Nutrient Management in Fruit & Vegetable Crops

David W. Lockwood

Plant Sciences

University of Tennessee

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Getting the best return from your fertilizer dollar

1. Establish & maintain optimum soil pH
2. Time of fertilizer application:
3. Know what you need (tissue analysis)
4. Method of application
5. Maximize resorption of nutrients in fall
6. Reduce competition

16 Essential Mineral Nutrients

Macronutrients
(major elements)

Nitrogen (N)
Phosphorus (P)
Potassium (K)
Magnesium (Mg)
Calcium (Ca)
Sulfur)S)

Micronutrients
(minor elements)

Iron (Fe)
Manganese (Mn)
Copper (Cu)
Zinc (Zn)
Boron (B)
Molybdenum (Mo)
Chlorine(Cl)

Carbon, hydrogen and oxygen are gotten from the atmosphere


Soil conditions
and other growth factors
YIELD
Sodium
Oxygen
Boron
Carbon Dioxide
Warmth
Light
Water
Nitrogen
Phosphorus
Potassium
Calcium
Magnesium
Sulphur
Iron
Chlorine

Taking Soil Samples

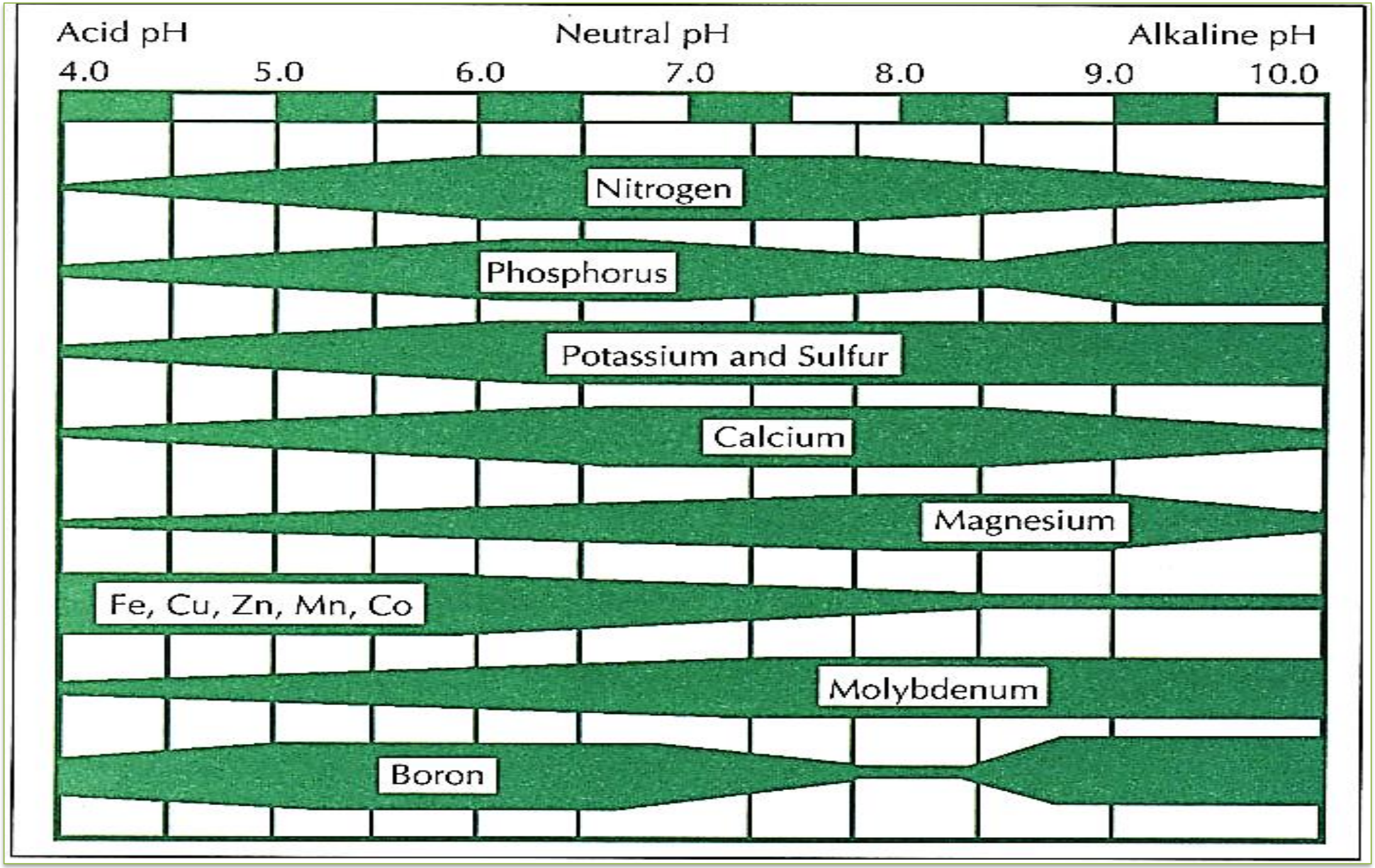
- **Preplant:**
  - pH – affects availability of nutrients
  - Phosphorus – only opportunity to adjust P levels in soils (preplant)
  - Potassium – can impact uptake of certain nutrients (Ca, Mg, N)
  - Calcium – calcitic limestone?
  - Magnesium – dolomitic limestone?
  - Organic Matter – can help to determine nitrogen fertilization rates

Sample at 2 depths:
- 1 to 8 inches
- 8 to 16 inches

- **Post plant:**
  - Monitor soil pH – correlation between soil test results and the actual nutrient content of the plant can be poor
  - Sample 1 to 8 inch depth

No other soil characteristic is more important in determining the chemical environment of higher plants and soil microbes than pH.

Effects of Soil pH on Nutrient Availability



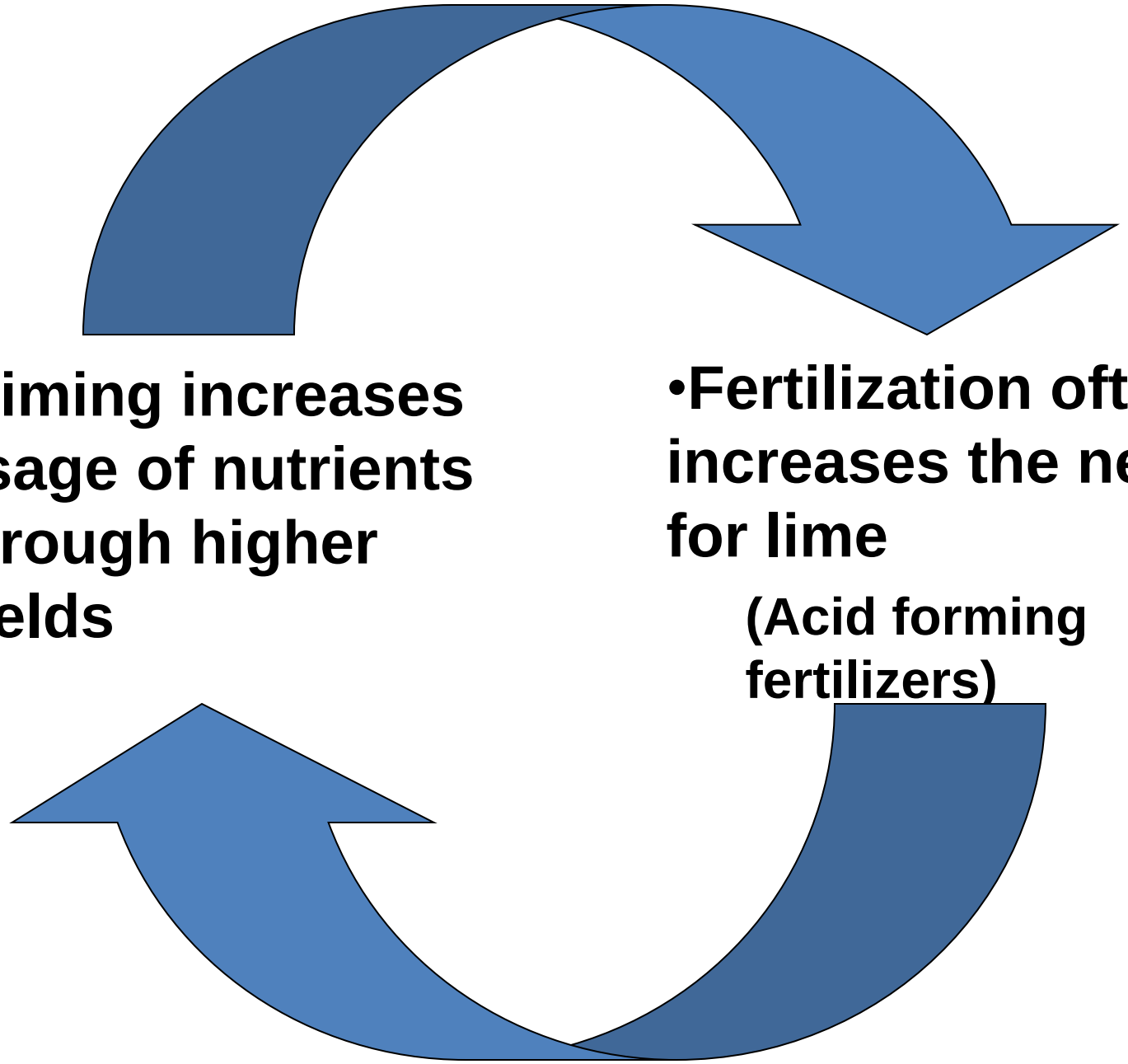
Liming Increases Fertility Efficiency and Decreases Soil Acids

	Availability			Fertilizer
Soil Acidity	**Nitrogen**	**Phosphate**	**Potash**	**Wasted**
Extremely Acid – 4.5 pH	30%	23%	33%	71.34%
Very Strong Acid –5.0 pH	53%	34%	52%	53.67%
Strongly Acid – 5.5 pH	77%	48%	77%	32.69%
Medium Acid – 6.0 pH	89%	52%	100%	19.67%
Neutral – 7.0 pH	100%	100%	100%	0.00%

Source: The Mosaic Company, 2016. Soil pH

Benefits of Liming

- **Improve soil pH:**
  - Provides better soil environment for plant growth
  - Prevents toxicity due to excess Al & Mn
  - Increases availability of P & Mo
  - microbiological processes such as nitrification and nitrogen fixation
    - may also indirectly improve the physical condition of the soil



•**Liming increases usage of nutrients through higher yields**

•**Fertilization often increases the need for lime**

(Acid forming fertilizers)

How Long Does It Take for Lime to Work?

- Often takes 1 year or more before a response can be measured under perfect conditions
- May take 2 – 3 years to get the full effect of liming
  - Reactivity time depends on type of lime used & fineness of grind
    - Calcitic lime probably reacts faster than dolomitic because it has a higher calcium carbonate equivalent
    - Water is required for reactions to occur

Key points for Fertilizing Vegetable Crops

- Fertilizer, whether organic or synthetic, is used to supply nutrients to plants when they need them.
- Fertilize based on soil test results and plant needs.
- Nutrient needs vary between plant families and species. For example, leafy greens require more nitrogen than beans and peas.
- Vegetable crops generally need nutrients most when getting established and during flowering and fruiting.

What to Use?

Determining the Nutrient Status of Plants

- **Soil testing**
  - preplant – pH, phosphorus, potassium, organic matter
  - postplant – monitor soil pH only (correlation between soil test results and the actual nutrient status is poor)
- **Plant tissue testing**
  - Except for nitrogen, amendments will be for next year's crop
- **Field observations:** leaf color, shoot growth, crop status
- **Records** from previous year

Nutrient Disorders

- Deficiencies
- Toxicities
- Imbalances
  - Nitrogen/potassium ratio
    1 – 1.25/1
  - Potassium/magnesium ratio
    - 4/1
  - Calcium/Magnesium ratio
    - 3/1

Reasons to Test Plant Tissue for Nutrient Status

- Monitoring over the growing season
  - In vegetables, works well if there is a means of regulating nutrition under field conditions (Fertigation)
- Diagnosing a suspected nutrient problem (deficiency, toxicity, imbalance
  - Often done after a problem has been detected
    - Economic losses will occur before visible symptoms are evident
  - Consideration: is there enough time left to apply needed nutrients AND will the addition actually enhance production

In fruit crops, with the exception of nitrogen, nutrient correctios are done for the next year's crop

Tissue Sampling Vegetable Crops

- **When** to sample:
  - For monitoring purposes:
    - Begin shortly after the crop emerges from the soil and continue at weekly or biweekly intervals
  - When a nutrient problem is suspected:
    - Sample as soon as the problem is evident

Edis.ifas.ufl.edu/publication/EP081

Tissue Sampling Vegetable Crops

- **What** to sample:
  - Follow recommendations for specific crops
    - Leaf tissue is most often used
    - Sometimes petioles are taken
  - For many vegetable crops, the most recently matured leaf is selected as the most sensitive indicator

Tissue Sampling Vegetable Crops

- **How to sample**:
  - The whole leaf, not containing any soil or stem tissue
    - Sweet corn or onions – remove the leaf just above the point where it is attached to the stalk or bulb
    - Compound leaves (carrots, peas, tomatoes, etc.) – collect the whole leaf, including the petiole, all the leaflets & the petiolules
    - Heading vegetables – take the outermost whole wrapper leaf
    - When sampling particularly young plants, take the entire above-ground portion

Tissue Sampling Tips

- The reliability of the results is only as good as the quality of the sample(s) submitted for analysis
  - Sample should contain 25 – 100 individual leaves
    - Same leaf (physiological age & position) taken from each plant
      - Avoid plants damaged by insects, diseases or chemicals
  - For confirmation or denial of a suspected nutrient problem,
    - Sample both affected and normal plants of the same variety, age and growing in the same general area of the field
  - Sample before a spray application to lessen contamination
  - Include a soil sample

Tissue Sampling Tips

- Contamination from pesticides, nutrient sprays, soil, dust, etc.
  - Quickly rinse samples in a dilute, non-phosphate detergent followed by rinsing twice in distilled water (avoid using tap water)
- Air dry samples in a clean environment prior to sending to the lab
- Put samples in clean paper bags (not plastic)
- Select a lab that can provide a quick turn-around time

Detection of micronutrient problems

- Do not rely exclusively on visible symptoms
  - Same symptoms may occur with:
    - Other elements
    - Weather stress
    - Herbicide damage
- **By the time symptoms are visible, damage has already occurred**
- Use tissue analysis plus soil testing to head off problems
- Consider foliar applications
  - Application directed where needed
  - Mobility in plant may be limited

“Shotgun” mixtures of micronutrients

- Not recommended
  - Seldom see over one deficiency problem at a time
  - Difference between deficiency and toxicity is small
  - Should not be applied unless tissue analysis demonstrates a need
    - Exception: Solubor for boron deficiency corking
  - Often contains a small amount of nitrogen which is usually responsible for any visible effects of application
    - Very expensive way to apply N

Sufficiency Ranges for Apples

Macronutrients (%)

N: 1.80 – 2.10 (for Golden delicious) 1.90 – 2.30 for other varieties

P: 0.15 – 0.50

K: 1.25 – 1.80

Ca: 1.00 – 2.00

Mg: 0.20 – 0.50

Micronutrients (ppm)

Fe: 50 – 400

Mn: 25 – 200

Zn: 20 – 50

Cu: 5 – 20

B: 25 - 60

Methods of Nutrient Application

- **Preplant:**
  - **Broadcast,** deep incorporation of lime, P & K
- **Postplant:**
  - **Broadcast** in weed-free strip down the tree row – N & possibly K
  - **Banding** (4 – 6” band 2 to 3’ each side of trunk for postplant P, and possibly K
  - **Fertigation** (microsprinklers or drip) down tree row (reduced rates, control destiny of fertilizer)
  - **Foliar** – best for most micronutrients, supplemental Ca, N - especially late in the growing season

Nutrient	Mobility in Soil	Mobility in Plants
Nitrogen (N)	Mobile as NO_3, Immobile as NH_4	Mobile
Phosphorus (P)	Immobile	Somewhat mobile
Potassium (K)	Somewhat mobile	Very mobile
Calcium (Ca)	Somewhat mobile	Immobile
Magnesium (Mg)	Immobile	Somewhat mobile
Sulfur (S)	Mobile	Mobile
Boron (B)	Very mobile	Immobile
Copper (Cu)	Immobile	Immobile
Iron (Fe)	Immobile	Immobile
Manganese (Mn)	Mobile	Immobile
Zinc (Zn)	Immobile	Immobile
Molybdenum ((Mo)	Somewhat mobile	Immobile
Chlorine (Cl)	Mobile	Mobile

Spreader Types

- Drop-Type Spreaders
  - precise application & pattern
  - Less chance of drift, more control of pattern
- Pendulum Spreaders
  - Ability to spread to either side, or both sides,
  - with or without spreading directly behind applicator
- Spinner-Type Spreader
  - Wider swath of coverage, faster application
  - Less uniform distribution, drift can be a problem
- Air-Boom Spreaders
  - Used mainly in larger acreages,
  - very uniform distribution pattern

Calibration: What is it & why do we do it?

- Calibration = process of determining the exact amount of fertilizer that is applied to a given area when the spreader is opened to a particular setting and operated under given conditions

- Factors which can influence application rates include:
  - Type (formulation) and physical properties of the fertilizer used
  - Speed of application
  - Mechanical differences of each spreader

Fertigation

Application of dissolved nutrients through the irrigation system

- Advantages:
  - Rapidly applying precise amounts of essential plant nutrients directly to the root zone
  - Applying nutrients at the exact time that the tree needs them
  - Limiting nutrient leaching to ground water & nutrient runoff

Foliar Applications of Macronutrients (N, P, K, Ca, Mg) are NOT Recommended as the Primary Method of Application

- Use as a supplement to soil-applied nutrients
- Adequate supplies are usually taken up by roots
- Not enough would be absorbed through leaves to correct a deficiency for very long

Why Consider Foliar Applications?

- Best for most micronutrients
- Provides an opportunity to:
  - Supply essential elements directly to the foliage, flowers or fruit at times when a rapid response may be required (overcome short-term deficiencies)
    - Cold weather during bloom or cold soils in spring may limit the availability of nutrients while increasing plant requirements
    - Pink or petal-fall
      - Rate of 5 to 10# urea per acre

Correcting Nutrient Deficiencies in Vegetable Crops

- Must be done in a timely fashion to minimize losses from reduced yields & quality
  - For open, bare ground culture: topdress over the crop or band along side of it
  - Where polyethylene mulch is used: apply nutrients to the root zone by manually punching holes in the plastic or applying through the drip line
  - Foliar application of macronutrients (N, P, K, Ca, Mg, S) is **not** advised
    - Leaves cannot absorb large quantities of nutrients.
    - Use a soil drench or band nutrients instead
  - Foliar application of micronutrients is advised
    - Carefully monitor rates