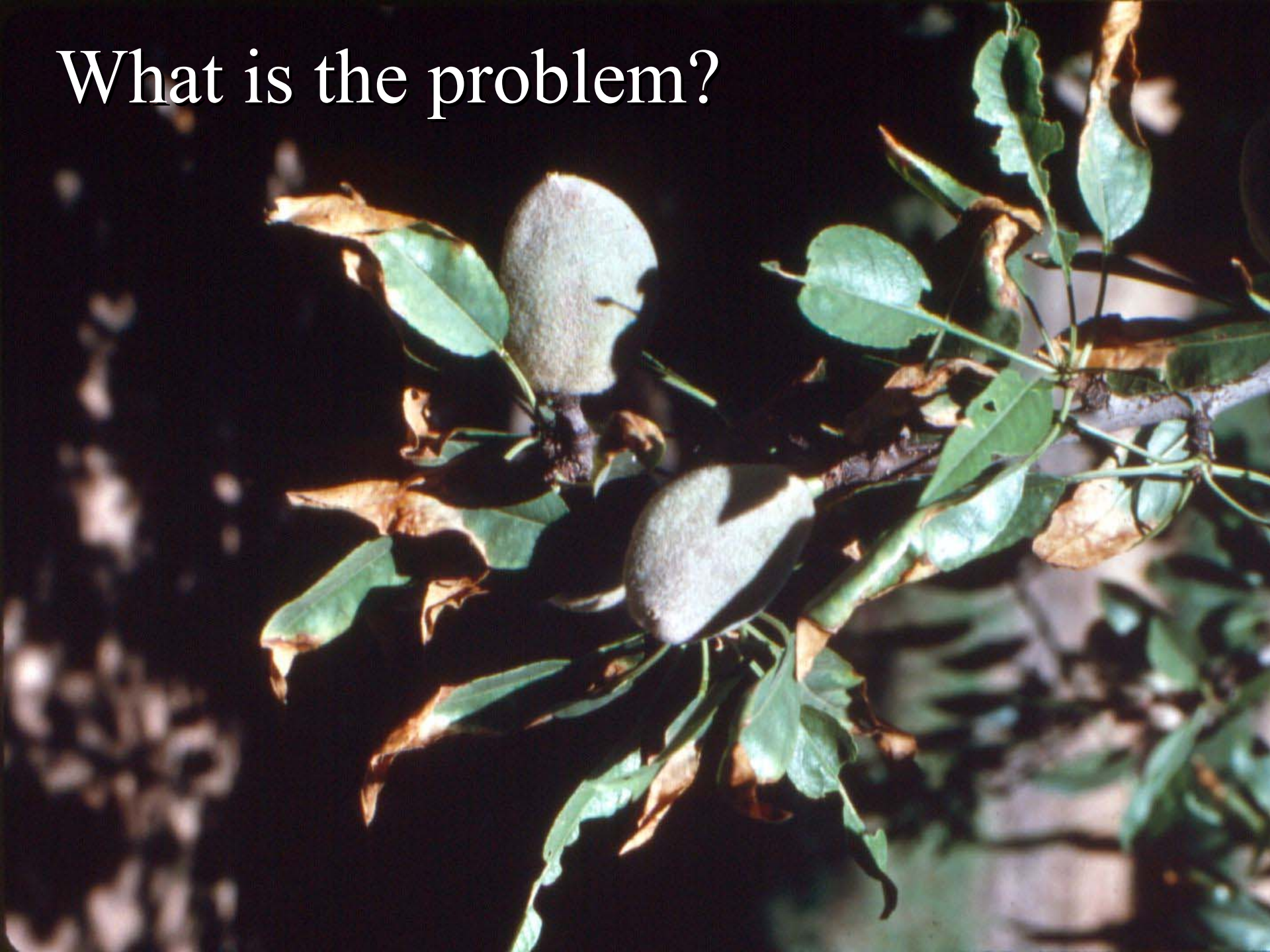
Nutrition of Fruit Trees

Patrick Brown

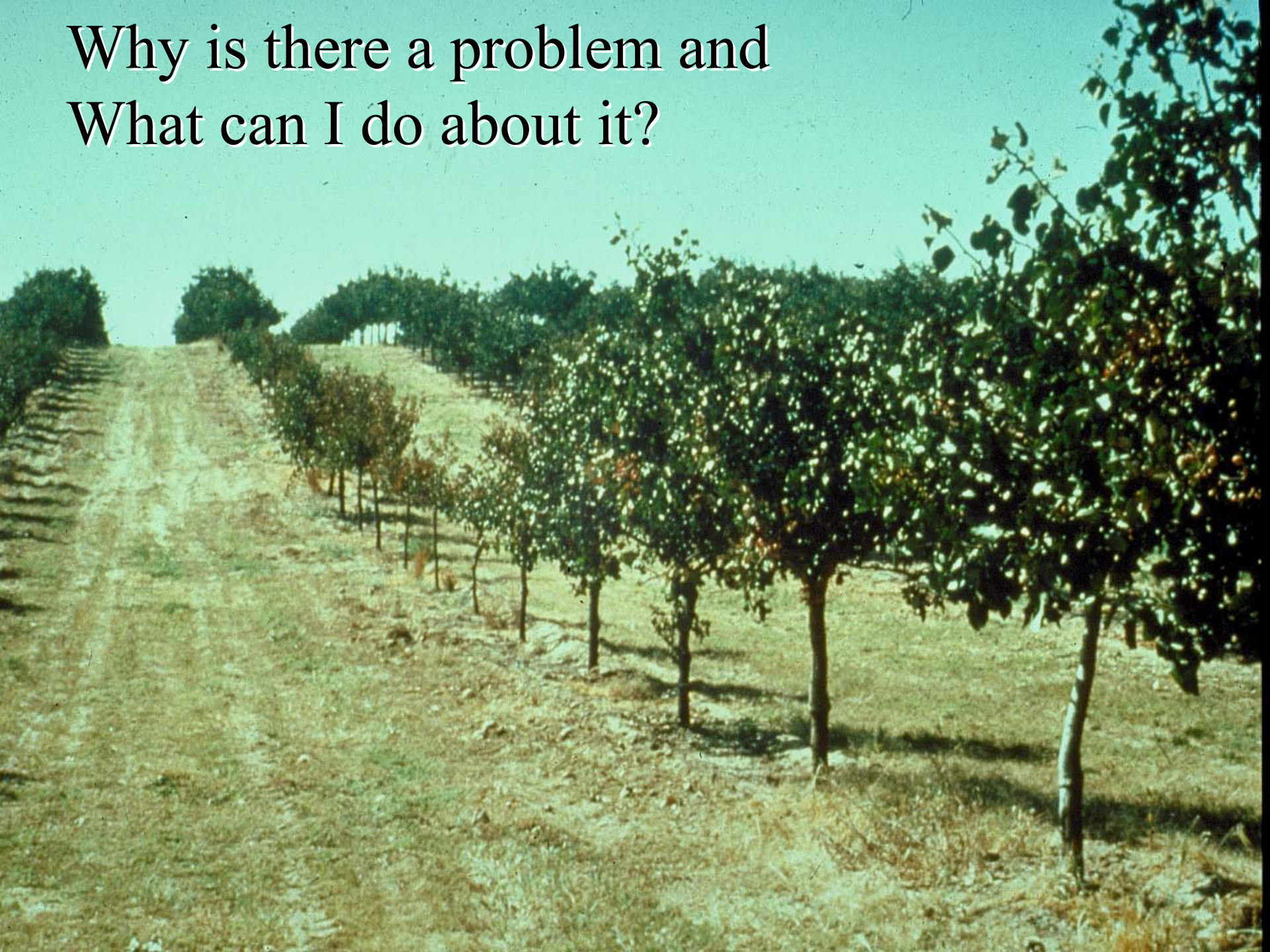
Pomology Department

University of California-Davis

What is the problem?



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



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 ‘pool’ and,
  - The ‘solubility’ of nutrients in the pool (pH)
- Roots are alive and nutrients are not uniformly distributed
  - Soils must allow root penetration, provide adequate water and oxygen for root growth.

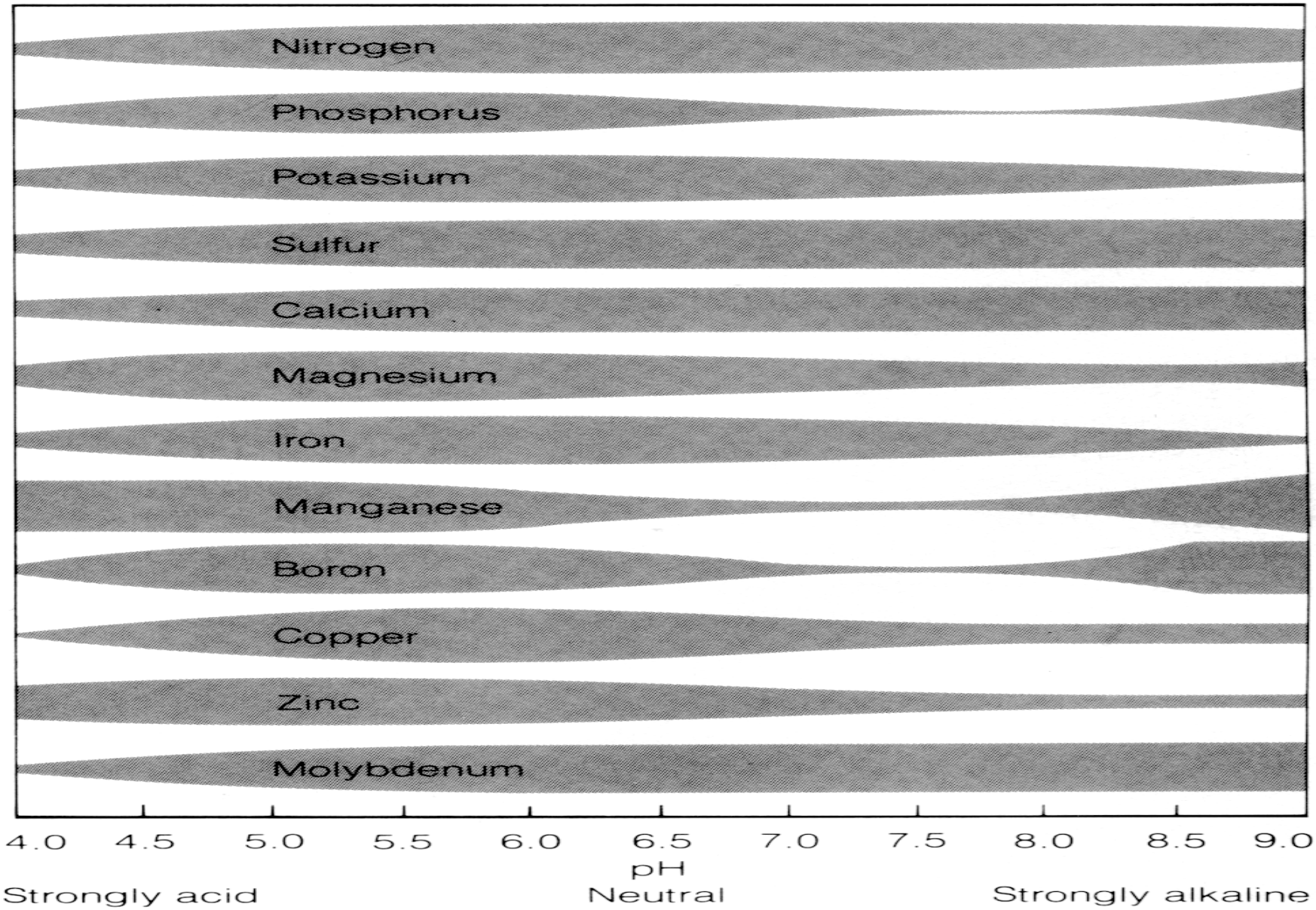


FIGURE 5.6. Influence of soil pH on the availability of nutrient elements in organic soils. The width of the shaded areas indicates the degree of nutrient availability to the plant root. (From Lucas and Davis, 1961.)

Soil Sampling

Purpose:

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

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

Sampling Strategy

Methodology:

-Samples should be collected from soil within the root zone of the plant.

-Samples should be taken across the field in a regular pattern. More variable fields, i.e. with several soil types will require more detailed sampling

-Samples from good and bad areas can help identify problems.

-Make note of depressions, hardpans, cuts and fills 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 depressions, hardpans, cuts and fills.

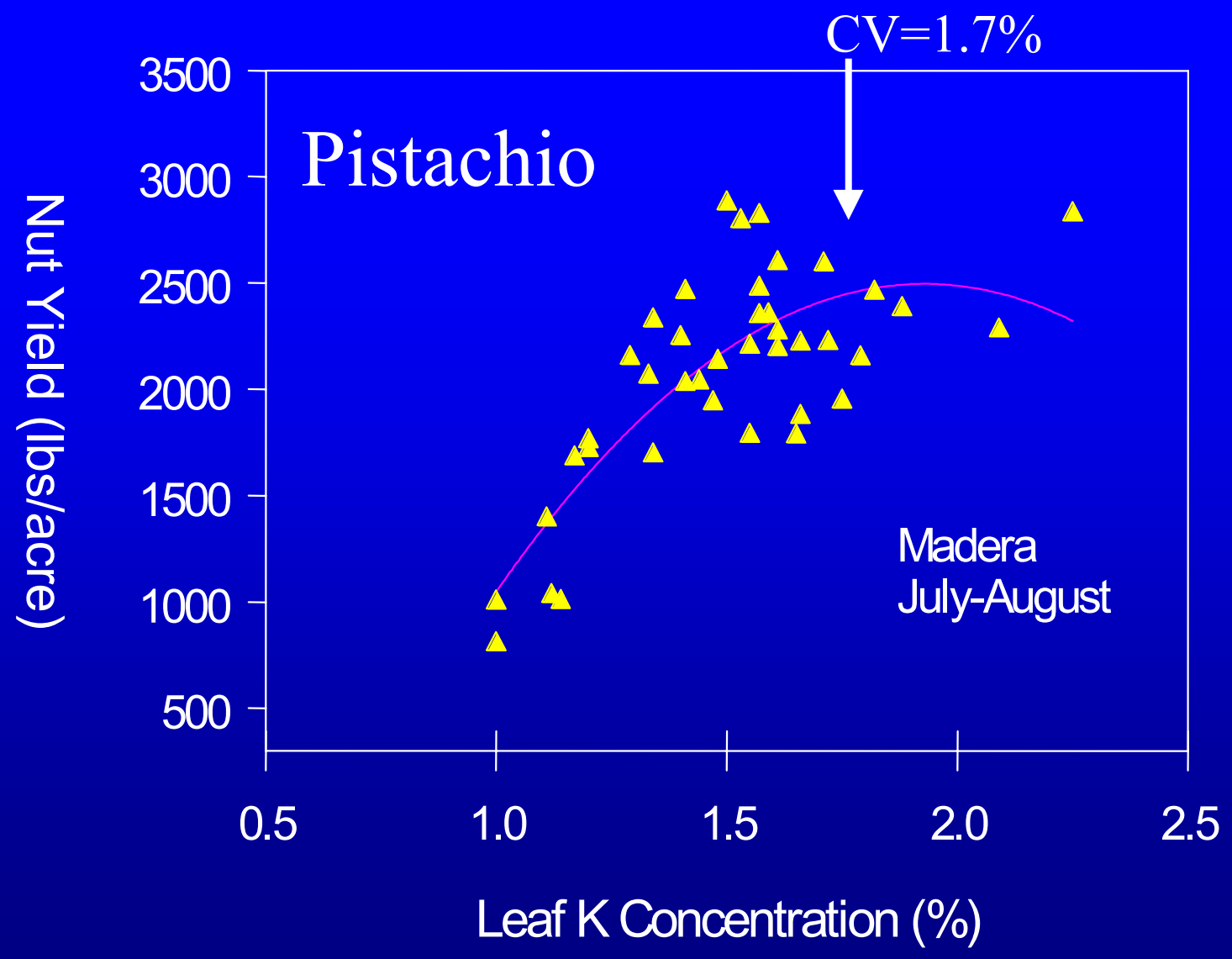
-Make note of changes in soil type, drainage etc that may help determine cause of deficiency.

-Keep records of year-year patterns

Methods of Plant Sampling and Analysis

- Choice of Leaf on the Plant
  - Choose exposed leaves in July
  - 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 6-8 ft above ground around canopy
- Compare analysis with standards (critical levels) developed for almond.

Critical Value



Critical Values

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 only
  - Optimal K cv in spring is different than the optimal K cv in Summer.

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

Major Nutritional Problems in Almond

- NITROGEN
- POTASSIUM
- BORON
- ZINC

OTHER NUTRITIONAL PROBLEMS

- COPPER
- MANGANESE
- MAGNESIUM
- IRON

BORON DEFICIENCY

- FOLIAR SYMPTOMS OF B DEFICIENCY ARE VERY RARE
  - Sometimes occur in sandy soils with high quality irrigation water
- Effects of B deficiency on fruit set are more common
  - Common in sandy soils using high quality irrigation water
  - Possible in all areas due to high B demand of almond hulls
  - lack of fruit may result in a high vigor tree (bull like)
- Flowers and Fruit Set have a higher demand for B than leaf growth does.

Boron deficiency in Mono Almond

Diagnosis of B Nutrient Status

- In almond
  - leaf analysis is only useful in determining if the tree is moderately-very B deficient
  - leaf analysis will not predict optimum yield or B toxicity
  - Hull analysis can detect deficiency, adequacy or toxicity
- Hull Samples can be collected any time after hull split following the same general procedure as leaf sampling

Correction of B Deficiency

- If leaf B is < 30 ppm (Hull 30-70ppm) apply:
  - soil B (2 oz Solubor/tree) and foliar B
- If HULL B is 70-150 ppm:
  - Foliar sprays of B at 0.2-0.4 lbs B* / 100 gallons are most effective
  - Sprays should be applied after fruit maturation while leaves are still active
  - Sprays at bud-swell are also effective
- If HULL B is >150 ppm:
  - do not apply B
  - remove hulls from orchard

***Equivalent to 1-2 lbs Solubor™ / 100 gallons**

Boron Toxicity

- No leaf symptoms.
- Brown-black necrotic lesions on bark.
- Tip die-back
- Gumming on fruits and bark
- Difficulty in shaking nuts.
- Peach rootstocks are more sensitive than almond or hybrid.

Boron Toxicity

Zinc Deficiency in Almond

- ‘Little leaf’ and rosetting
- Leaf yellowing and coloration
- Dormant ‘blind’ buds.
- Delayed bud burst.

- Occurs in sandy and high pH soils.
- May also occur where organic manures have been used excessively.

Zinc Deficiency in Pistachio

- ‘Little leaf’ and rosetting
- Leaf yellowing and coloration
- Dormant ‘blind’ buds.
- Delayed bud burst.

Zinc Fertilization

Knowledge of your soil pH and Ca content is critical

- High pH / high lime soils will make fertilizer Zn unavailable
  - apply large amounts of Zn in concentrated applications: Either..
    - 5-10 lb Zn-Sulphate per tree (plus 5 lb sulphur)
    - 5-10 gallons Zn-Sulphate per tree injected into root zone
    - 1-5 lbs Zn-Chelate
  - apply foliar Zn (see later)
  - inject Zn through irrigation system

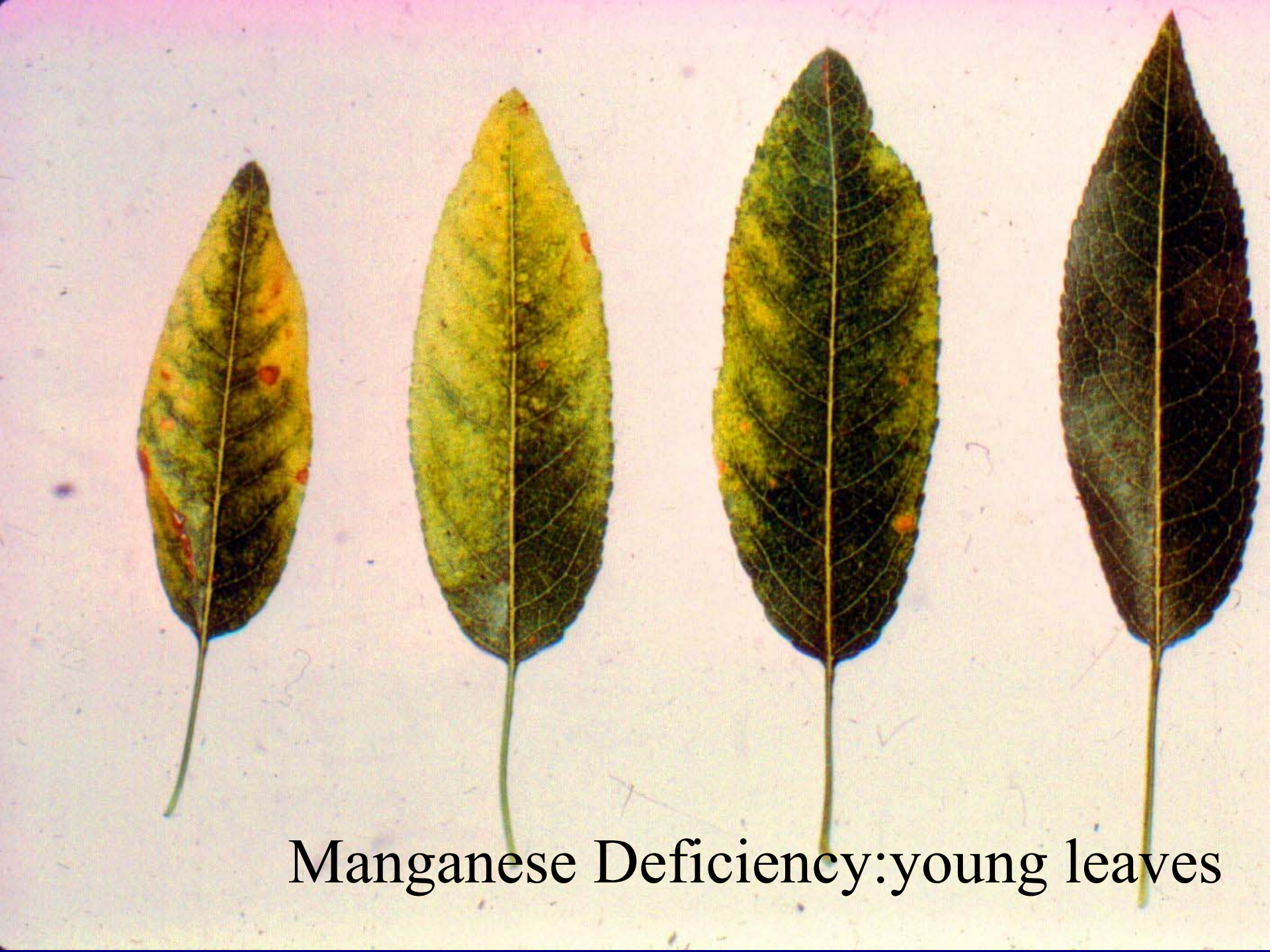
Zinc Fertilization

- Sandy Soils
  - reduced application rates at more frequent intervals
  - injection into irrigation
    - 5-10 gallons Zn-Sulphate injected into root zone
    - 1-5 lbs Zn-Chelate
  - foliar Zn
  - inject Zn through irrigation system

Foliar Zinc Application

Foliar Zn applications appear to be the most effective approach to Zn correction.

- Dormant sprays of Zn-Sulphate 10-15 lbs/100 gallons
- Early spring sprays (50-70% leaf expansion) of Zn-EDTA at 2 lb /100 gallons or Zn-Sulphate at 0.5 lb/100 gallons (beware of leaf burn)
- Late spring/summer sprays basic Zn-sulphate 5 lbs/100 gallons or 2 lb Zn-EDTA/100 gallons
- Post harvest spray Zn-Sulphate at 10 lbs/100 gallons or 30 lb/acre concentrate
  - effective but inefficient use of Zn. More research is needed to optimize.



Manganese Deficiency:young leaves

Magnesium Deficiency (older leaves)

Iron Deficiency

Chlorotic leaves varying from markedly interveinal to allmost white.

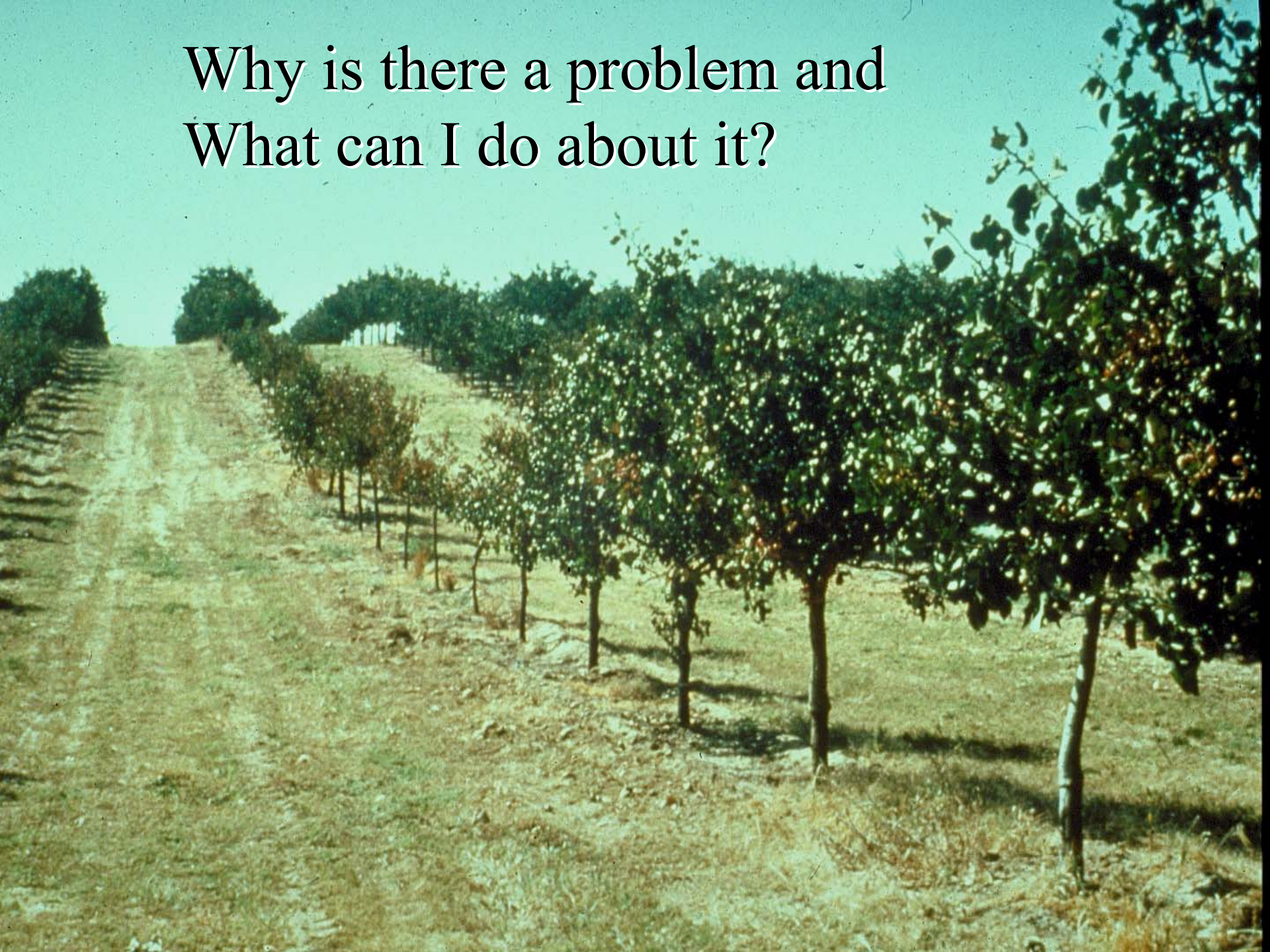
Chloride (salt) Toxicity

Separating Nutrient Deficiencies from Disease, Spray Drift etc.

In general if a plant is suffering from growth reduction due to nutrient deficiency the following patterns will be observed

- Leaves of similar age will express similar symptoms
- A gradation in symptoms will exist
- Symptoms may be present in localized areas that correspond to changes in soil type, drainage or topography (this may also occur with root diseases.)

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

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