know where their nutrients come from
  - 25 lbs of N from a synthetic source is the same as 25 lbs from an organic source
  - Economically – which is less expensive per pound of N
- But is that all there is? – Can organic fertilizers add "more"
  - Remember the Law of the Minimum
  - Research should be able to show a difference if one exists
- Finally – which formulation has a smaller environmental footprint? – I can argue both ways

When to apply?

- Proper timing of fertilizer applications are critical in obtaining greatest agronomic and economic responses and minimizing environmental contamination
- Traditionally in grapes, fertilization in the spring and in the fall – just after harvest
  - In theory – there is a flush of root growth at those times
  - Recent research from UC Davis says that it may not be so
- Applications should be in advance of plant needs

When to apply? – Too Late Here

When to apply? – Nitrogen Cycle



How Much to Apply?

- Agronomic
  - Enough to eliminate the deficiency
  - Possibly a little extra for insurance
  - Monitor results of fertilization with tissue testing
  - Rates also depend on expected yields
  - Examples
    - Nitrogen 0 – 50 lbs N per acre
    - Potassium 0 – 50 lbs K_2O per acre
    - Iron 0 – 1.5 lbs Fe per acre
    - Zinc 0 2.5 lbs Zn per acre

How Much to Apply?

- Economic
  - Optimum economic rate would be where marginal cost = marginal revenue
  - Economics says apply enough to maximize net income, which is usually less than that required to maximize yield/quality
  - Minimal economic penalty for over-fertilization

How Much to Apply?

- Environmental
  - Large penalty for over-fertilization from an environmental stand point
  - Important to remember that “balanced” nutrition is best
  - Add only what is needed and make sure you do
    - Example: If you need potassium but you add nitrogen – you waste nitrogen

Thank You – Are there any questions?