Aspects Related to Mineral Nutrition in Irrigated Grapevines

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Mineral Nutrient Deficiencies and Excesses in Grapes

Common
- Nitrogen
- Potassium
- Zinc
- Boron

Less Common
- Phosphorus
- Magnesium
- Iron
- Manganese

Infrequently or not observed
- Calcium
- Sulfur
- Copper
- Molybdenum

✓**Excesses**
- Nitrogen
- Chloride
- Boron
- Sodium

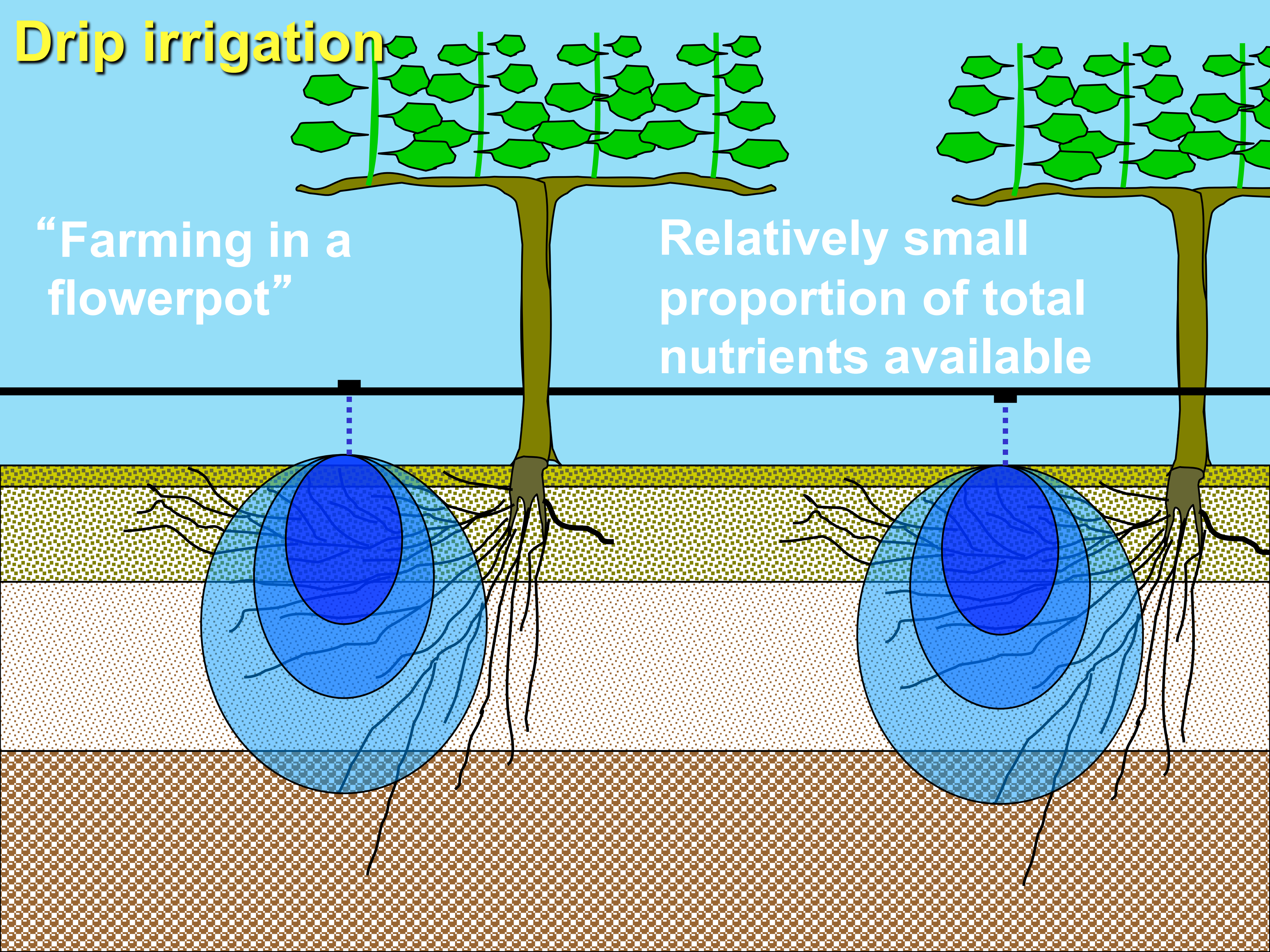
Macronutrients - yellow
Micronutrients - white

Managing Mineral Nutrition

Knowledge of:

- Site/Soil characteristics and chemistry
- Vineyard production goals
- Fertilizer inputs
- Cultural practices
- Tissue and soil analysis
- Observation and judgment

Drip irrigation



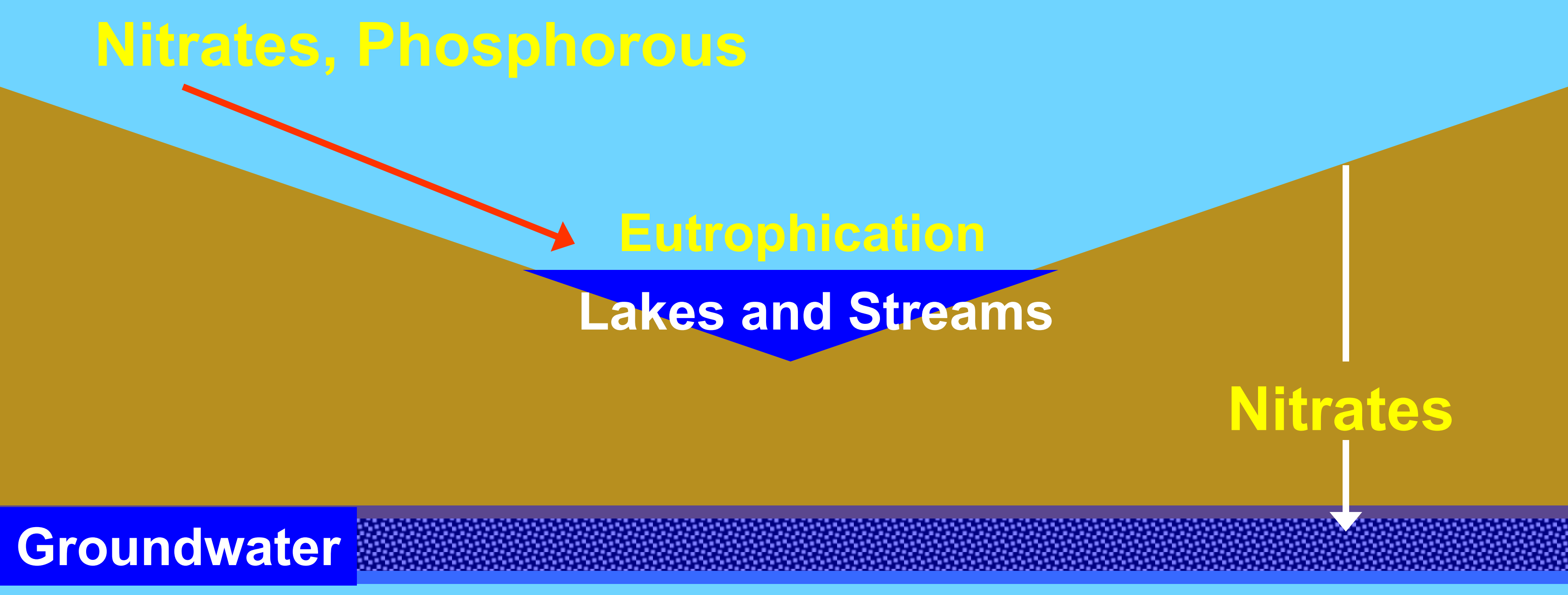
FERTILIZERS

- Fertilizers are a method of supplying supplemental elements where deficient or unavailable to the plant
- The most common element supplied by fertilizers to vineyards is nitrogen

Nutrient Mobility

- Another way of classifying nutrients is their behavior in water.
- Some move wherever water goes and some are held strongly by the soil.

Problem: Contamination of surrounding water bodies



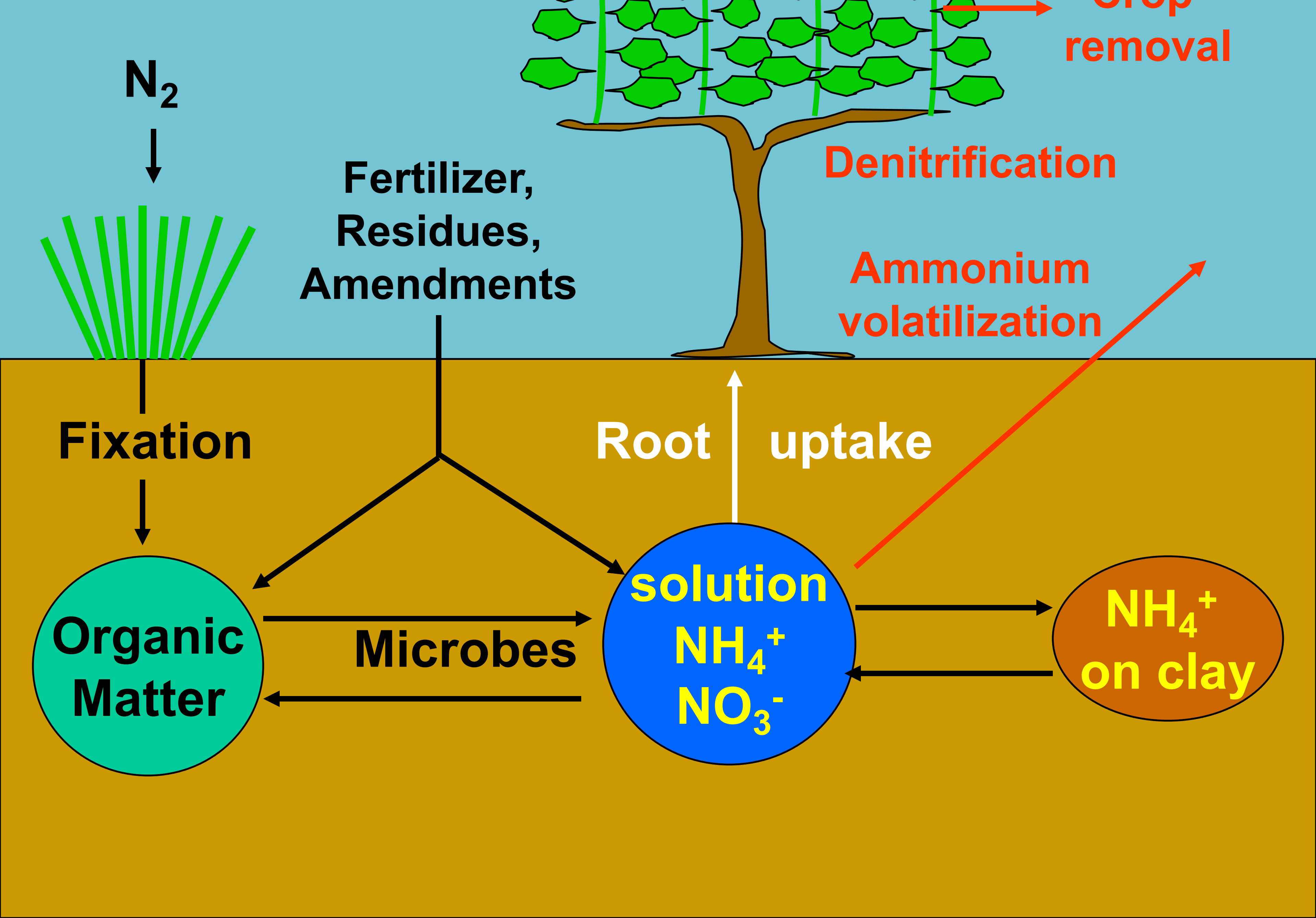
Nutrient Management

- Nitrogen basics:
  - Essential plant nutrient
  - Taken up by plants in both ammonium ($NH4^{+}$) and nitrate ($NO3^{-}$) forms
  - Majority of plant uptake is the nitrate form
- Nitrogen becomes an environmental problem when it moves off-site
  - Surface water, groundwater
  - Agriculture is only one of the nonpoint sources

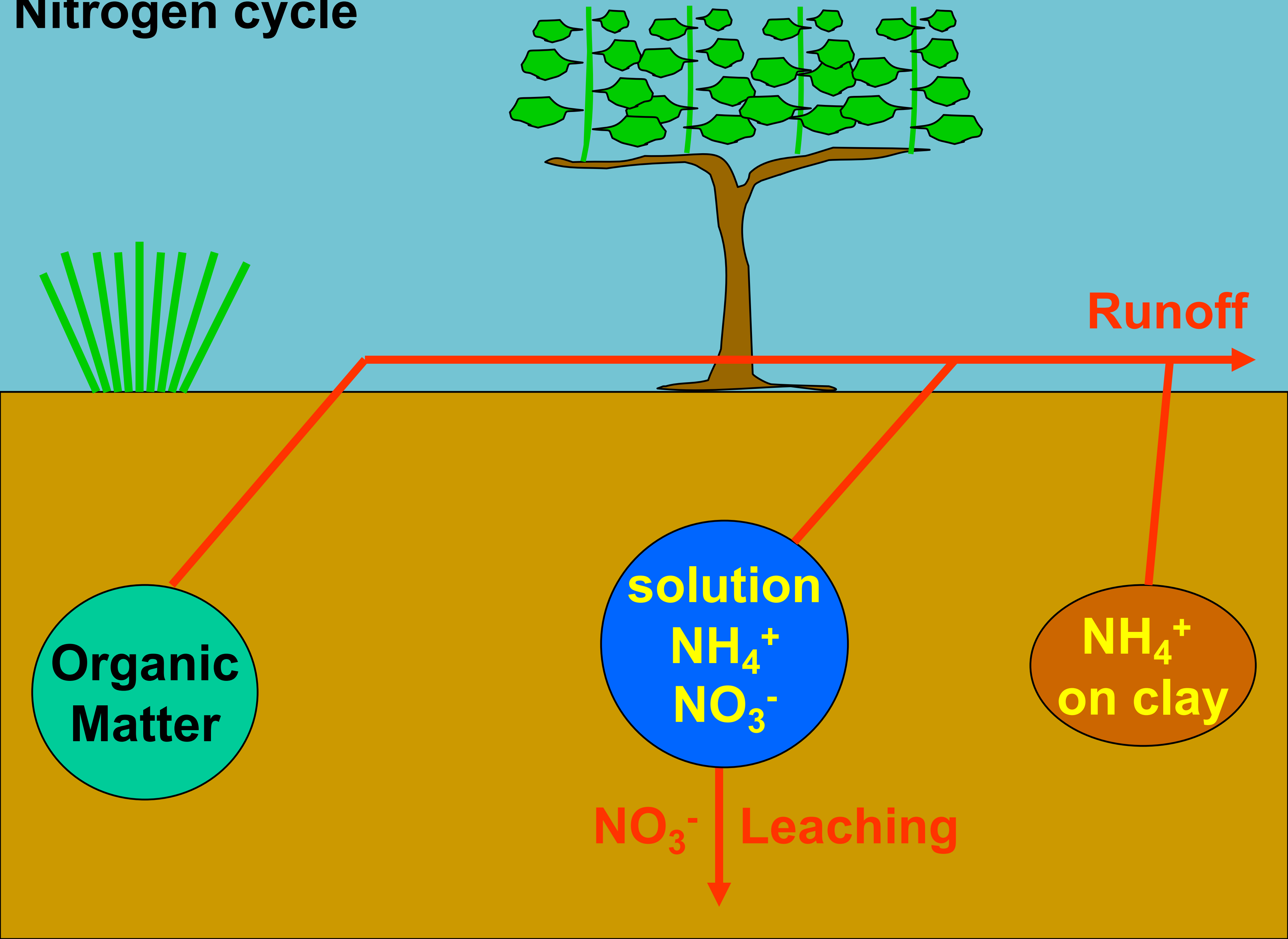
Nitrogen Sources

- Soil reserves
- Irrigation water
- Fertilizer
- Cover crops

Nitrogen cycle



Nitrogen cycle



Determine Fertilizer Requirements

- Determine nutrient contents of soil amendments
  - Manure, compost

Determine Fertilizer Requirements

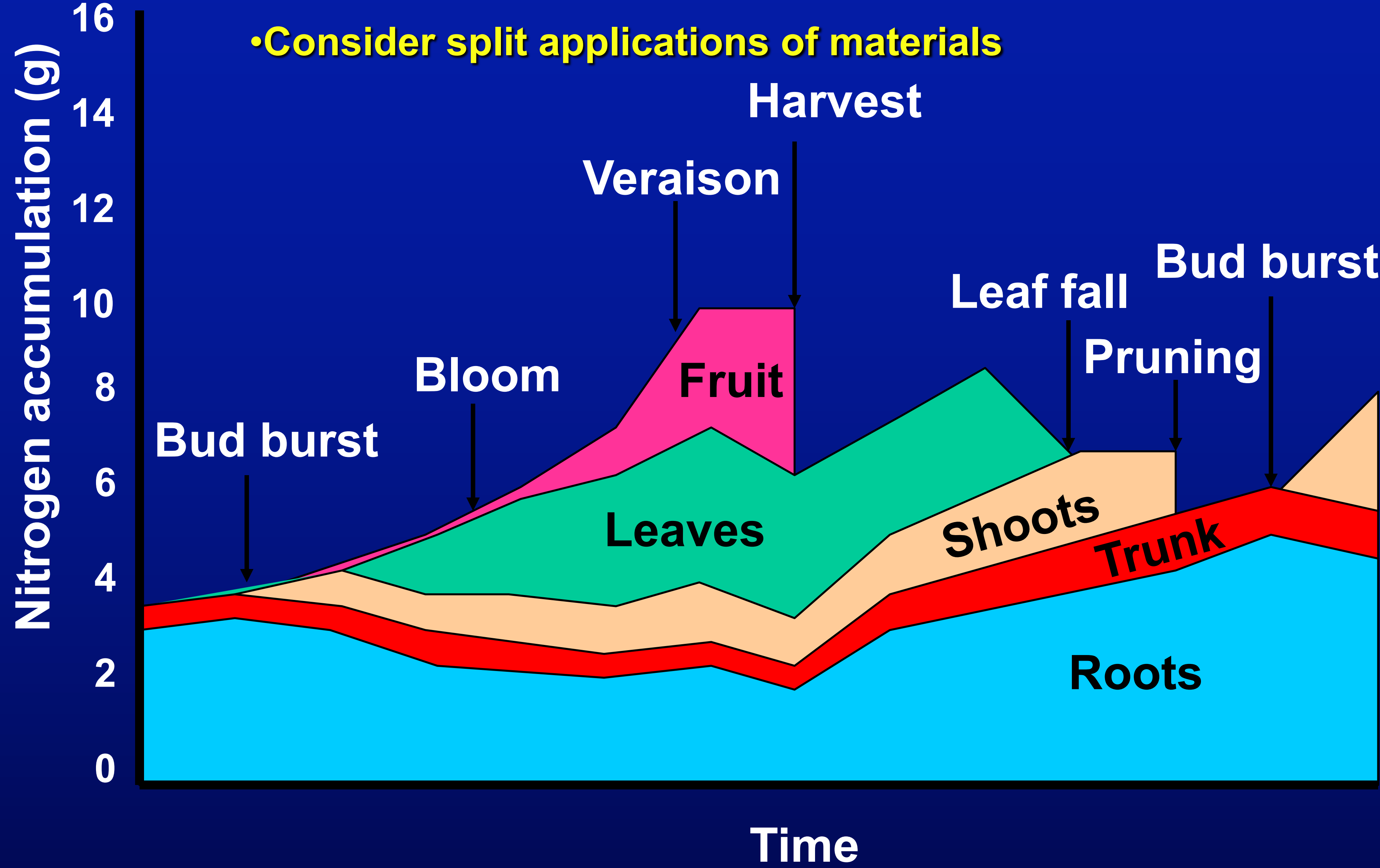
- Evaluate well water for nutrient levels

  1 ac/ft water with 10 ppm nitrate-N provides 27.9 lbs/N per acre

  The nitrates from well water are indistinguishable from fertilizer nitrates, and function identically.

Apply Fertilizers Efficiently

- Time Fertilizer Application to Plant Uptake
- Consider split applications of materials



Apply Fertilizers Efficiently

Once crop nutrient requirements are determined:

Use fertigation to apply fertilizers, if feasible

Apply Fertilizers Efficiently

Irrigation system

- Practices to improve system efficiency & uniformity

Reduce Nutrient Movement

- From water, wind, eroding soil
  - Cover crops
  - Filter strips
  - Vegetative Buffer Strips

- Sequester nutrients, keep in organic form
- Reduce erosion
- Trap sediments

Reduce Nutrient Movement

- Manage irrigation and fertigation to avoid losses below root zone

- Avoid applying fertilizers prior to predicted rain events

Factors affecting nutrient uptake

<u>**Absolute deficiency**</u>

Nutrient is at inadequate levels for vine growth

<u>**Induced deficiency**</u>

Nutrient present in but uptake by grapevine roots affected by:

- Phylloxera or nematode damage
- Soil moisture status or irrigation patterns
- High levels of other mineral in the soil
- Variety or rootstock
- High crop levels

Tissue sampling

✓Most reliable method for nutritional analysis

✓Nutrients that the vine can remove from soil

Two sampling purposes:

1. General nutritional levels

2. Diagnosing visible vine disorders

Soil fertility analysis

- ✓ A major limitation is that soil analysis is not a good indicator of nutrient availability

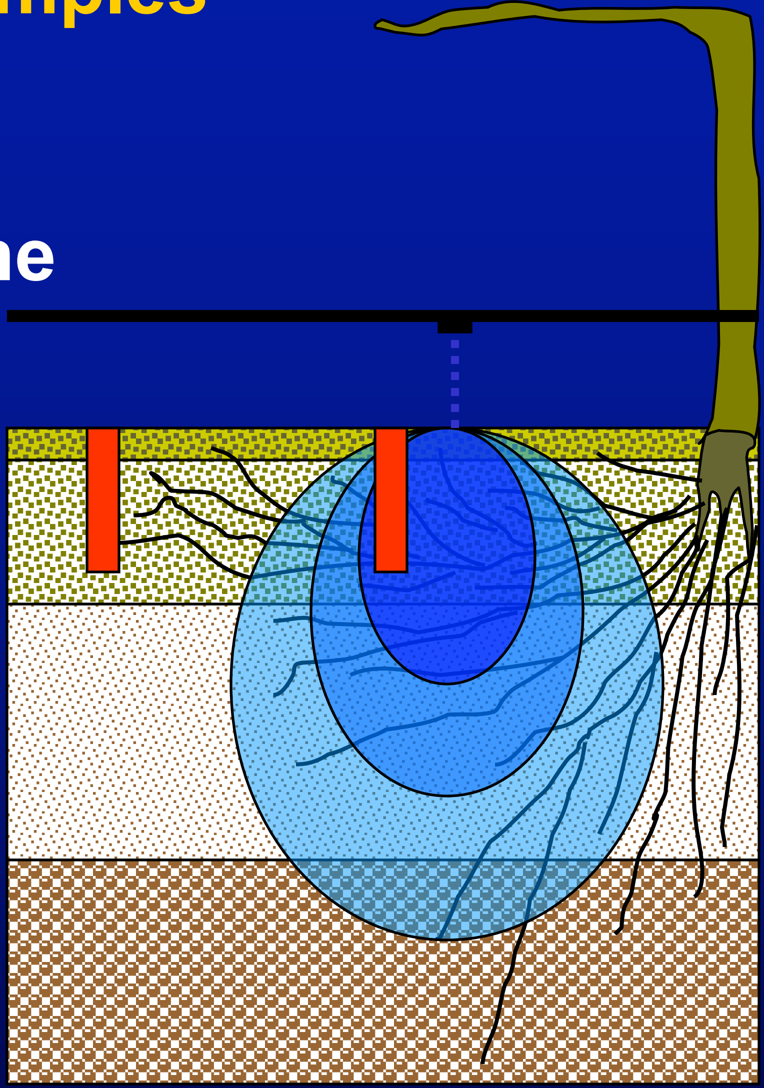
In a nutrient management program soil analysis is important to:

- Establish a benchmark for soil amendments
- Evaluate site uniformity
- Avoid the buildup of harmful elements

Soil fertility analysis

- Location of soil samples

Consider nutrient variability within root zone



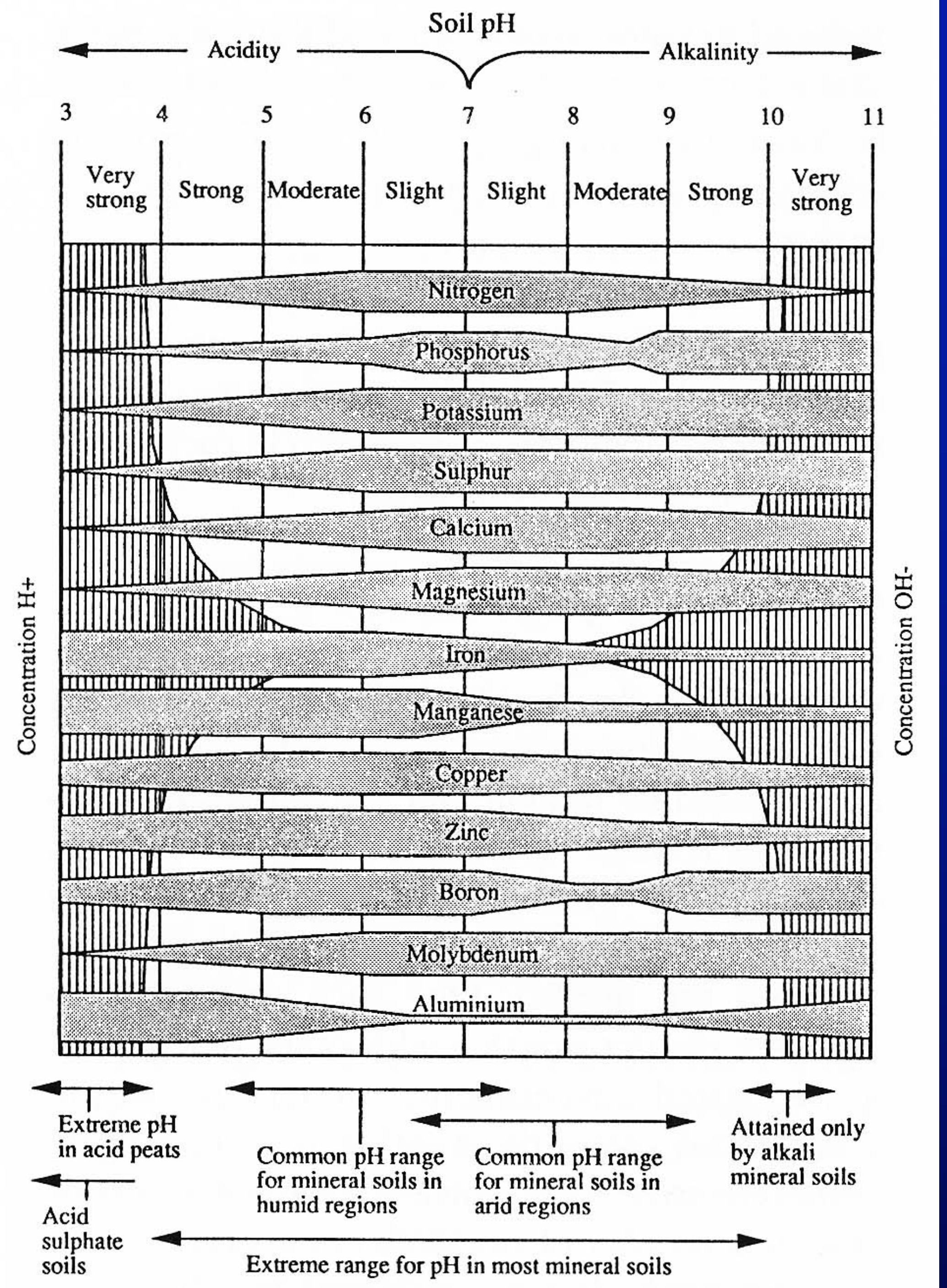
- Fertigation delivers nutrients to confined area
- Nutrients preferentially extracted from wetted zone

Soil Chemical Analysis

pH -	Acidity and Alkalinity
Salinity -	EC (electrical conductivity)
Permeability -	ESP (exchangeable sodium percentage)
Toxicity -	Chloride, Boron, Sodium
Cation Exchange -	Potassium, Calcium, Magnesium
Amending -	Lime or gypsum requirement
Baseline nutrient levels -	Background information and awareness

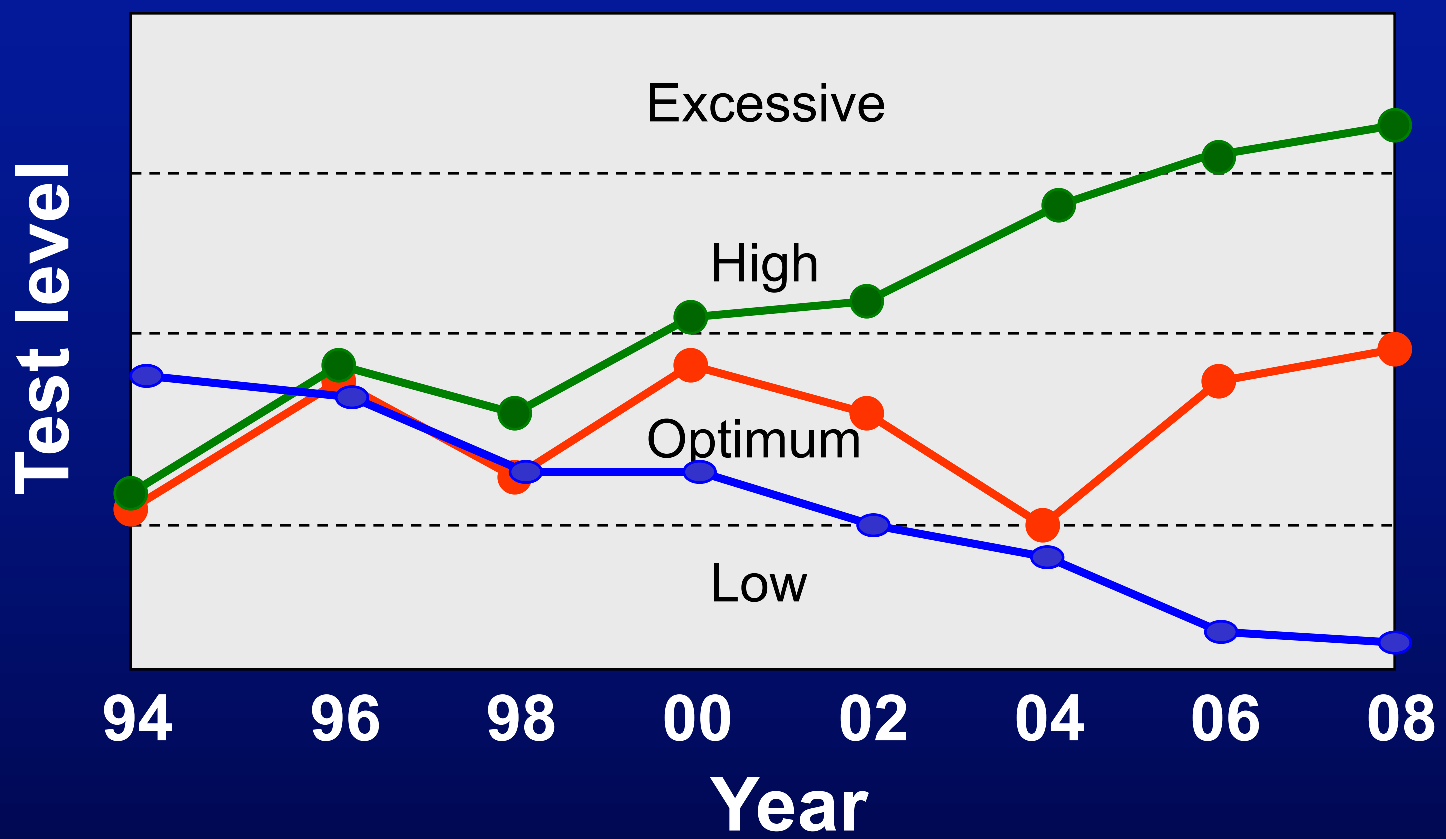
Soil chemistry components

pH effect on nutrient availability



Soil Fertility Analysis

- Changes in soil test level over time



Tissue Analysis - Phenology Stages

Bloom

- Survey Sampling
- Early information
- Easy sampling
- Useful for determining nutrient needs

Veraison

- Follow-up sampling
- Refining K needs

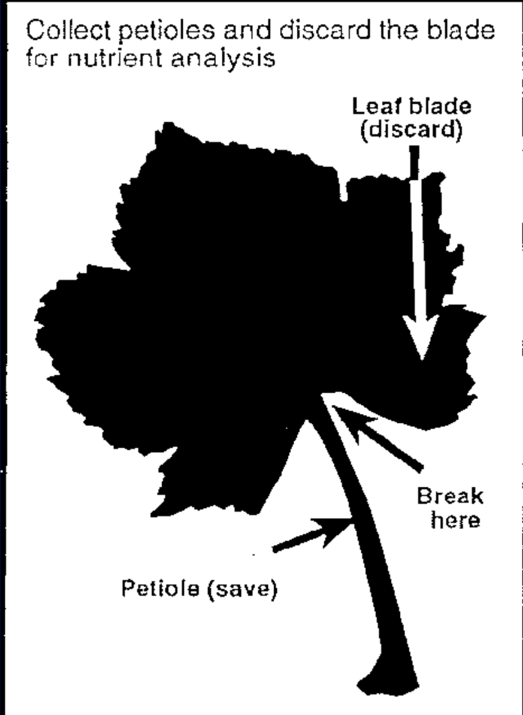
Midsummer to Harvest

- Problem solving, especially for Na, Cl & K

Monitoring Tissue Nutrient Levels

For evaluating fertilizer needs:

- ✓Sample at full bloom
- ✓Petioles from 75 -100 vines
- ✓Sample leaf opposite a cluster



Veraison Follow-up Sampling

- Sample recently fully expanded matured leaves (6th or 7th back from tip)

Diagnosing Visible Symptoms

- Sampled when abnormal symptoms appear
  - Symptoms generally appear midseason or at harvest
- If symptoms show, sample affected leaves
- If toxicities a concern, sample both petiole and blade
- Sample non-symptom vines for comparison

Sampling

Intensity should reflect:

- ✓Soil variability
- ✓Varieties and rootstocks
- ✓Intensity of farming

What plant analyses to make

General

- Nitrate-nitrogen (NO_3^-)
- Total Phosphorus (P)
- Total Potassium (K)
- Zinc (Zn)
- Boron (B)

Trouble diagnosis

- Chloride (Cl)
- Boron (B)
- Sodium (Na)
- Potassium (K)
- Magnesium (Mg)
- Manganese (Mn)

Toxicity

Deficiency

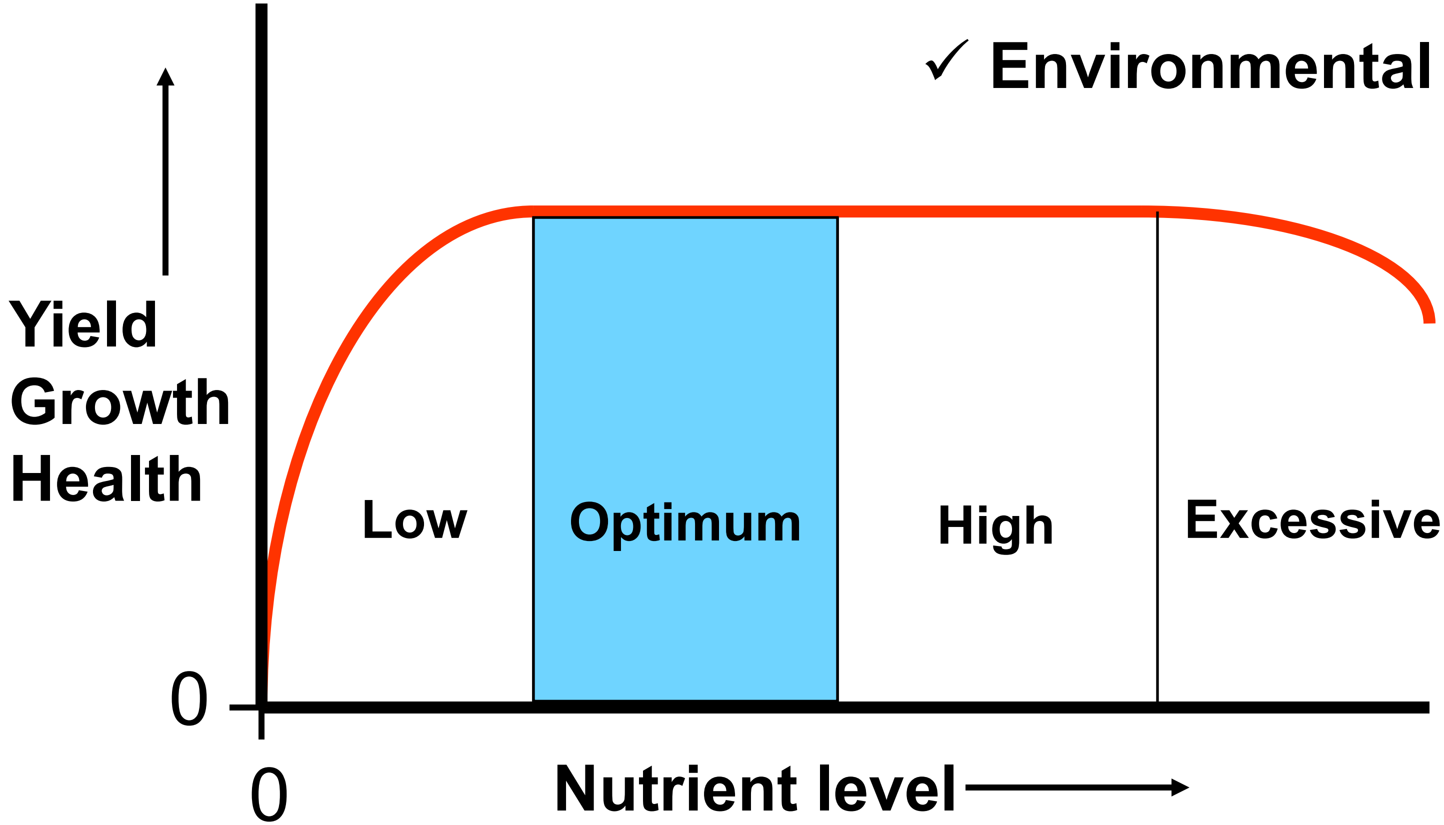
Nutrient Analysis

- Interpretation of laboratory results

✓ Adverse plant effects

✓ (-) Economic return

✓ Environmental issues



Interpretive Guide for Grape Petiole Analysis at Bloom and Veraison

Nutrient	Deficient (below)	Adequate (above)	Excessive (above)	Toxic (above)
NO_3-N, ppm	350	500	2,000	8,000
N (total), %		0.9		
P (total), %	0.10 (0.08)*	0.20 (0.15)*		
K (total), %	1.0 (0.5)*	1.5 (0.8)*		
Mg (total), %	0.2	0.3		
Zn (total), ppm	15	26		
B (total), ppm	25	30	100	150

* Veraison values in parenthesis
(Christensen 2000)

Tissue Analysis Limitations

Nitrate-N	Differs by cultivar, region, and weather
Phosphorus Potassium Magnesium Zinc Boron Manganese	Critical levels are more consistent
Iron	Lack of relationship to symptoms, contamination

N Critical Levels

* Petiole NO_3-N provides a wider spread between adequate and deficient levels as compared to % total N based on N rate studies

Assessment of Nitrogen Requirements

- Vine vigor
- Canopy density
- Cultural requirements of cultivar and site
- Rootstock influence on nutrient uptake
- Knowledge of N inputs
  fertilizer, irrigation water, cover crop
- Soil and root conditions
- Tissue analysis to detect extreme values and trends over seasons

Nutrients removed in one ton of grapes

(Averages in literature)

Nutrient	lbs/ton
N	2.92
K	4.94
P	0.56
Ca	1.0
Mg	0.2
Zn	0.00115
B	0.00065
Fe	0.01050

Nitrogen practice – Drip irrigation

Timing: Spring to early summer
and/or
Postharvest

Rate, lbs N/acre: 0 to 30

Rate is dependent on vine vigor level and production level

Apply in increments over time

Nutrient Management

- Retention is a problem in many soils
- Advantageous to apply nutrients in small increments as needed


END