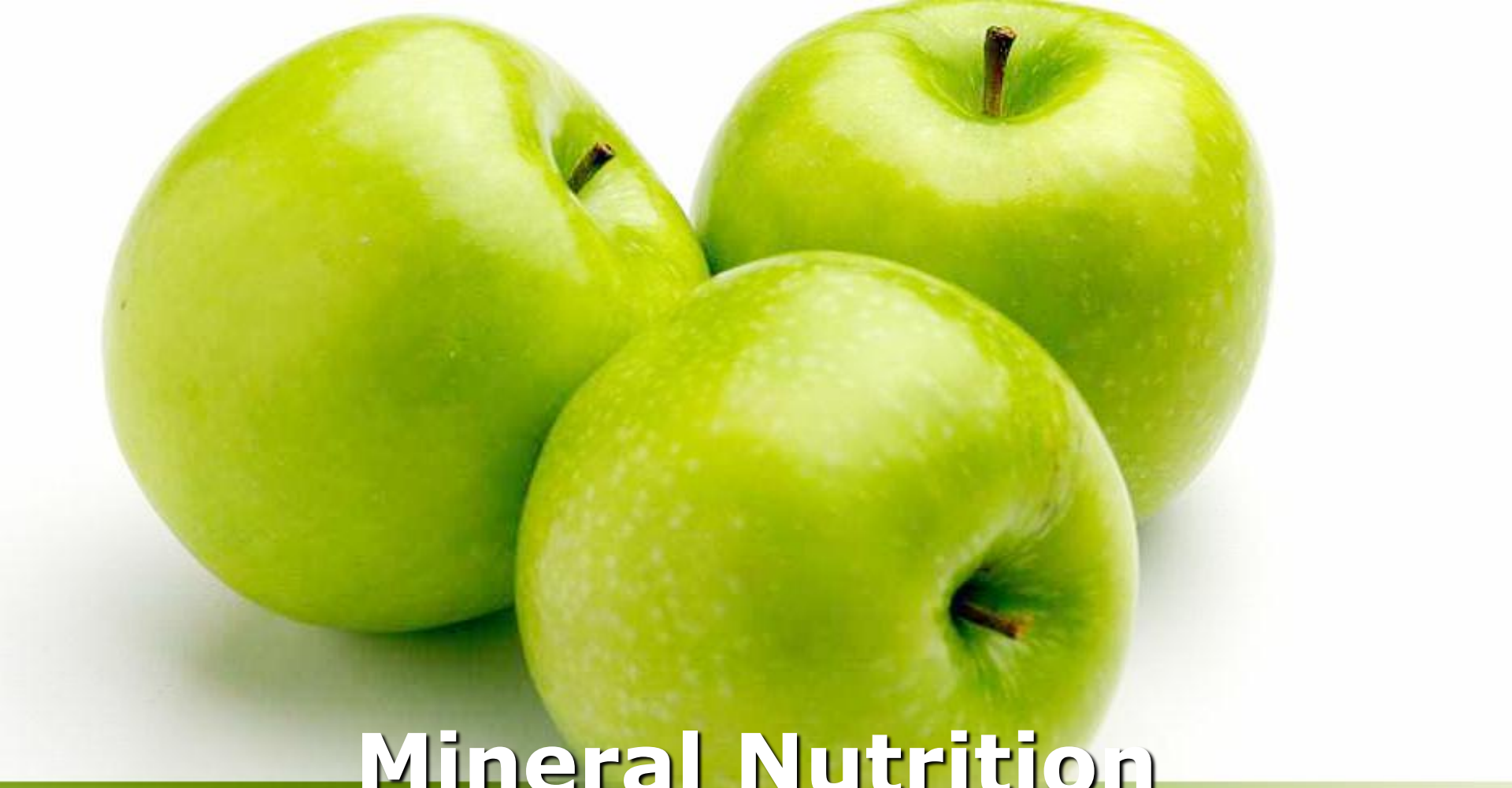


Mineral Nutrition & Management

Dr. Richard Rosecrance

California State University, Chico

Topics to Be Covered

Read Chapter 3 Soil & Fertilizer Mgt

1. Hardpan and compacted soil
2. Essential nutrients
3. Calculating Fertilizer Amounts
4. Nutrient Deficiencies

2 Nutrient Management Module No. 2

CCA
1.5 NM
CEU

Plant Nutrition and Soil Fertility

by Clain Jones and Jeff Jacobsen

Introduction

This module is the second in a series of Extension materials designed to provide pertinent information on a variety of nutrient

Nutrient Ma

a self-study course from the MSU Exten

How do nutrients get to the plant roots?

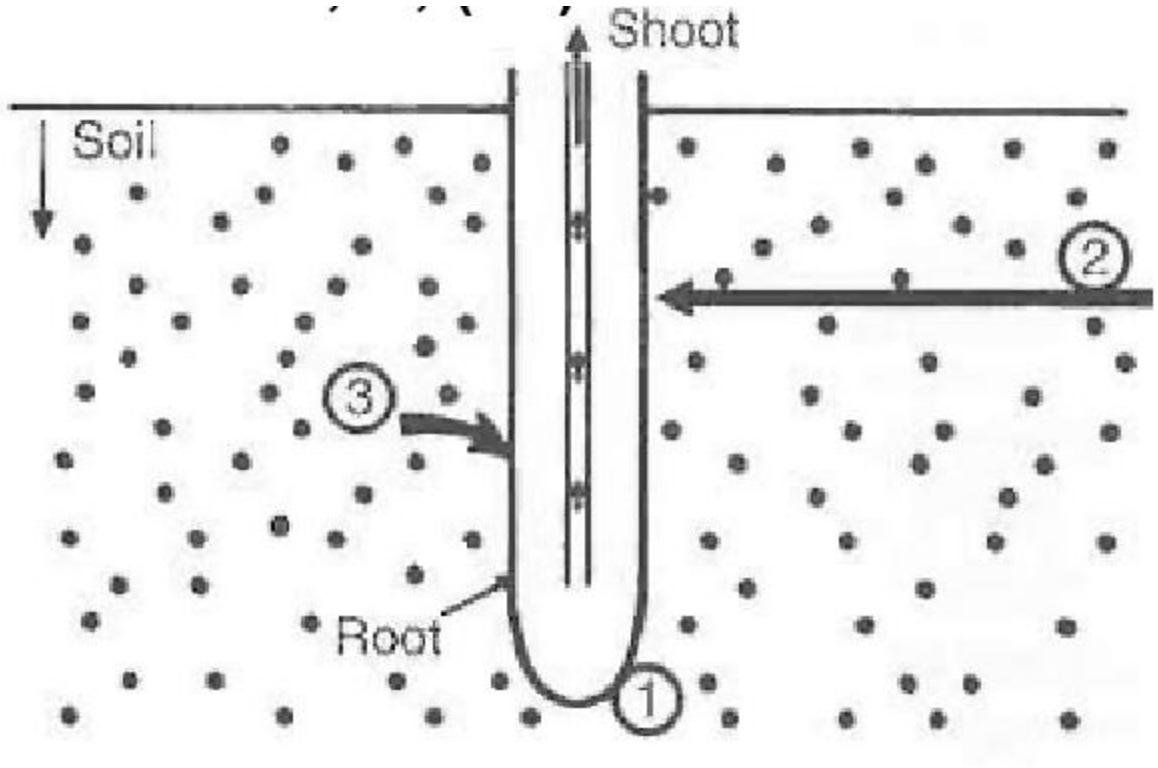
1.

2.

3.

Nutrient Pathways to Roots

1. **Root interception: Ca, (Zn)**
2. **Mass flow of water: N, Ca, Mg, S, B, (K), (Zn)**
3. **Diffusion: P, K, (Zn)**



When is the best time to apply nitrogen?

33% 1) 1.

33% 2) 2.

33% 3) 3.

0% 4) 4.

Nutrient elements that are relatively immobile in the soil, but mobile (translocated) in plants include

33%	✓ a.	P and K.
67%	b.	N, P, K and S.
0%	c.	Cl, B, and S.
0%	d.	N, P, K and B.

If you applied ammonium nitrate fertilizer to a soil, subsequent rainfall would be expected to:

1. leach the nitrate (NO_3^-) but not the ammonium (NH_4^+)
2. leach the ammonium (NH_4^+) but not the nitrate (NO_3^-)
3. leach both the ammonium (NH_4^+) and the nitrate (NO_3^-)
4. leach neither the ammonium (NH_4^+) or the nitrate (NO_3^-)

Hardpans – formed by cemented silica

Cemented Hardpan

- Primary cementing agent
  - In our area – silica
  - In Southwest: (caliche) – carbonates
- Sand, silt, & clay grains are cemented together into a hard, impermeable layer of varying thickness
- Not always continuous across the


Soil Compaction

Effects of Compaction on Soil

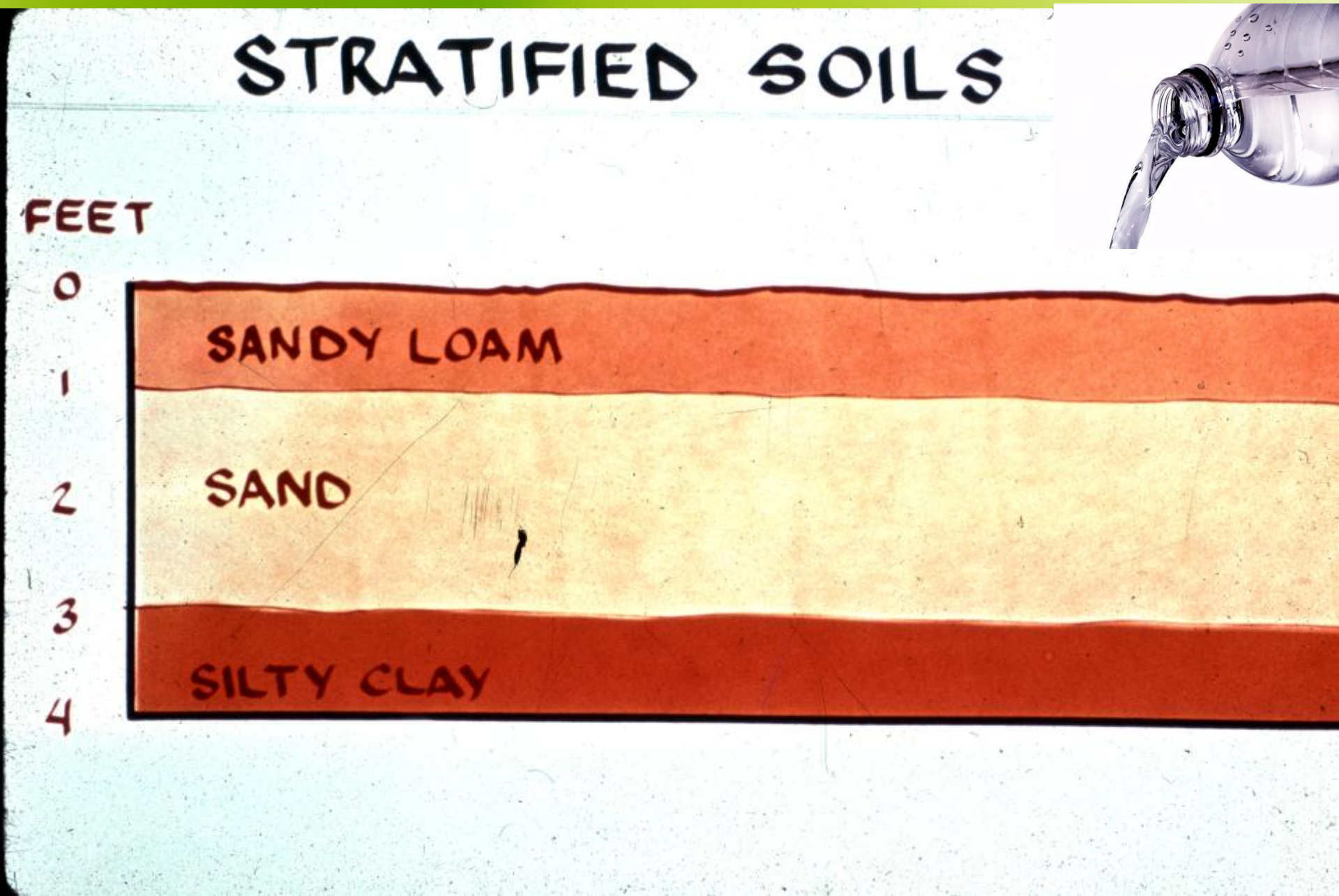
Soil structure is destroyed – pore space is severely reduced

Soil drains slowly and is prone to being anaerobic

Compacted soil physically impedes root growth


CAT
TENCO

What happen when you add water to stratified soils?

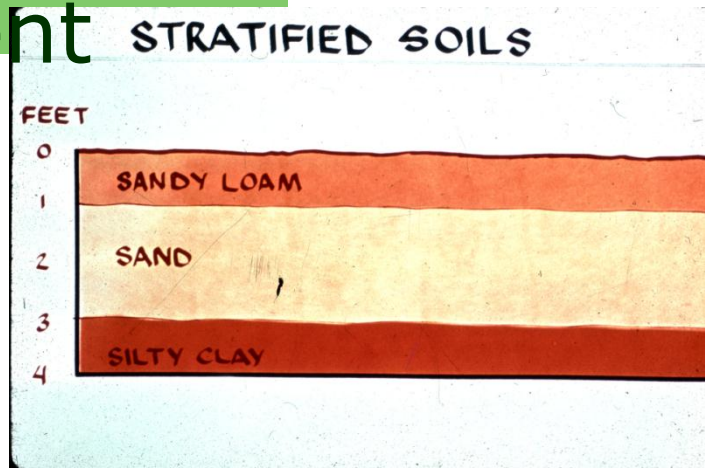


What happen when you add water to stratified soils?

33% ✓ 1. Water will be impeded by sand layer

33% 2. Water will increase in velocity once it hits the sand layer

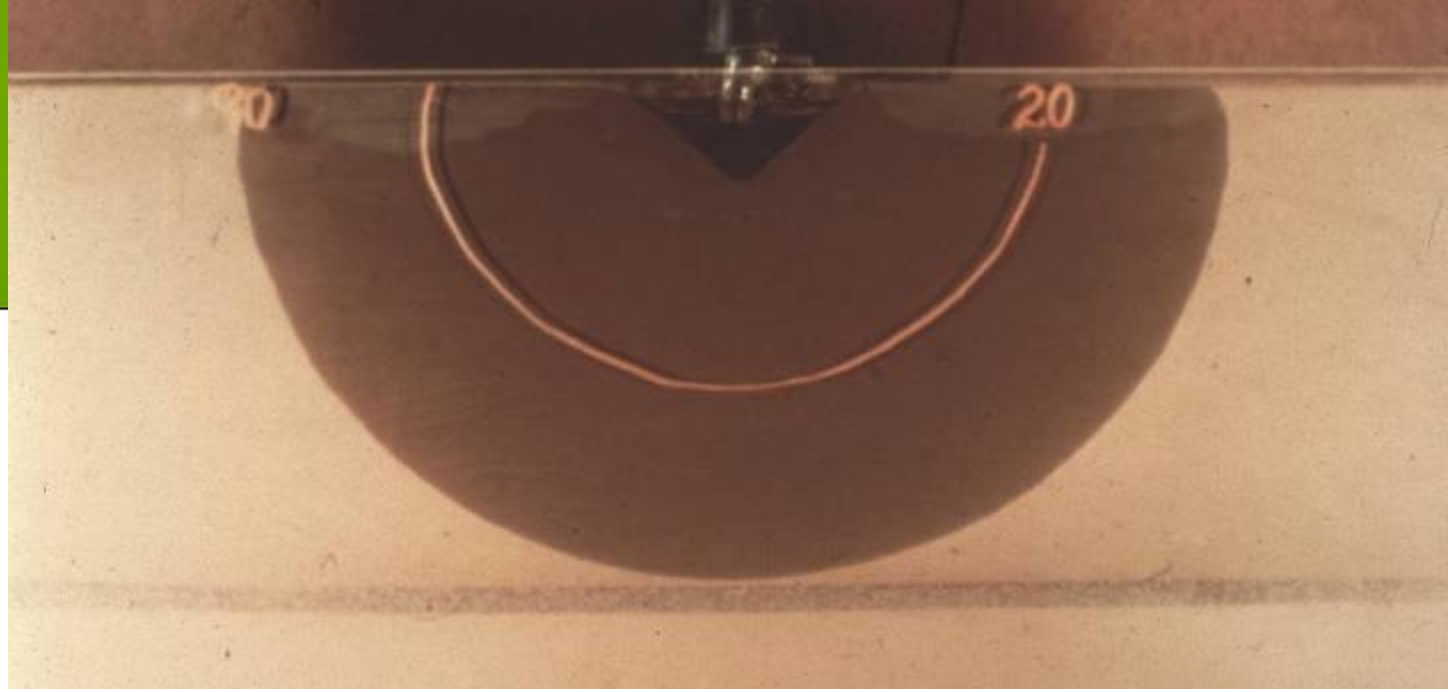
33% Sand layer will have no effect on water movement



Stratified Layer

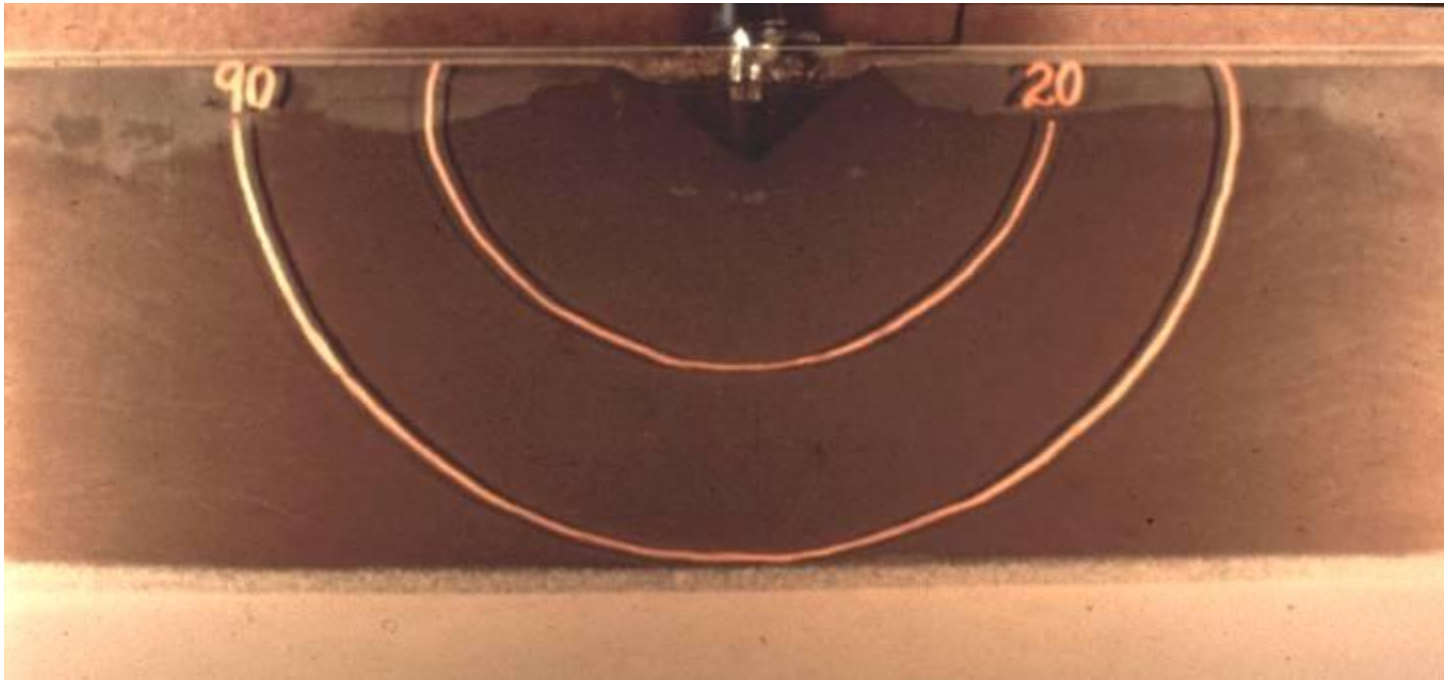
Loam →

Sand →



Loam →

Sand →



Soil Stratification

Effects of Poorly Drained Soil

Effects Of Soil Compaction

normal

compacted

- soil structure altered
- impaired root growth and function
- reduced tree growth, dieback, death

Waterlogging-Induced Chlorosis

Serious Compaction or Overwatering!

Deep soil improves drought tolerance and anchorage

Compacting the Planting Site

What is a Gardener to Do?

The Main Goal

Create & maintain soil conditions most favorable for root growth and water movement

Drainage systems may be needed, but are costly.

Ripper

(maybe a little big for landscapes)

Mix the Soil

Plow

Backhoe

Drill or Trench Soil

Backhoe or Excavate

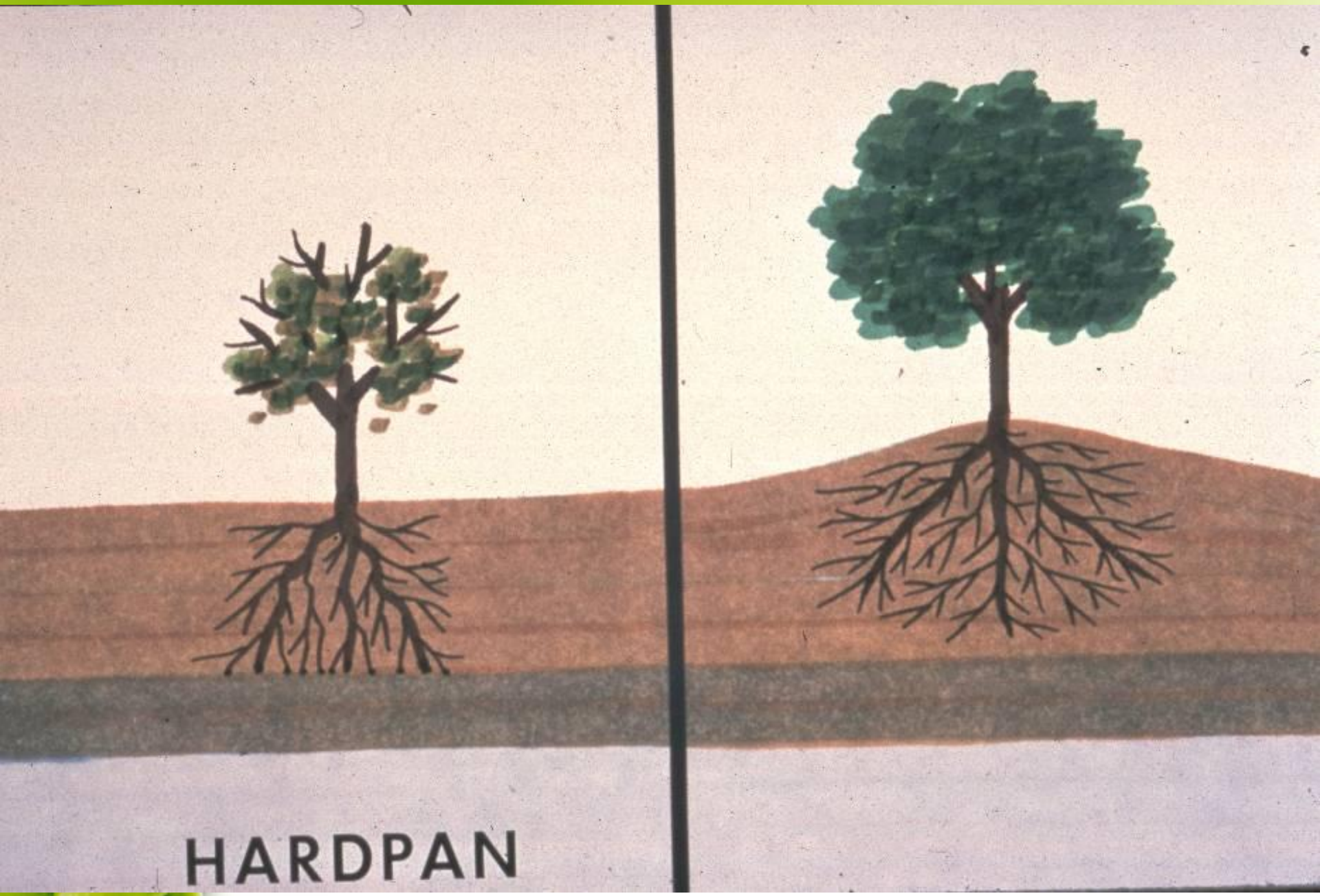
Jackhammer with clay spade attachment

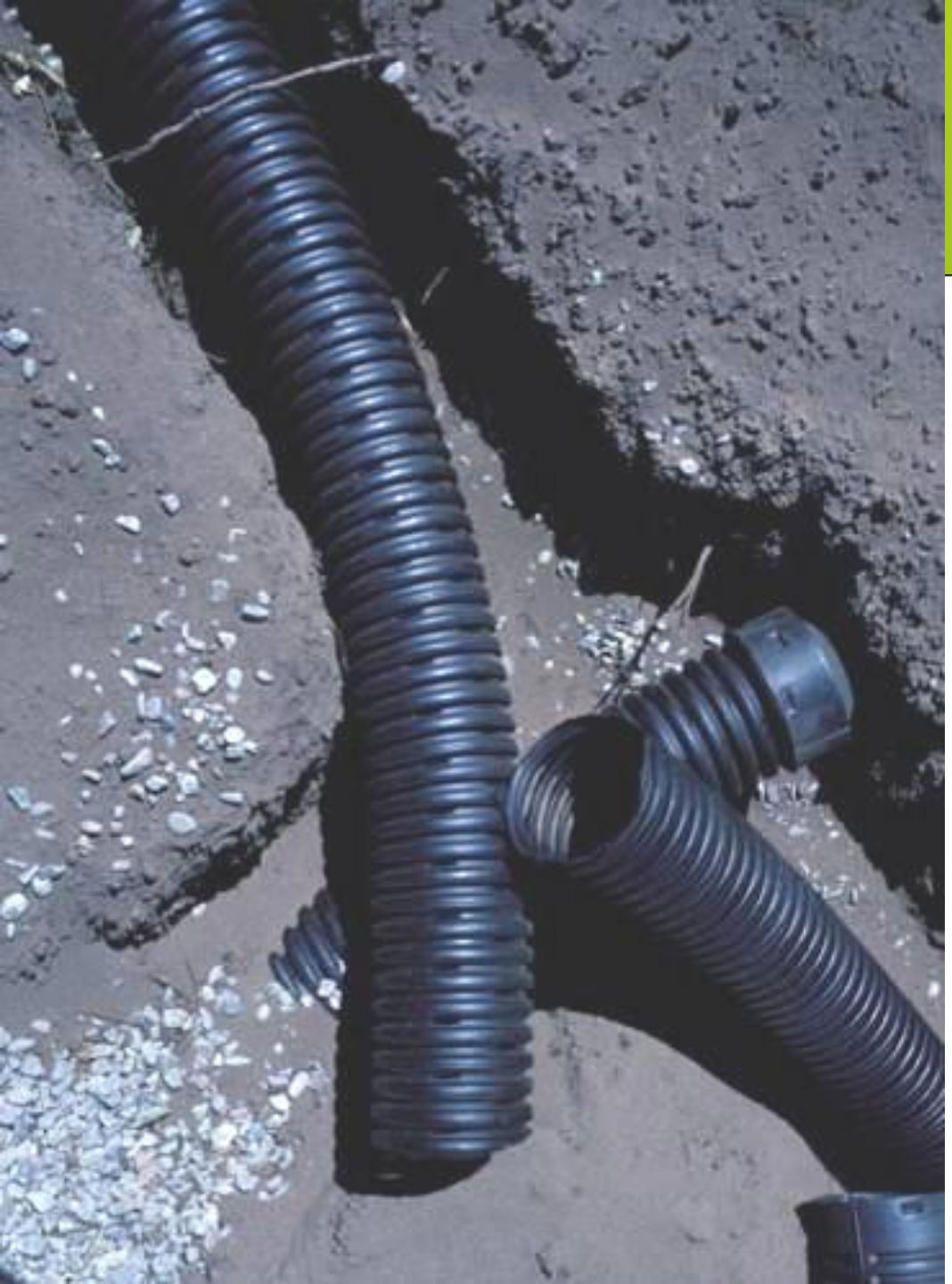
Pickaxe

Then add compost…

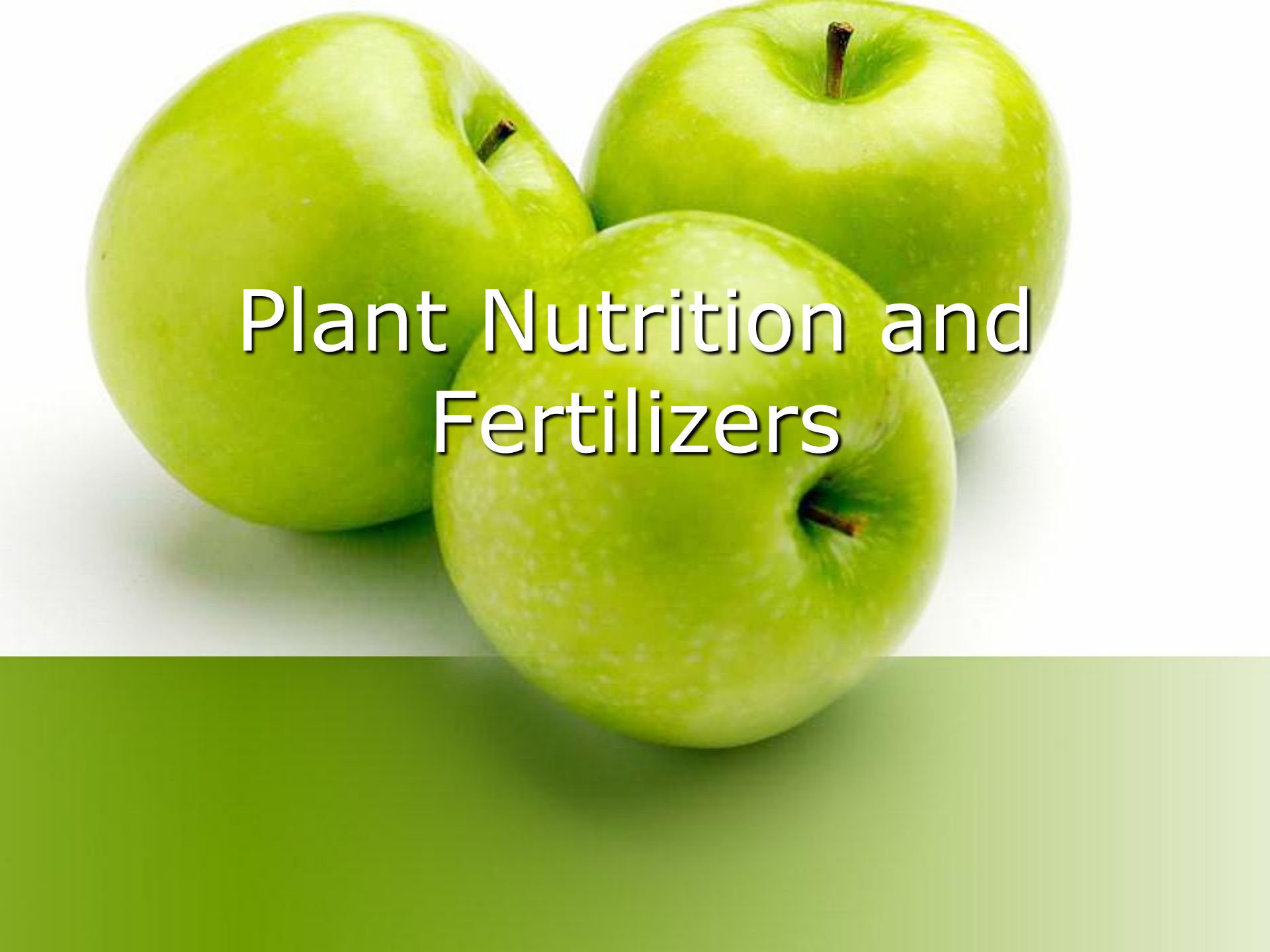
Use Raised Beds…

…Or Raised Planters


HARDPAN



Use subsurface drainage, but…

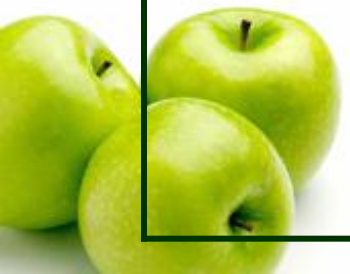


Plant Nutrition and Fertilizers

High pH leads to micronutrient deficiency in sensitive species

Essential Plant Nutrients

Major Nutrients from Air & Water	Major Nutrients from Soil	Minor Nutrients from Soil
Carbon	**Nitrogen**	Iron
Hydrogen	**Phosphorus**	Zinc
Oxygen	**Potassium**	Manganese
	Sulfur	Copper
	Magnesium	Chlorine
		Boron
		Molybdenum



Roles of Nitrogen

- Forms amino acids in plant
  - Building blocks for proteins
  - Essential for cell ÷& plant growth
- Necessary for enzyme reactions
- Constituent of chlorophyll (photosynthesis)

Roles of Phosphorus

- Plays role in photosynthesis, respiration, energy storage & transfer, cell division & enlargement
- Promotes seedling root formation & growth
- Contributes to disease resistance

Roles of Potassium

- Photosynthesis
- protein synthesis
- Regulates transpiration

Tree Research Has Shown:

- Majority of feeder roots in top 12 "
- Growth rate increase from N fert.
  - No effect on structural integrity
  - No effect on relationship of height, crown spread, & trunk diameter
- Fertilizing most ornamental trees with nitrogen has little benefit!

PUBLICATION 8046

Planting Landscape Trees

GARY W. HICKMAN, County Director/Horticulture Advisor, University of California Cooperative Extension, Mariposa County; **PAVEL SVIHRA,** Horticulture Advisor, University of California Cooperative Extension, Marin and Sonoma Counties

UNIVERSITY OF CALIFORNIA
Agriculture

The performance of a landscape tree depends a great deal on how it is planted. Survival after initial transplanting, rate of growth and establishment, root development, and many other factors can be improved by proper planting techniques. Topics to consider when planting include the size and shape of the planting hole, whether to add soil amendments or fertilizer, pruning, staking, mulching, and watering.

Deficiencies are Rare!

N – Sandy, overwatered, or sub soils

P, K, S – P deficient in foothills

Ca, Mg – Acidic or sandy soils

Fe, Mn, Zn, B – High-pH or waterlogged soils

Nitrogen Loss

Nitrate mobile in soil → leaching

Loss through volatilization

Raking leaves can remove 1-3 lbs. N / 1,000 sq. ft.

Slow Release Nitrogen

- "Organic" fertilizers
  - Synthetic (e.g., UF, MU, IBDU)
  - Natural (e.g., compost, manure, bloodmeal)
- Polymer coated fertilizers
- Longer lasting-- Not readily leached

Polymer Coated Fertilizer

Fertilizer Analysis

N - P - K - S

21 - 0 - 0 - 24

Ammonium Sulfate

Calculating Fertilizer Amounts

Fertilizer content: 24 – 4 – 12 (N – P – K)

If you want: 2 lbs. N / 1,000 sq. ft.

2 / 0.24 = 8.3 lbs. fertilizer / 1,000 sq. ft.

How much P does this apply?

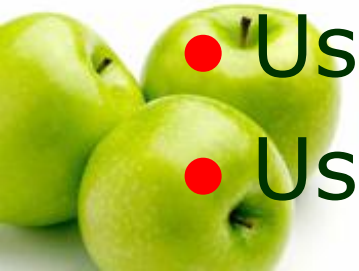
8.3 lbs. fertilizer x 0.04 = 0.33 lb. P

Excess N Fertilizer Application

- Kills roots, can cause salt damage
- Wastes nutrients, pollutes
- Excess vegetative growth
- Increased pest problems
  - Spider mites, sucking insects
  - Diseases (fire blight), pine pitch canker

Tree Fertilization
Points to Remember

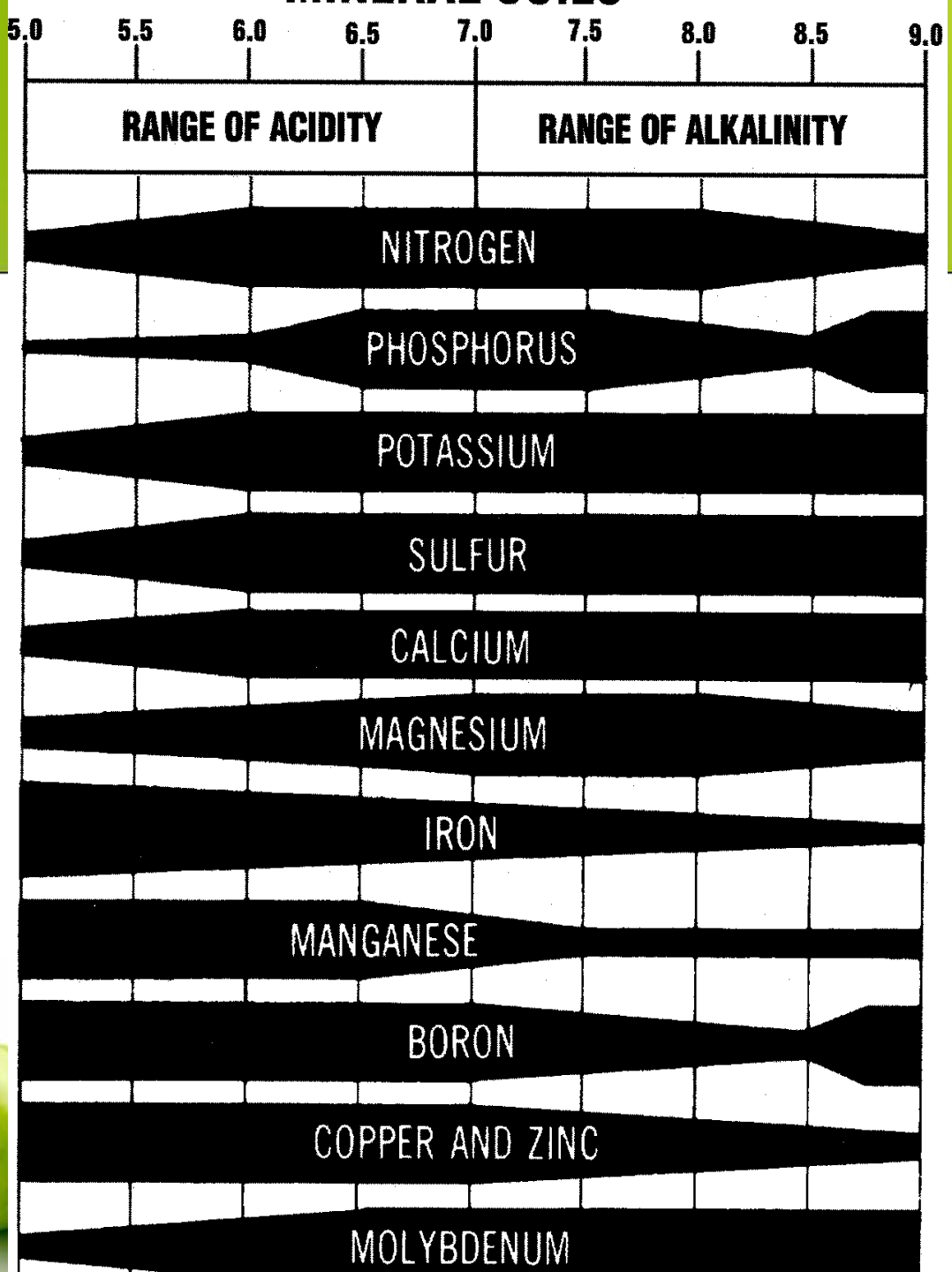
- Trees adapted to low soil N levels!
- Routine N-P-K fertilization unjustified unless deficiency exists
- High N wasteful, polluting, and may increase pest problems
- Trees in turf may not require fertilization
- Use compost, wood chip mulch
- Use slow release fertilizers



Typical Nutrient Content of Animal Manures

	% Dry Weight Basis		
Manure	N	P	K
Chicken, fresh	5.1	2.0	1.8
Chicken, partially composted	2.9	3.3	3.3
Cattle	2.5	0.4	0.7
Horse	1.8	0.5	1.2

pH and Nutrient Availability



Materials for Changing pH

Raising pH

- Limestone
- Hydrated lime
- Oyster shell lime
- Dolomite
- Wood ash

Lowering pH

- Soil sulfur
- Ammonium-based
- fertilizers

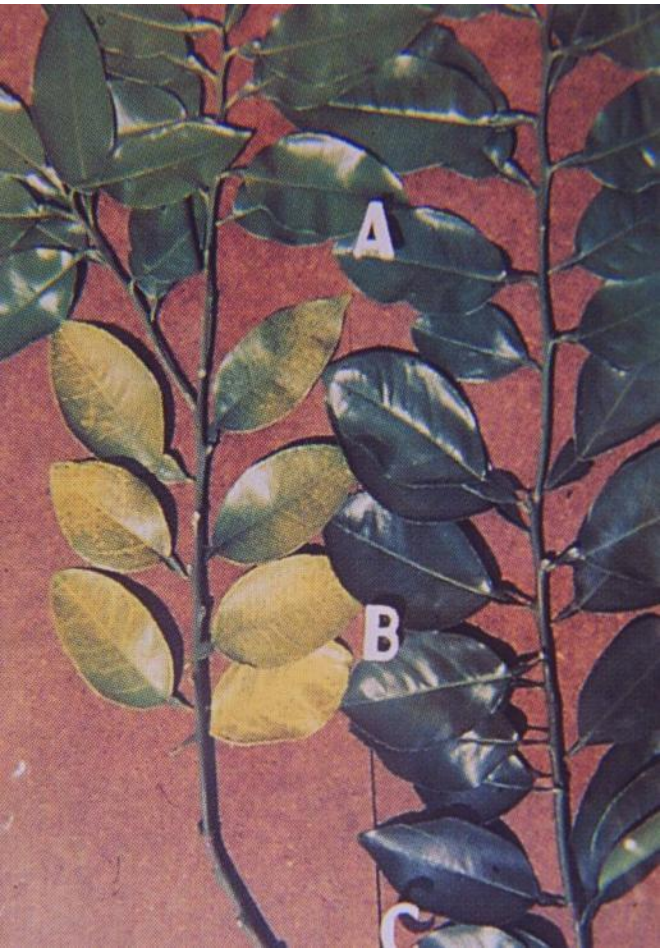
Nutrient Deficiencies

Which is correct concerning mobile vs immobile nutrients?

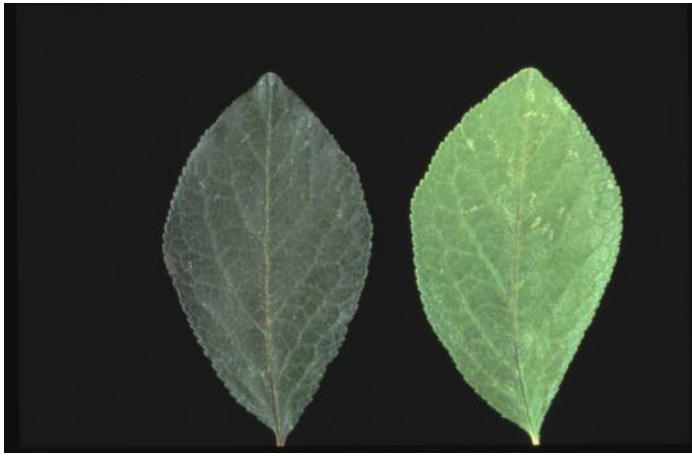
1. Plant immobile element deficiencies are found first on young tissue & plant mobile nutrients deficiencies are noticeable first on older tissue.
2. Plant mobile element deficiencies are noticeable first on younger tissue and plant immobile nutrients deficiencies are noticeable first on older tissue.
3. Plant mobile and immobile element deficiencies are both noticeable first on younger tissue
4. Plant mobile and immobile element deficiencies are both noticeable first on older tissue.

Nitrogen (N) Deficiency
(Stunting, overall yellowing)

Citrus (mobile)



Plum

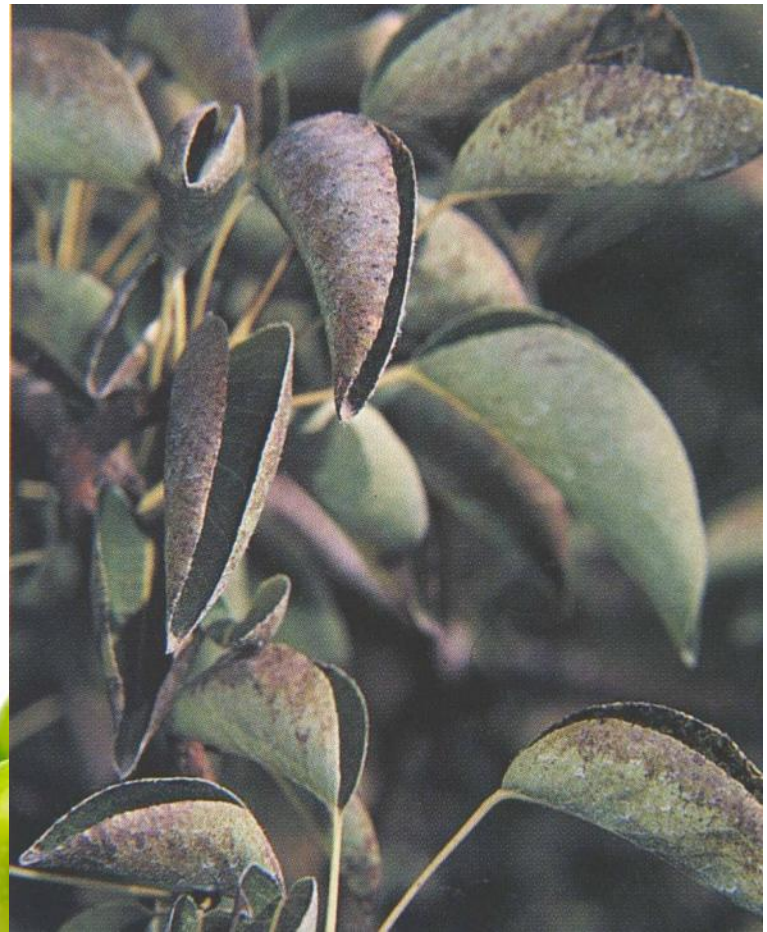


Peach

Phosphorus (P) Deficiency
(Reddening)

Potassium (K) Deficiency
(Discoloration, Boating)

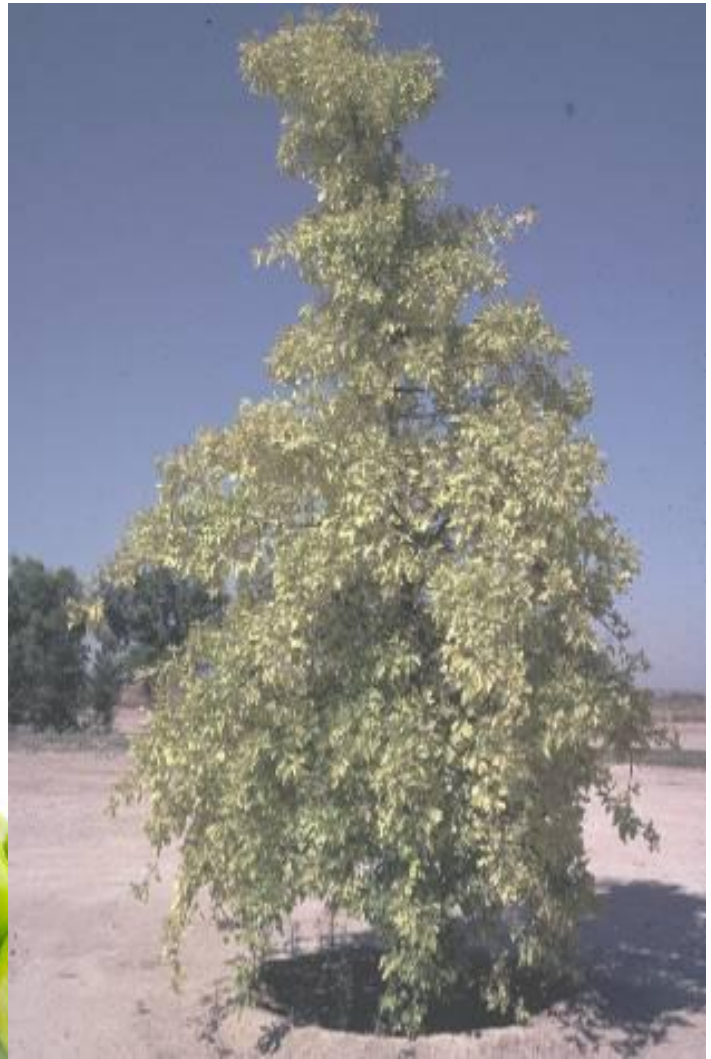
Pear



Peach

Iron (Fe) Deficiency

(Interveinal chlorosis, sharp green veins)

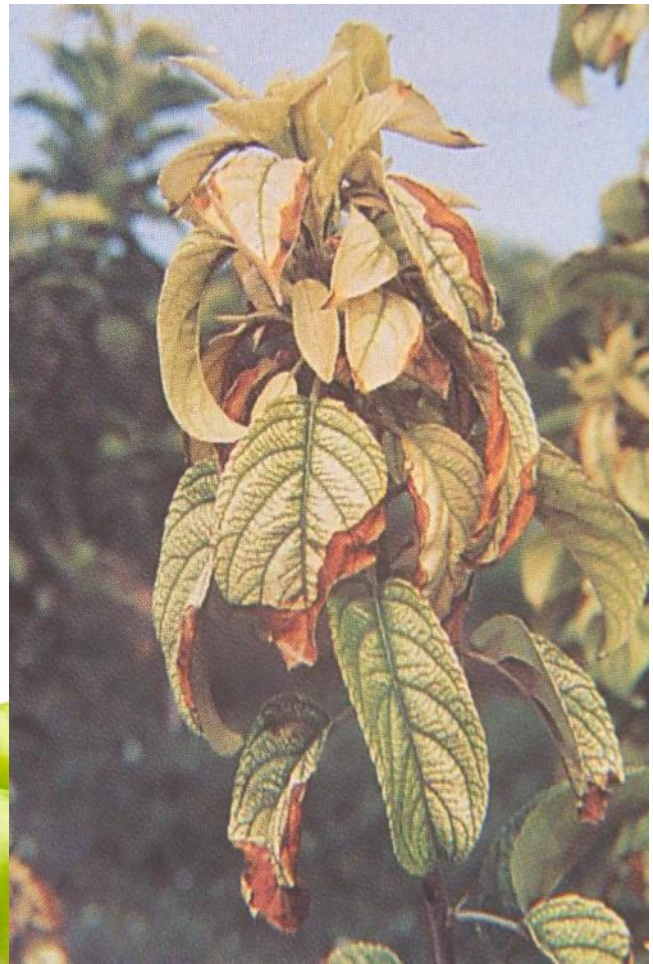


Pin Oak

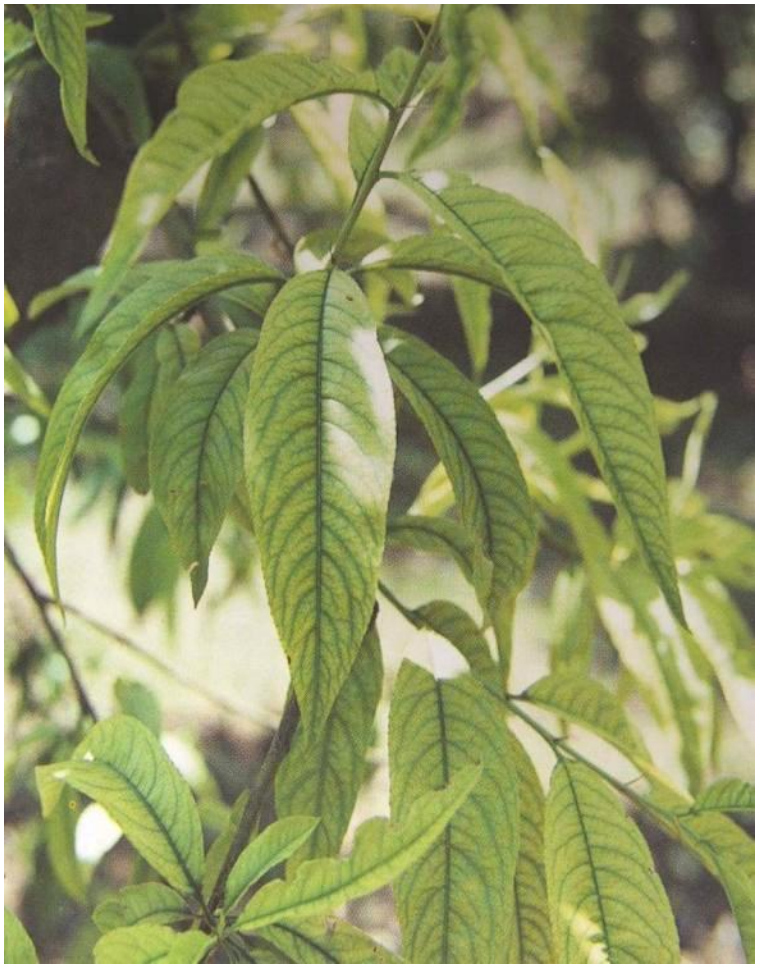
Alder

Iron (Fe) Deficiency

Apple (severe)



Peach

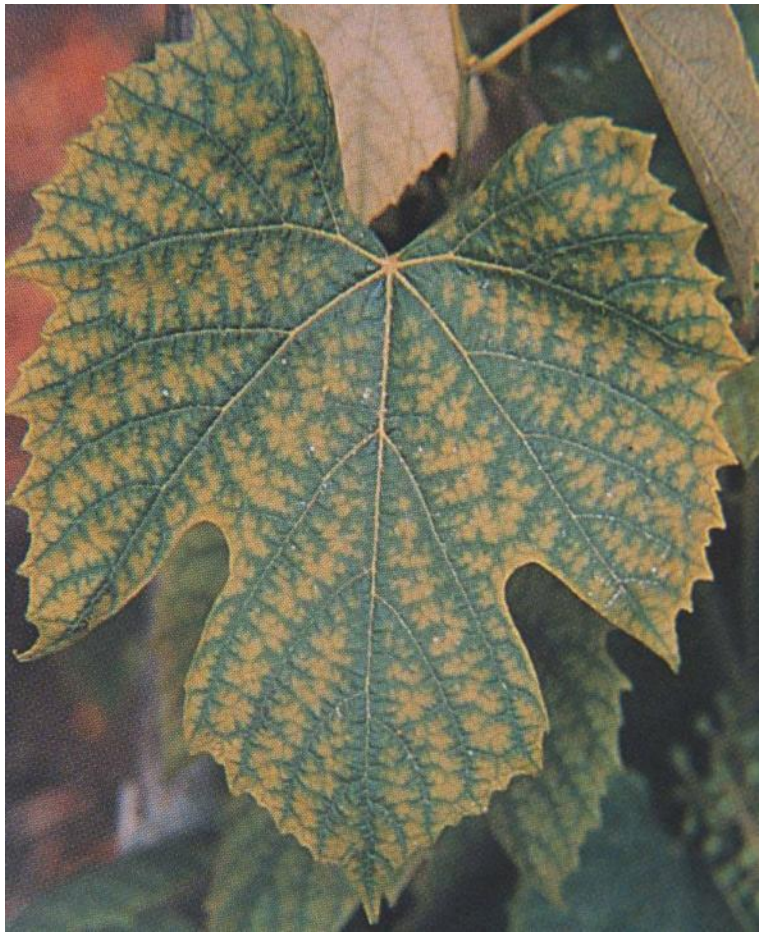


Manganese (Mn) Deficiency

(Interveinal chlorosis, wide green veins)

Walnut

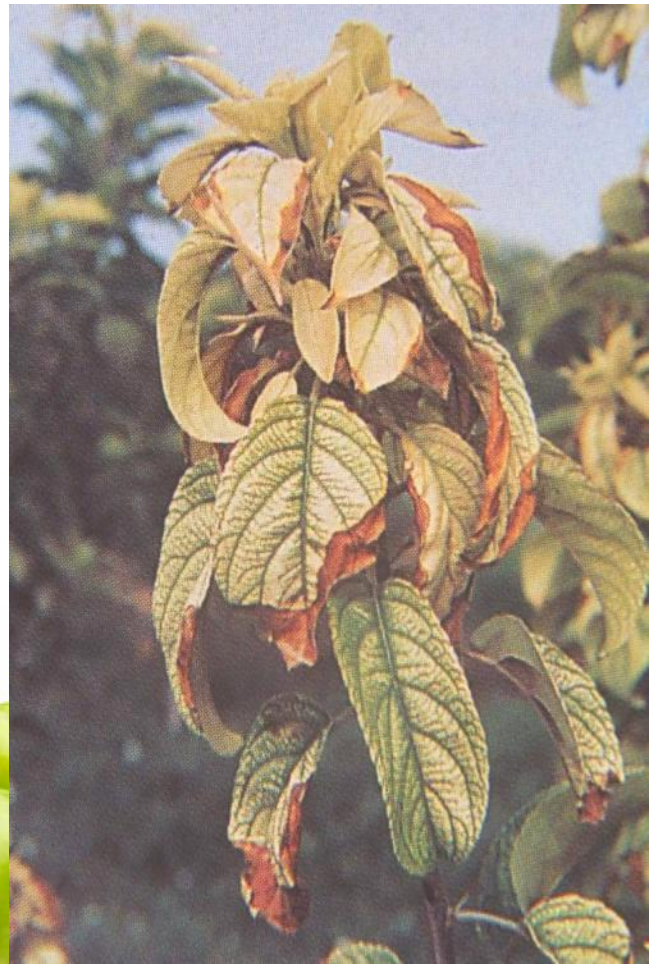
Grape



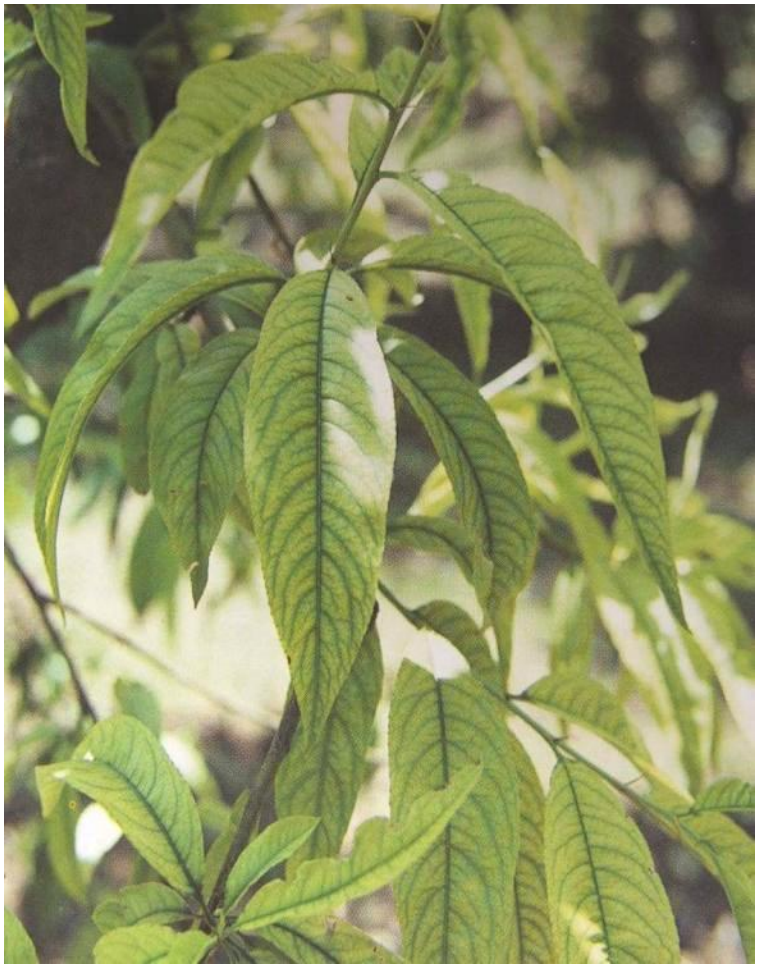
Fe, M

Iron (Fe) Deficiency

Apple (severe)

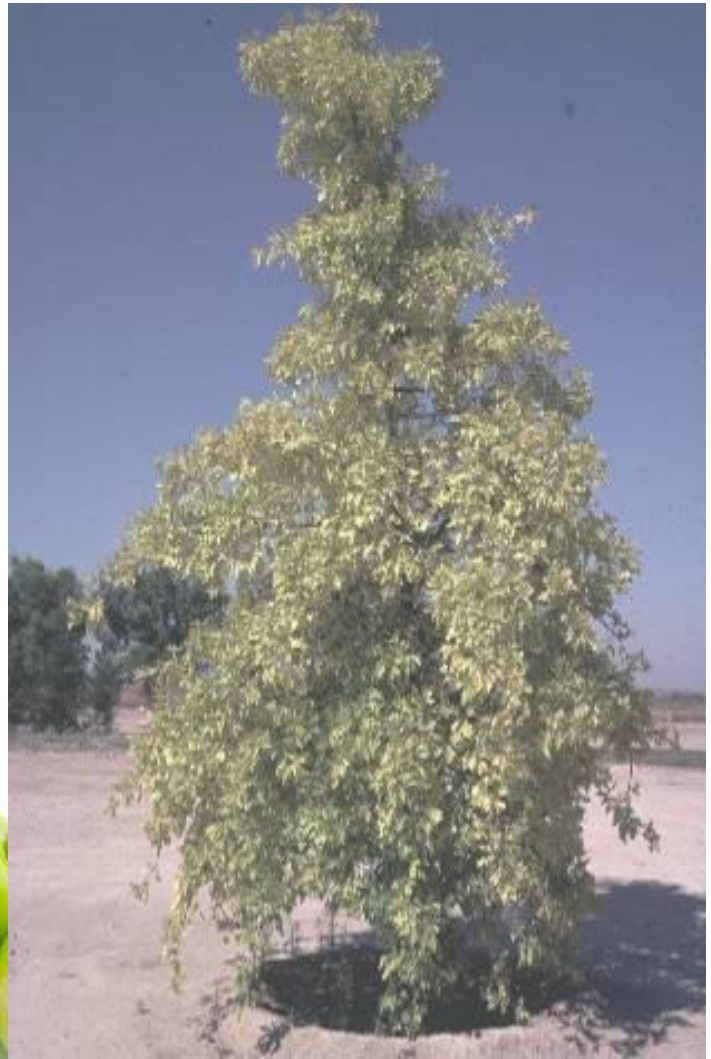


Peach



Iron (Fe) Deficiency

(Interveinal chlorosis, sharp green veins)

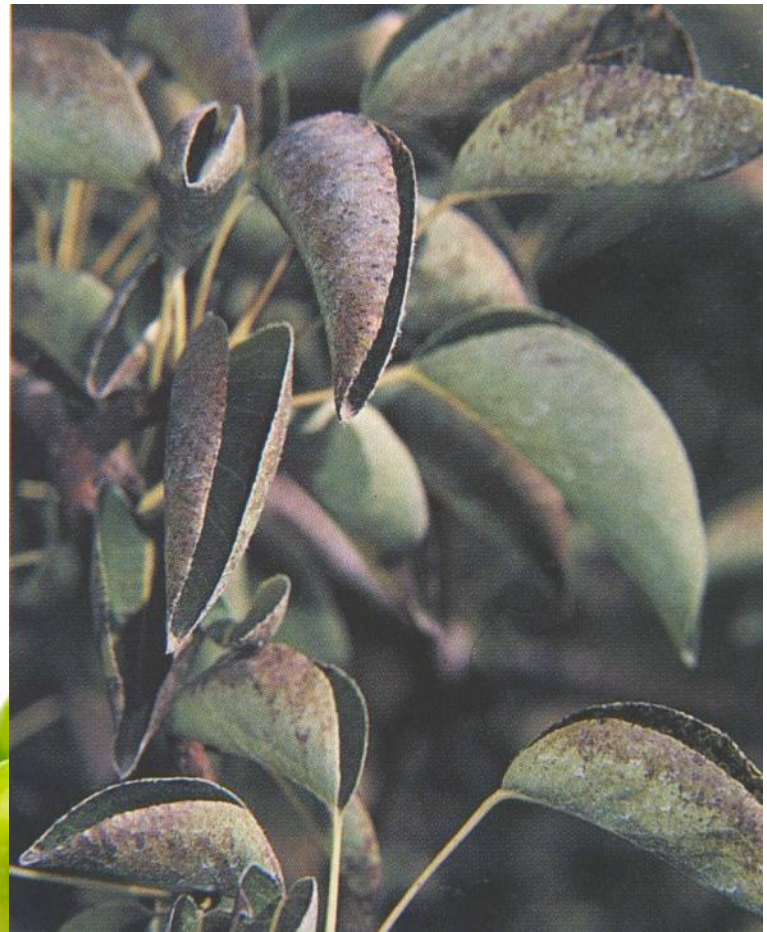


Pin Oak

Alder

Potassium (K) Deficiency
(Discoloration, Boating)

Pear

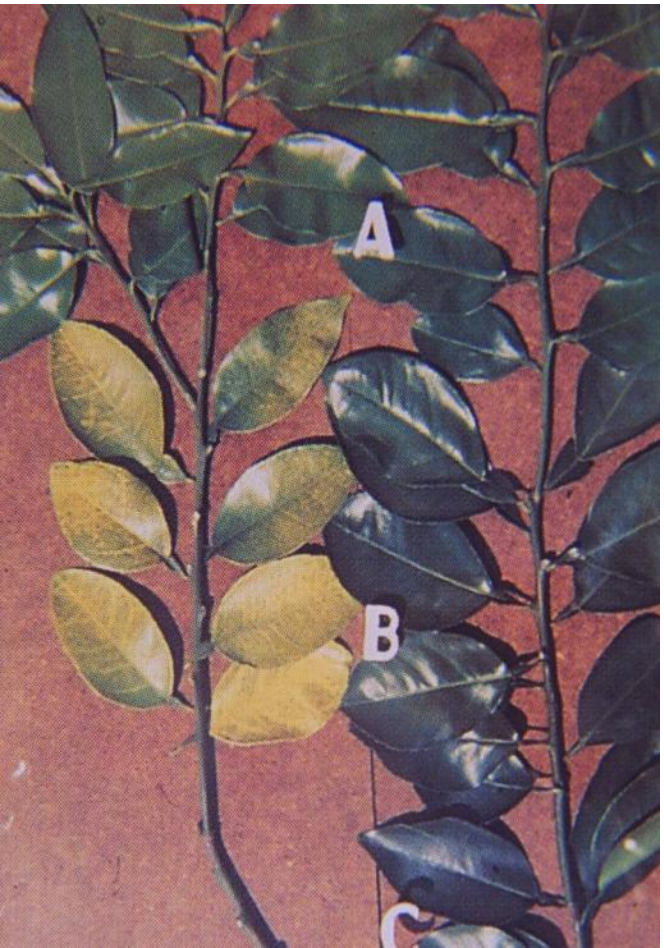


Peach

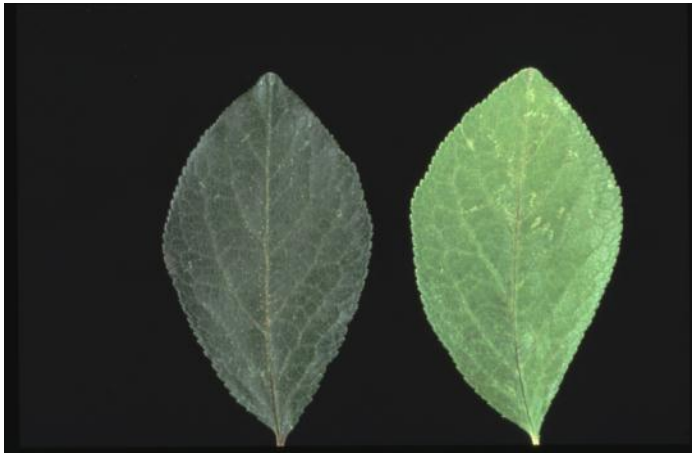
Phosphorus (P) Deficiency
(Reddening)

Nitrogen (N) Deficiency
(Stunting, overall yellowing)

Citrus (mobile)



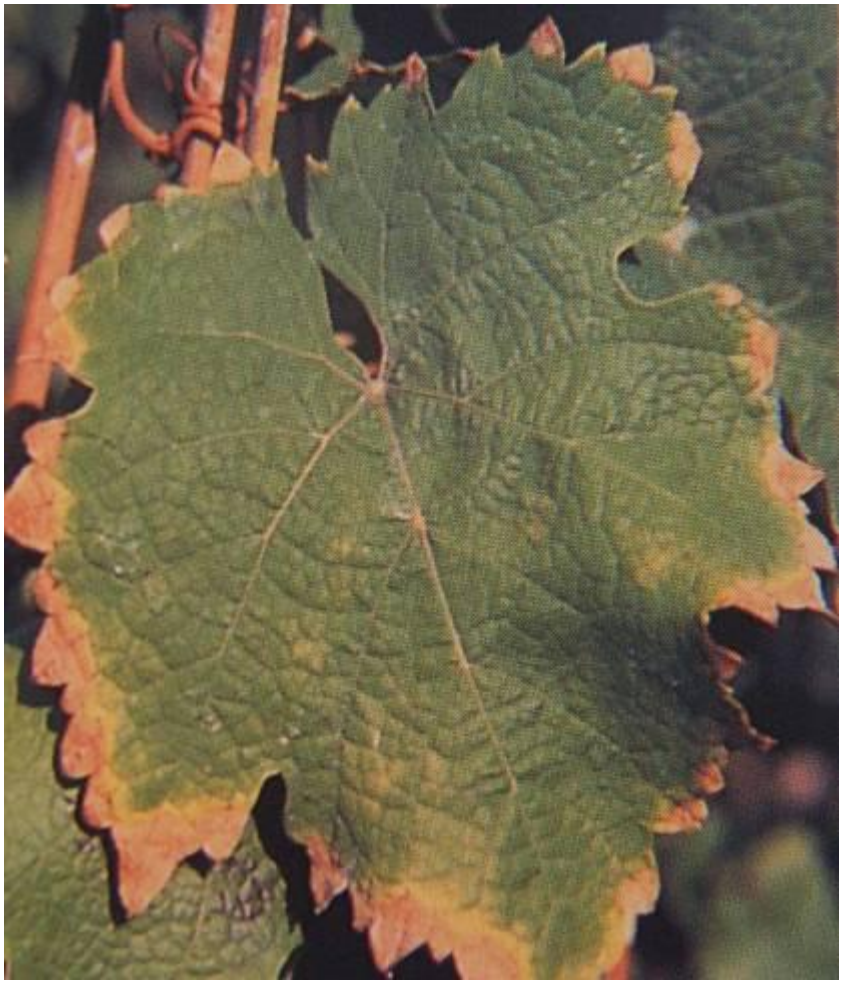
Plum



Peach

Salinity Problem – Apple

Chloride (Cl) Toxicity – Grape



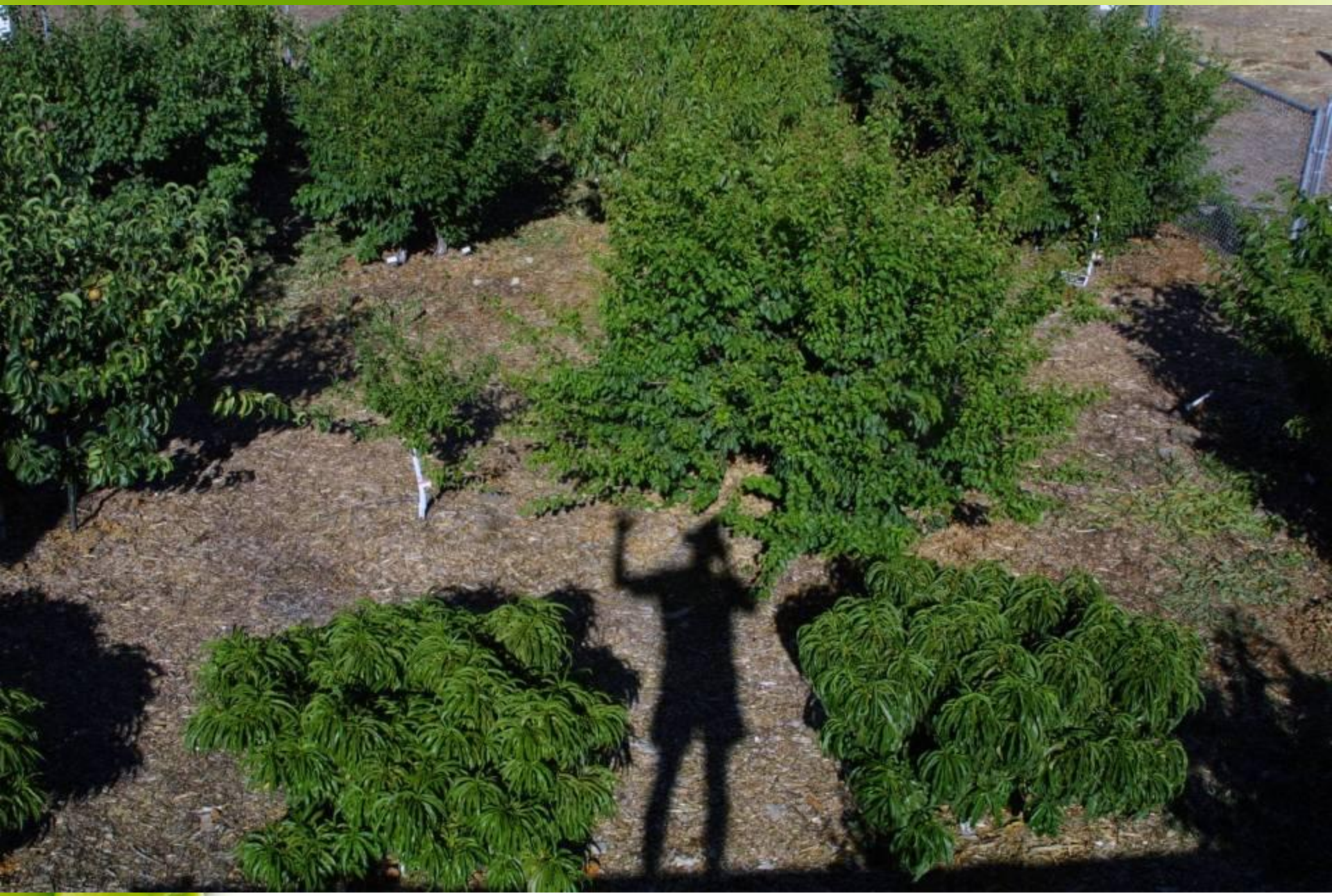
Boron (B) Toxicity in Walnut

Herbicide Damage – Pittosporum

Herbicide Damage – Redwood

Chlorine Toxicity? – Redwood


Mulching



Nitrate In Groundwater