Nutrition of Fruit Trees

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What is the problem ?

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Why is there a problem and what can I do about it?

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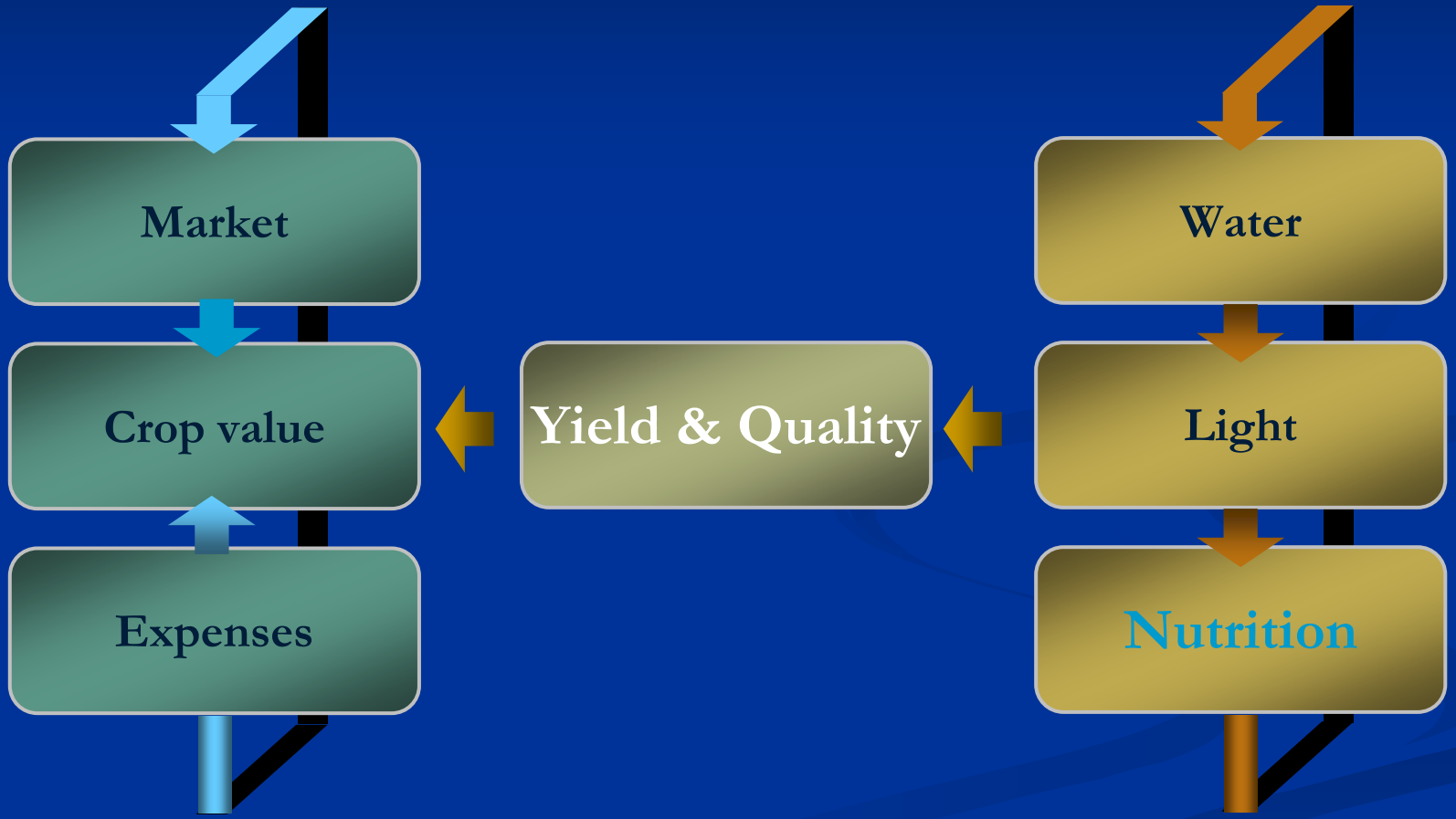
Trees Productivity & Profitability



Essential Element

- What is an essential element?

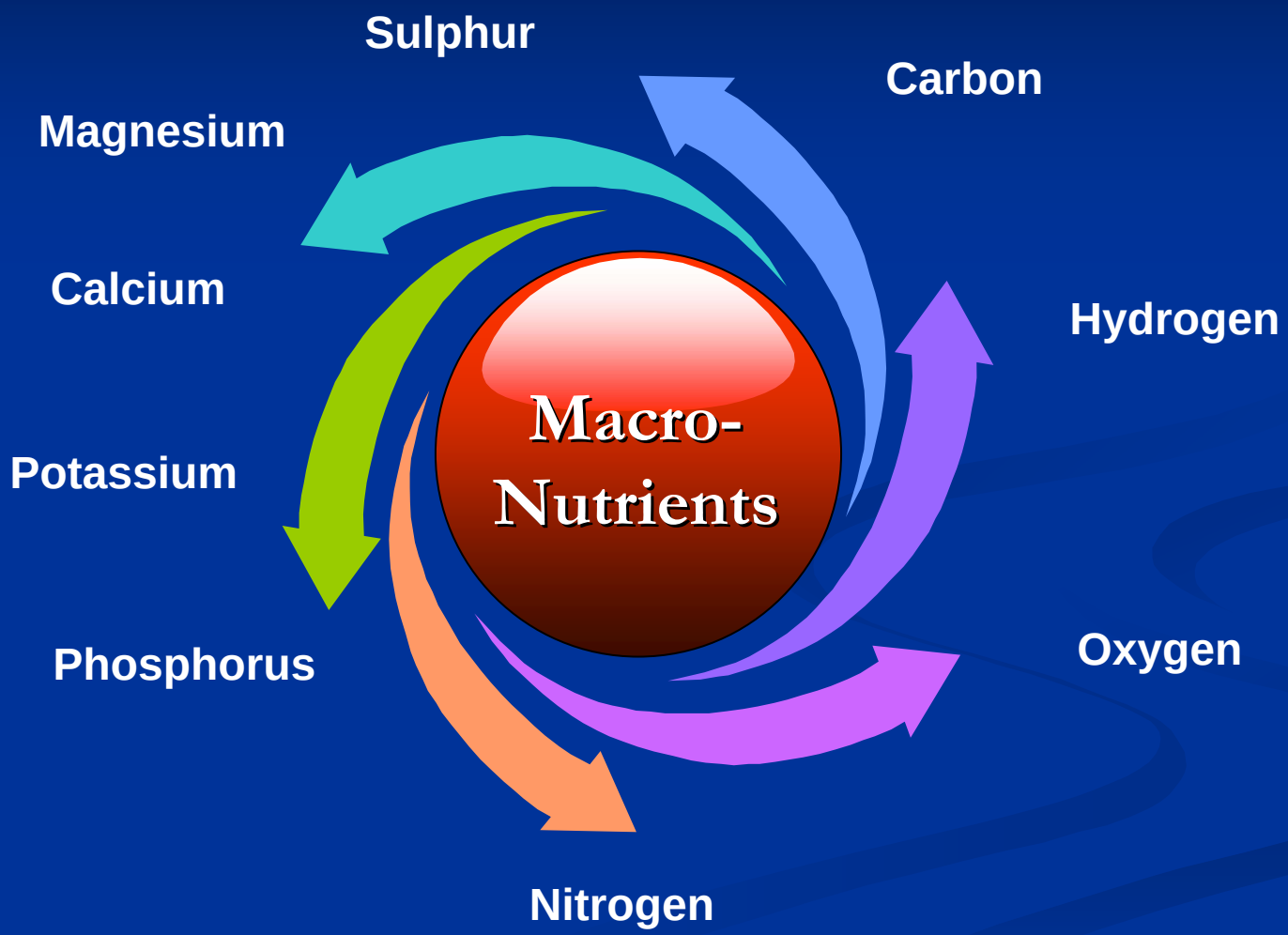
An element required by plants for normal growth, development and completion of its life cycle, and which cannot be substituted for by other chemical compounds.

- Classified based on quantity required

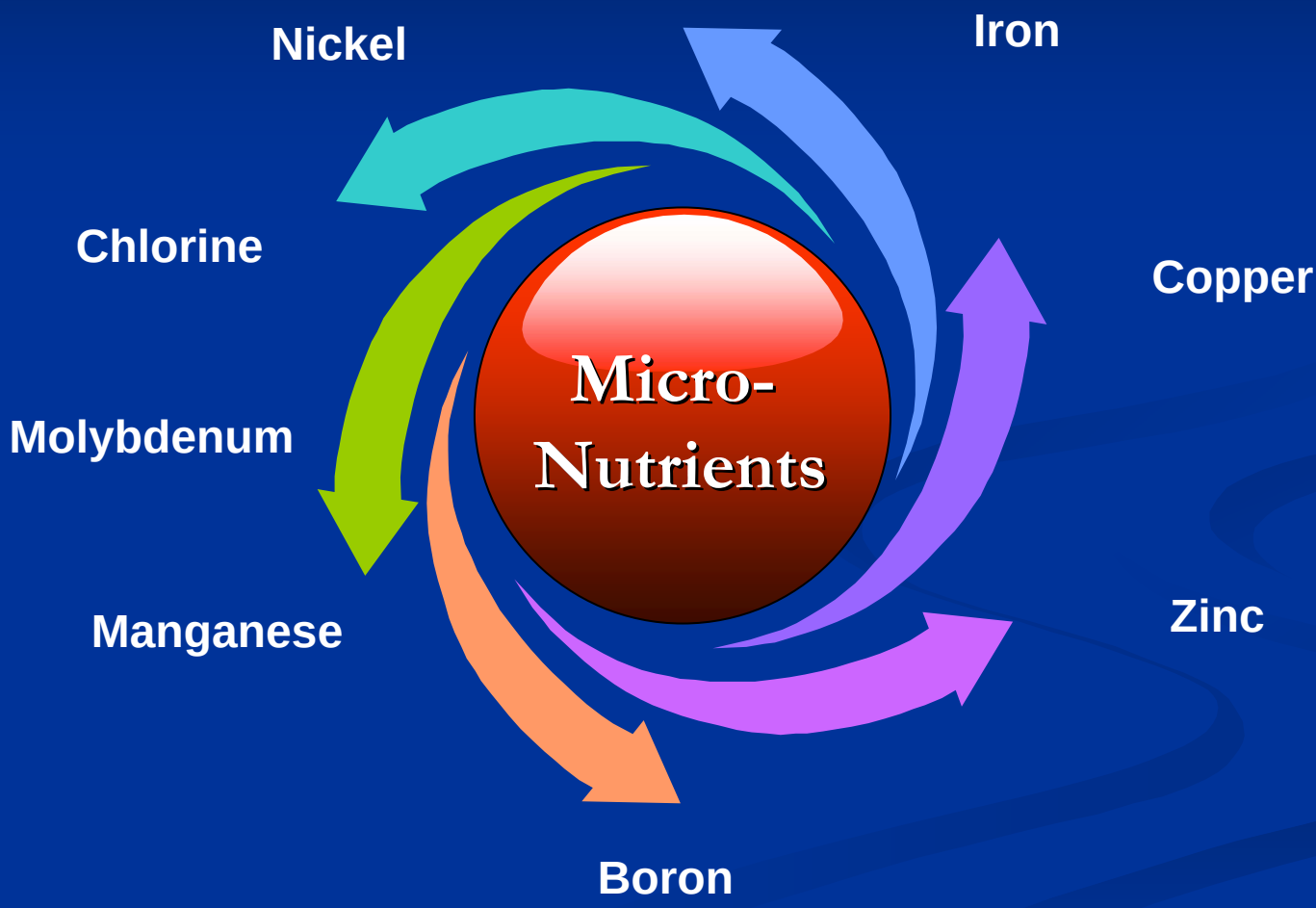
- Macro-nutrients
(>1000mg/kg of dry weight)
-Micro-nutrients
(<100mg/kg of dry weight)

Both are equally important

Essential Elements

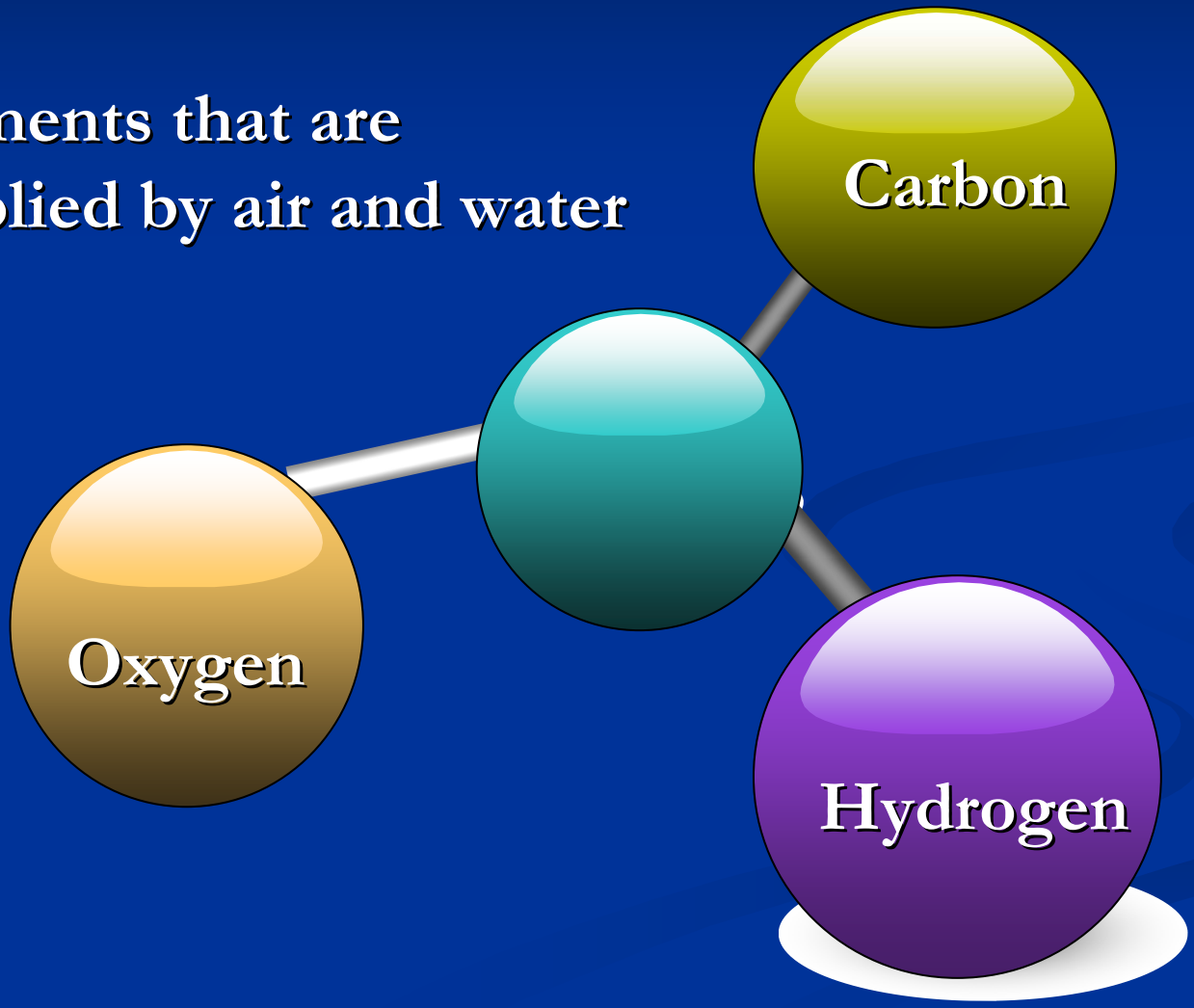


Essential Elements



Non-Mineral Elements

- Elements that are supplied by air and water



Nutrient Requirements

- Nutrients are required for plant processes to function

1. Transpiration
2. Respiration
4. Photosynthesis

Nutrient Loss

Nutrients are lost in many ways

- Depleted by plants
- Used by microorganisms
- Leached because of watering
- Conversion to gaseous form


Root absorption
takes place as
Active absorption
takes place as an exchange phenomenon and requires energy. Most plant nutrients are absorbed in this manner.
Passive absorption
is part of the transpiration cycle (mass flow). Water and some dissolved solutes are absorbed by this process.

Gas exchange

Gas exchange takes place through the stomata found in leaves. Carbon dioxide required for photosynthesis and oxygen required for plant respiration are exchanged through the leaves.

Deficiency of an element

Deficiency will result in the decrease in normal growth of the plant, affect the crop yield and produce more or less distinct deficiency symptoms.

- Typical deficiency symptoms are not often clearly defined. Masking effects due to other nutrients, secondary causes like disease, herbicide toxicity or insect infestation can confuse field diagnosis.
- Waterlogged conditions or dry soils and mechanical damage can often create symptoms that mimic deficiencies.

When the level of an essential plant nutrient is below the required amount for optimum yields or when there is an imbalance with other nutrients it is considered insufficient.. The symptoms of this condition are seldom clearly visible, resulting in poor yield.

Toxicity level will often cause nutrient imbalances and will result in poor plant growth, delayed maturity, stunted and spindly growth and also show visible symptoms of chlorosis or necrosis.

Deficiency symptoms can be categorized into five types.

1. Chlorosis, which is yellowing, either uniform or interveinal of plant leaf tissue due to reduction in the chlorophyll formation.

2. Necrosis, or death of plant tissue.

3. Lack of new growth or terminal growth resulting in rosetting

4. An accumulation of anthocyanin and / or appearance of a reddish colour

5. Stunting or reduced growth with either normal or dark green colour or yellowing.

Keys of Nutrient Deficiency Symptoms in Fruit Trees

Colour Change in Lower Leaves

N	**Plant light green, older leaves yellow**
P	**Plants dark green with purple cast, leaves and plants small**
K	**Yellowing and scorching along the margin of older leaves**
Mg	Older leaves have yellow discolouration between veins-finally reddish purple from edge inward
Zn	**Pronounced interveinal chlorosis and bronzing of leaves**

Colour change in upper Leaves
(Terminal bud dies)

Ca	Delay in emergence of primary leaves, terminal buds deteriorate
B	Leaves near growing point turn yellow, growth buds appear as white or light brown, with dead tissue.

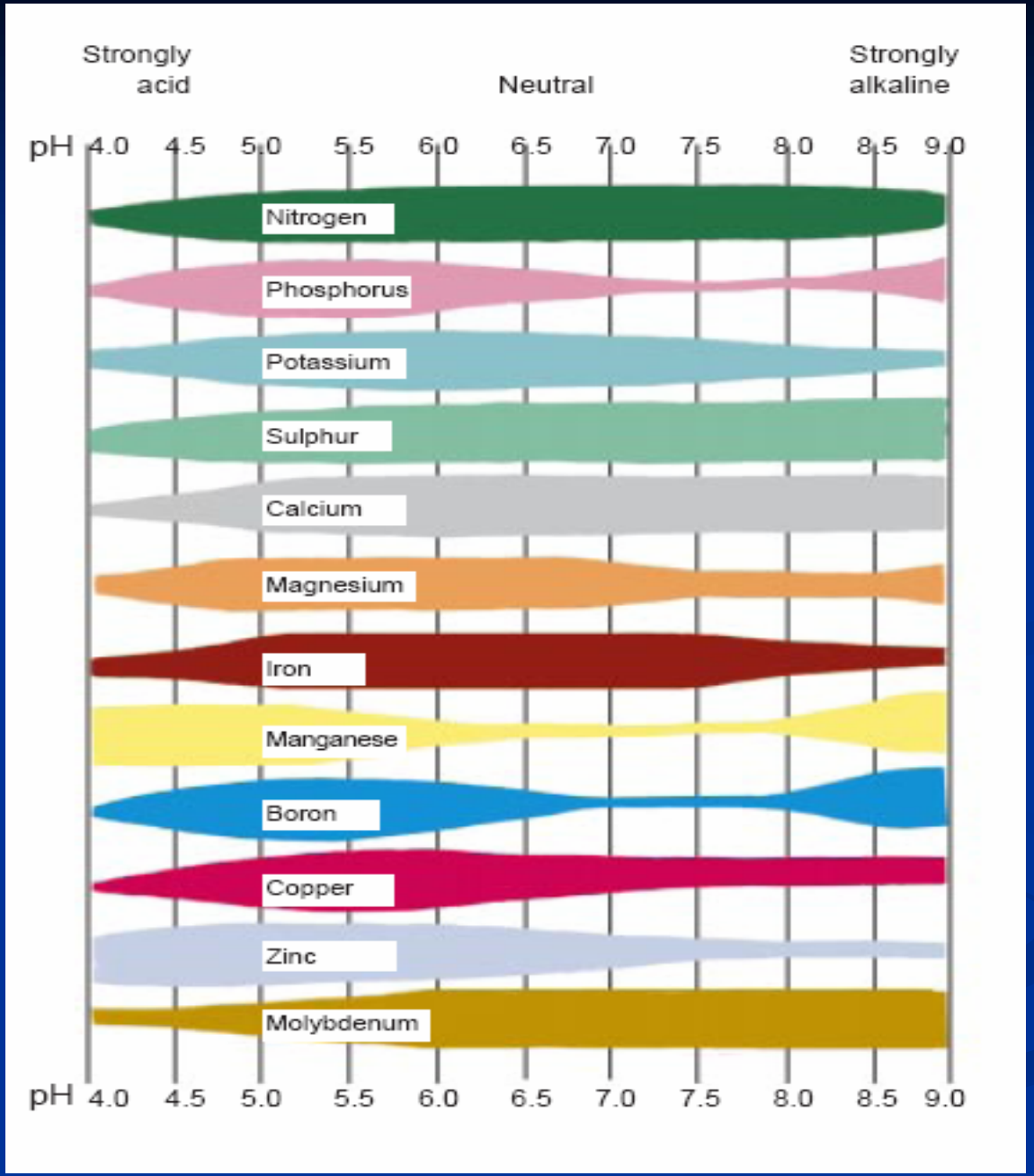
Colour Change in Upper Leaves

(Terminal bud remains alive)

S	Leaves including veins turn pale green to yellow, first appearance in young leaves.
Fe	Leaves yellow to almost white, interveinal chlorosis at leaf tip
Mn	Leaves yellowish-grey or reddish, grey with green veins
Cu	Young leaves uniformly pale yellow. May wilt or wither without chlorosis
Mo	Wilting of upper leaves, then chlorosis
Cl	Young leaves wilt and die along margin

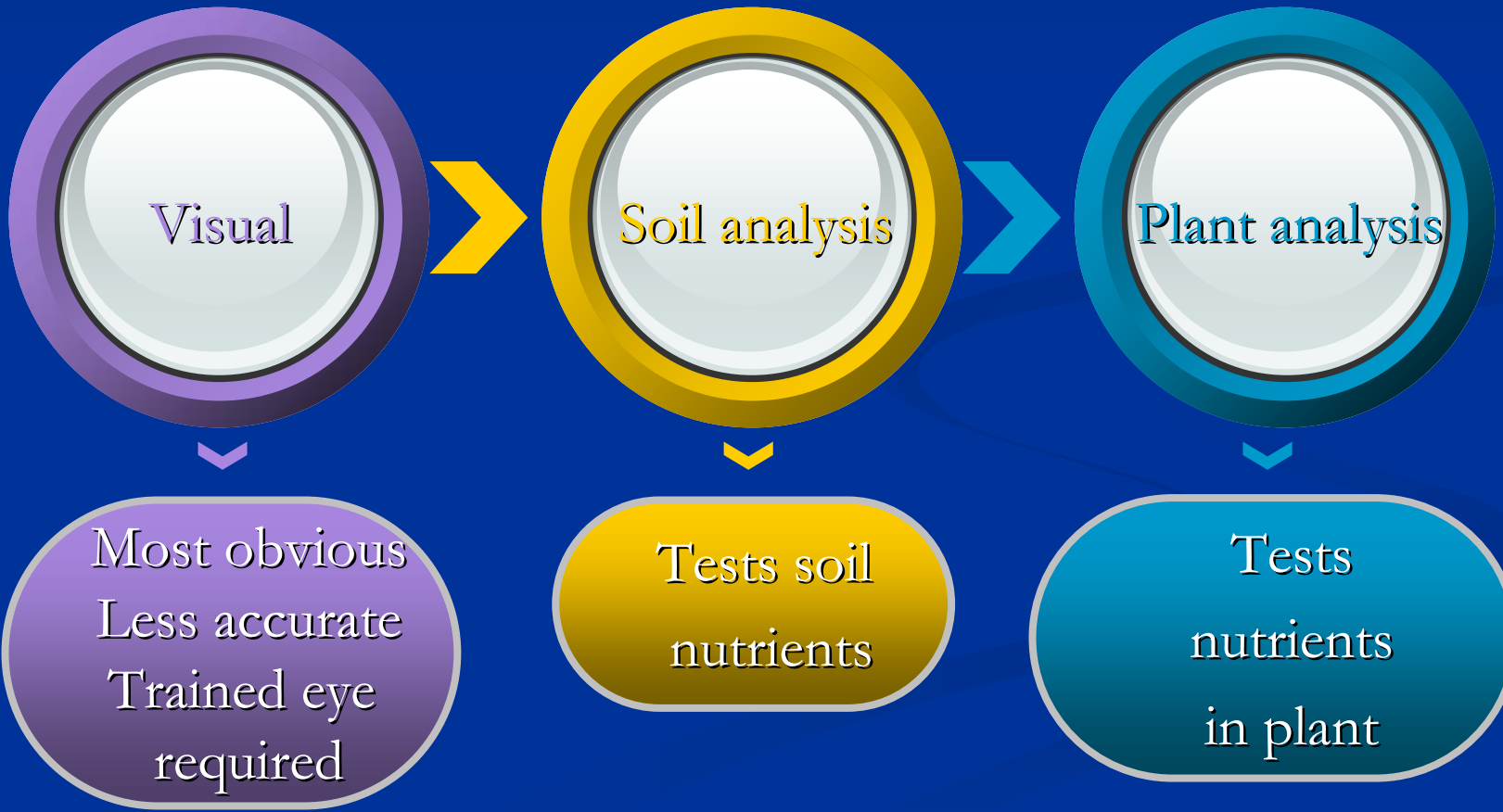
The Soil Supplies the Majority of Plant Nutrients

Nutrients move to the root in soil moisture
  – No water, no uptake
- Nutrient supply from a soil depends on:
  – The 'size' of the nutrient and,
  – The 'solubility' of nutrients (pH)
- Roots are alive and nutrients are not uniformly distributed
  – Soils must allow root penetration, provide adequate water and oxygen for root growth.



Source: Lucas & Davis 1951

Determining the need for fertilizer



Soil Sampling Purpose

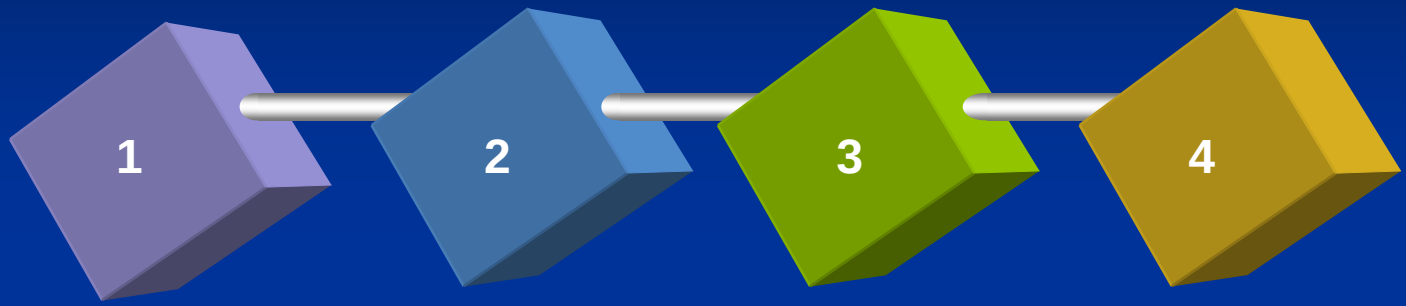
1

To collect samples that are representative of the soil that the plant roots are growing in.

2

To collect samples that reflect the field as a whole or, problem areas specifically.

Sampling Strategy



1. Samples should be collected from soil within the root zone of the plant.
2. Samples should be taken across the field in a regular pattern. More variable fields,
3. Samples from good and bad areas can help identify problems.
4. Make note of waterlogging, hardpans, as these can often be related to nutrient problems.

Interpreting Soil Analyses

Limited recommendations are available for trees

- Look for soil 'problems'

-pH > 7.5 or < 5.5

-soil conductivity of >2.5 mmhos/cm

-soil chloride > 10 meq/liter, Na > 15%, B> 1ppm

-high levels of other elements (i.e. Ca, Mg, Ni, Cd, Pb)

-waterlogging, hardpan etc.

Nutrients may be present but not available

Plant Sampling and Analysis

Methods of Plant Sampling and Analysis

-Samples should be taken across the field in a regular pattern. More variable fields, will require more detailed sampling

-Samples from good and bad areas can help identify problems and can be compared to each other at anytime during the year.

-Make note of waterlogging, hardpans.

-Make note of changes in soil type, drainage etc that may help determine cause of deficiency.

-Keep records of year-year patterns

Methods of Plant Sampling and Analysis

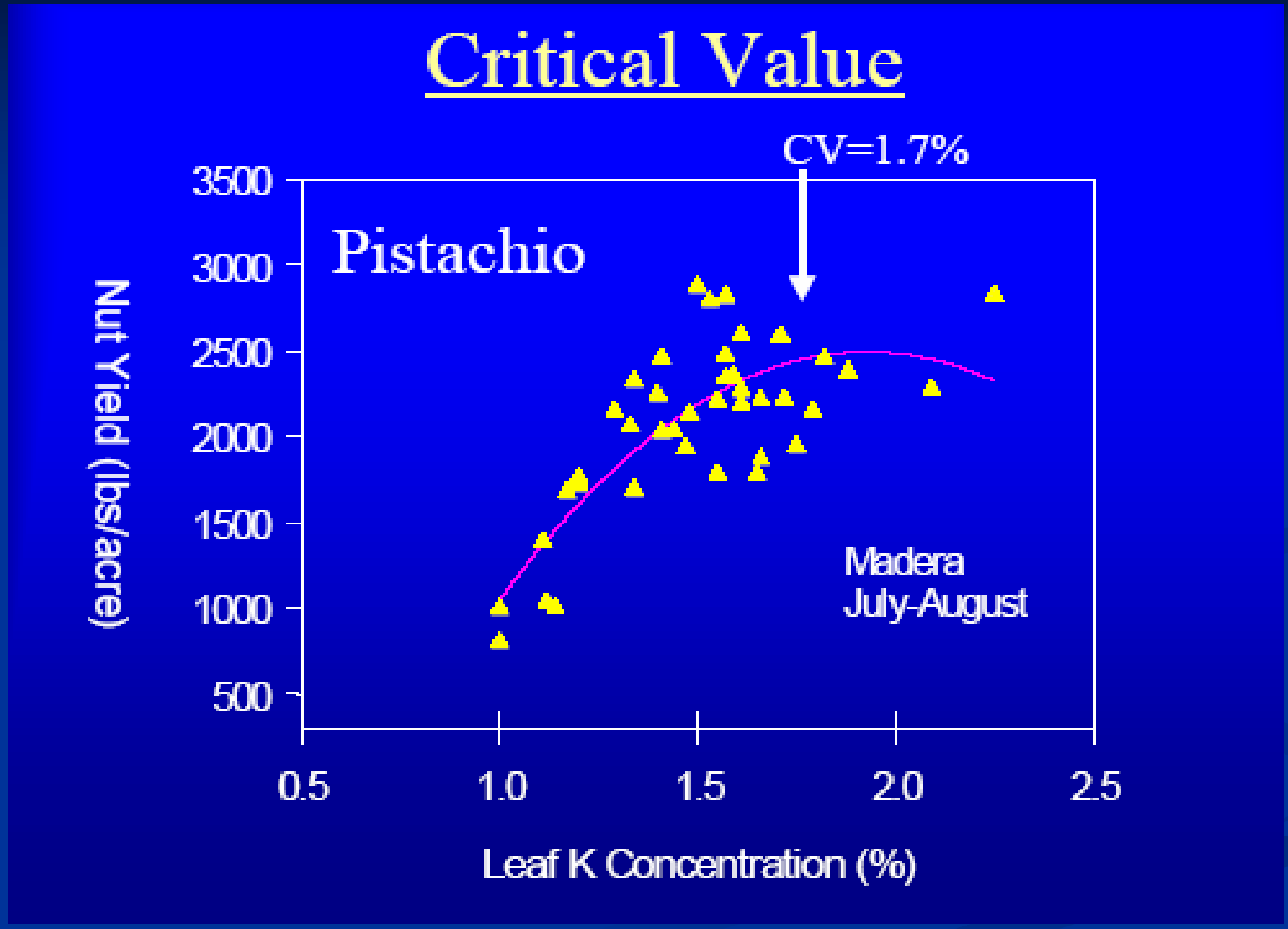
* Choice of Leaf on the Plant
– Choose exposed leaves in Mid-season
– Avoid leaves close to fruit
– Avoid damaged leaves
– Plants that have been sprayed with foliar nutrients cannot be analyzed for that nutrient.
• Choose 6 -10 leaves from 1-2 m above ground around canopy
• Compare analysis with standards (critical levels) developed for almond.

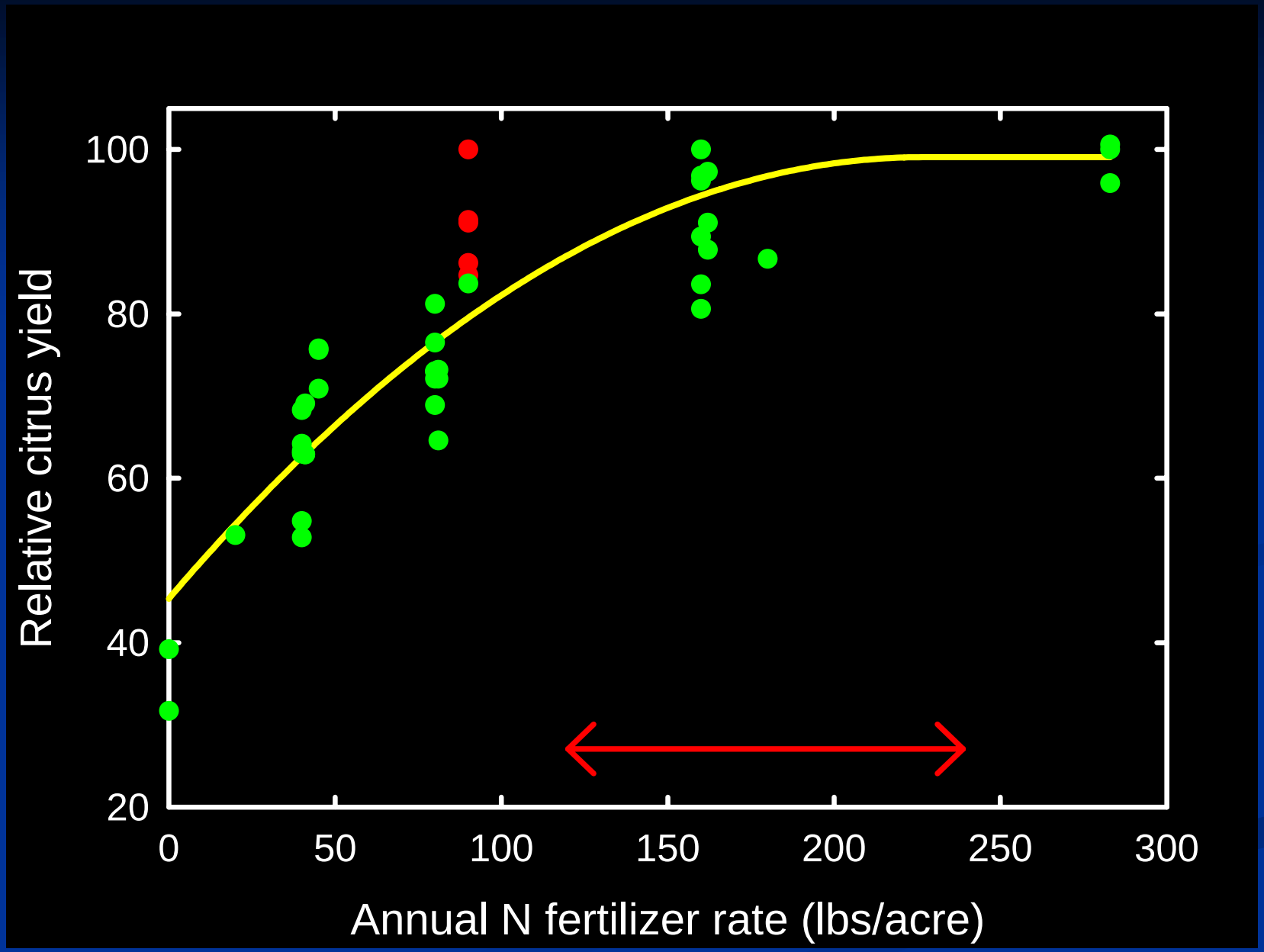
Soil Sampling Purpose

The tissue concentration of an element above which no additional yield can be expected.

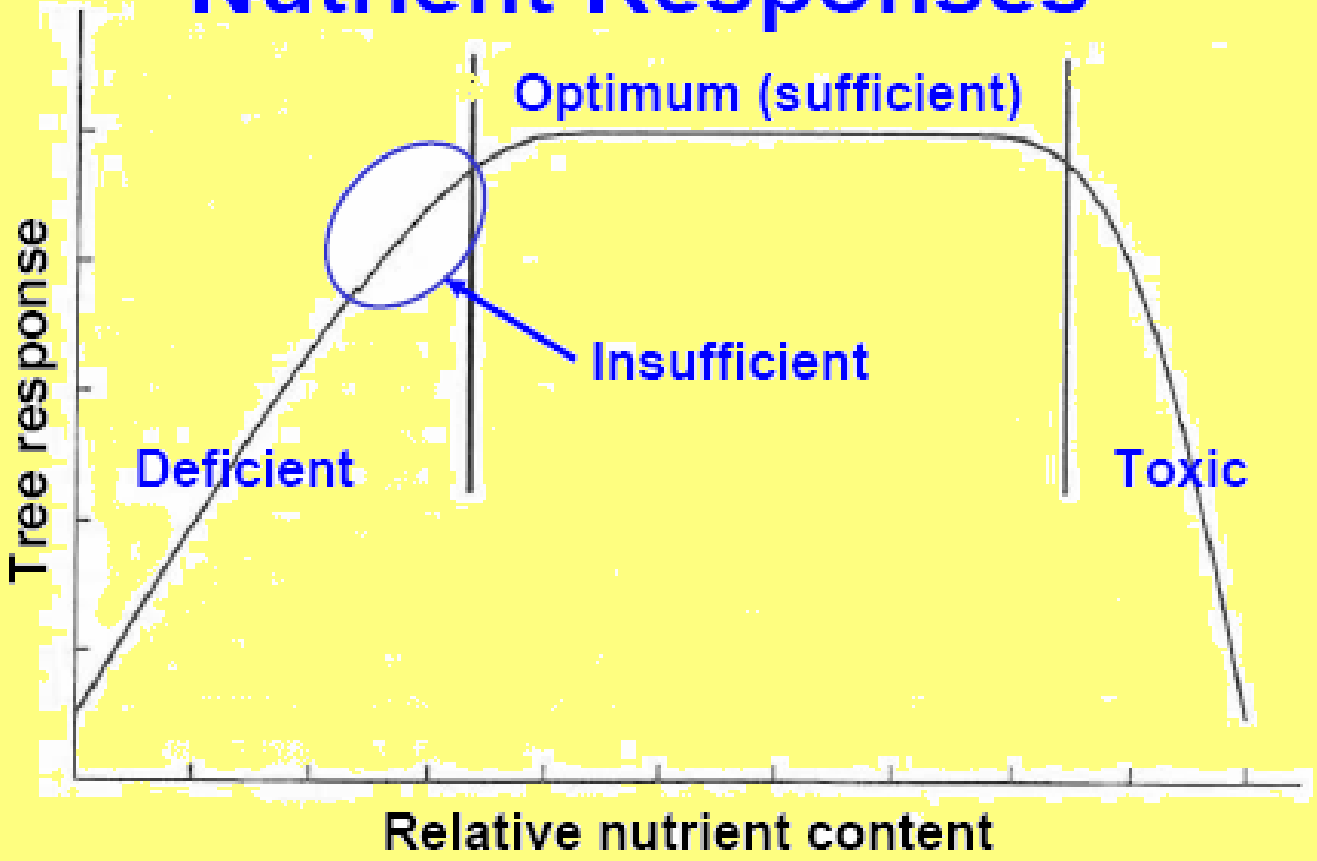
- Recommended Critical Values have been determined for most elements in crops
- These are often crop specific
  - Optimal N in Almond is different than Pear
- Critical Values are relevant for particular stages of growth
  - Optimal K cv in spring is different than the optimal K cv in Summer.

Critical Value




Relative citrus yield
100
80
60
40
20
0
50
100
150
200
250
300
Annual N fertilizer rate (lbs/acre)

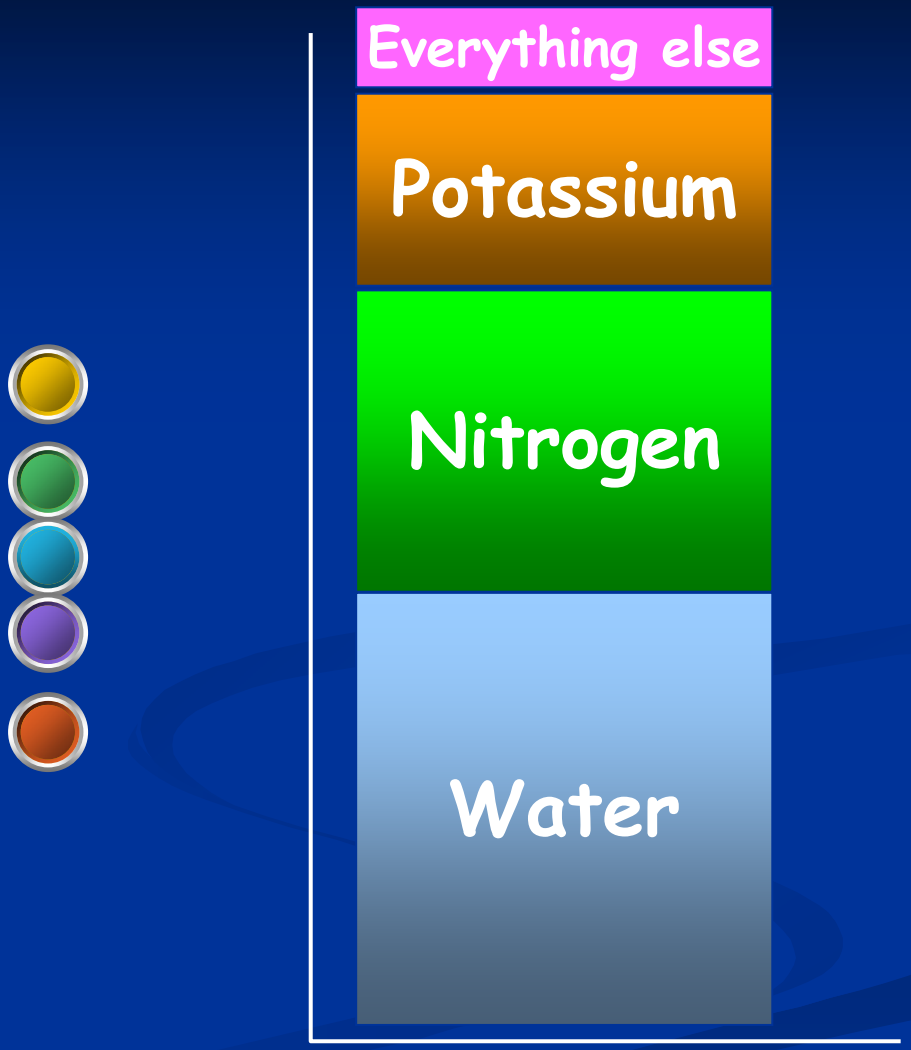
Nutrient Responses



Leaf analysis provides the best available guidelines for managing nutritional programs (Citrus)

Element	Def.	Low	Opt.	High	Excess
% N	<2.2	2.2-2.4	2.5-2.7	2.8-3.0	>3.0
% P	<0.09	0.09-011	0.12-0.16	0.17-0.30	>0.30
% K	<0.7	0.7-1.1	1.2-1.7	1.8-2.4	>2.4
% Ca	<1.5	1.5-2.9	3.0-4.9	5.0-7.0	>7.0
% Mg	<0.20	0.20-0.29	0.30-0.49	0.50-0.70	>0.70
% S	<0.14	0.14-0.19	0.20-0.40	0.41-0.60	>0.60
% Cl	---	---	<0.5	0.50-0.70	>0.70
ppm Mn	<17	18-24	25-100	101-300	>300
ppm Zn	<17	18-24	25-100	101-300	>300
ppm Cu	<3	3-4	5-16	17-20	>20
ppm Fe	<35	35-59	60-120	121-200	>200
ppm B	<20	20-35	36-100	101-200	>200
ppm Mo	<0.05	0.06-0.09	0.10-1.0	2.0-5.0	>5.0

Relative importance of nutritional factors that affect yield of mature citrus trees



Summary

- Analyze soil to determine baseline characters and 'problem' conditions
  – pH, salinity, structural problems, CEC, OM content, existing deficiencies.
- Conduct routine leaf analysis
  – Compare with recommendations
  – Keep good records
- Apply fertilizers to provide missing nutrients and to replace what is used by crop
- Time applications to match uptake by crop
- Consider all yield and quality components

Optimizing Plant Nutrition

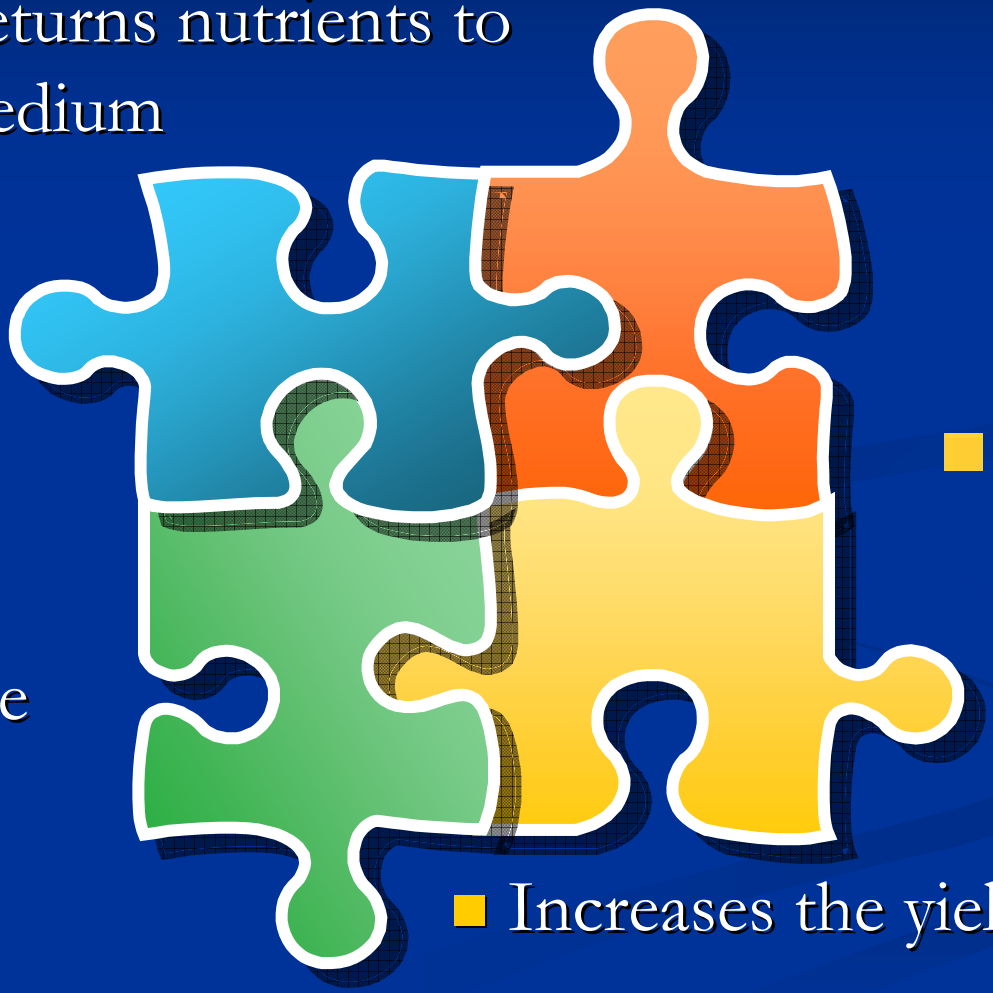
- Conduct Soil Analysis over orchard
  - once in orchard lifetime
  - one sample from each soil type or change in topography
- Replace Nutrients removed in crop
- Always determine the cause of the deficiency BEFORE choosing a fertilizer strategy
- Conduct routine plant analysis
  - yearly or more often
- Maintain records of fertilization strategies, sampling sites and times and nutrient analysis.
  - watch for trends and responses

Fertilization

- What is a fertilizer
  - Fertilizer is a product made of elements that are required or beneficial for plant growth
- Why is it important
  - Plants stay healthy and are maintained in vigorous growing condition
    - Are less susceptible to pests and diseases

Fertilizer Use

- Fertilizer returns nutrients to growing medium



- Adequate levels of nutrients increases the health and quality of plants
- Promotes foliage of fruit crops
- Increases the yield of plant crops

Fertilizer use efficiency (FUE)

Fertilizer use efficiency (FUE) can be defined in two ways. Soil scientists equate FUE with the percentage of the applied nutrients (through fertilizer) utilized by a crop.

Thus,

FUE = Percentage of applied nutrient utilized by the crop

$$= \frac{\text{Amount of fertilizer nutrient removed by the crop}}{\text{Amount of fertilizer nutrient applied}} \times 100$$

A FUE of 100% means the entire amount of fertilizer added to a soil is removed by the crop. This is very unlikely because fertilizer nutrients added to a soil undergo four types of disposal; they are :-

- Removed by the crop;
- Remain in the soil solution but is not removed by the crop;
- Fixed to the soil and not available; and

l Lost through leaching and other forms.

The FUE for nutrients like nitrogen (N) will be limited to one season whereas phosphorus (P), potassium (K) and other nutrients will last for longer periods due to residual effects. The FUE for N is generally less than 50% while for P and K the values are often less than 15-20% for a growing season of a crop. The residual effects of P and K will last for a longer period and FUE for P and K at later stages may be as low as 2-3%.

From an agronomic point of view, FUE is defined as the amount of produce per unit of applied nutrient. i.e.

$$FUE = \frac{YF - YO}{N}$$

Where:-

YF = yield of the fertilized treatment;

YO = yield of the unfertilized control; and

N = amount of applied nutrient.


Any Question?

Thank You !

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