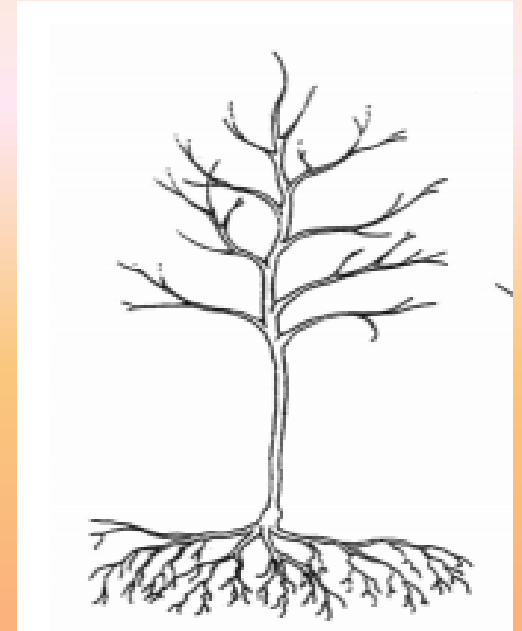


Soil Health and Mulches



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Soil / Water / Roots



What Do Roots Need?

Oxygen: Gas Exchange

Space to Grow

Water

Nutrients

Temperature



**Roots are Opportunistic:
They will grow where
there is opportunity.**

Soil Provides : Pore Space

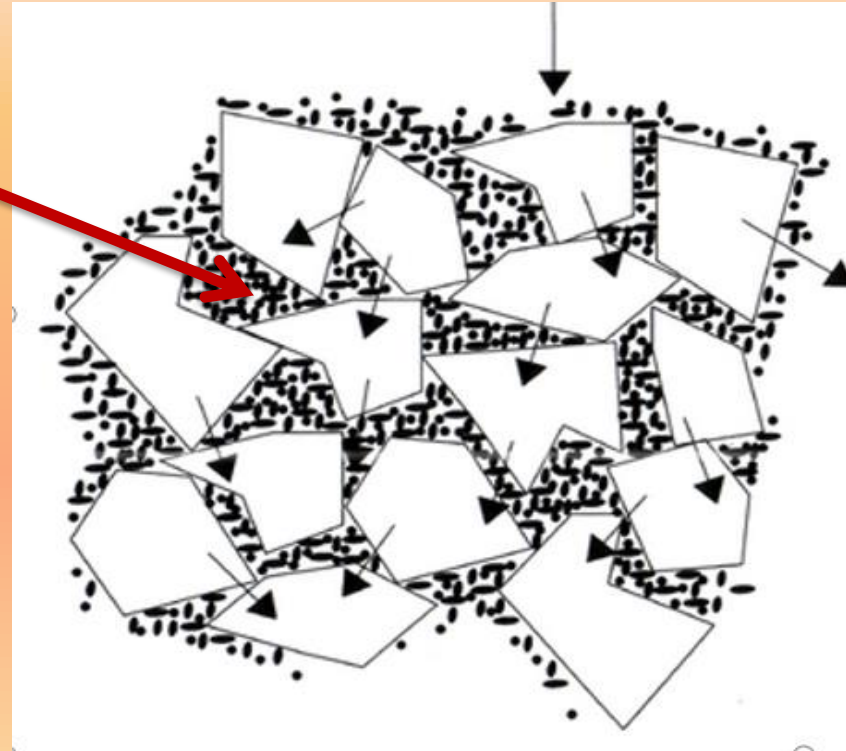
Oxygen: Gas Exchange

Space to Grow

Water

Nutrients

Temperature



Cornell Structured
Engineered Soil

Layers

- **Horizons >> Profile**

A Horizon : Topsoil: Dark colored first layer, decomposing organic matter

B Horizon: Subsoil Zone of Accumulation :

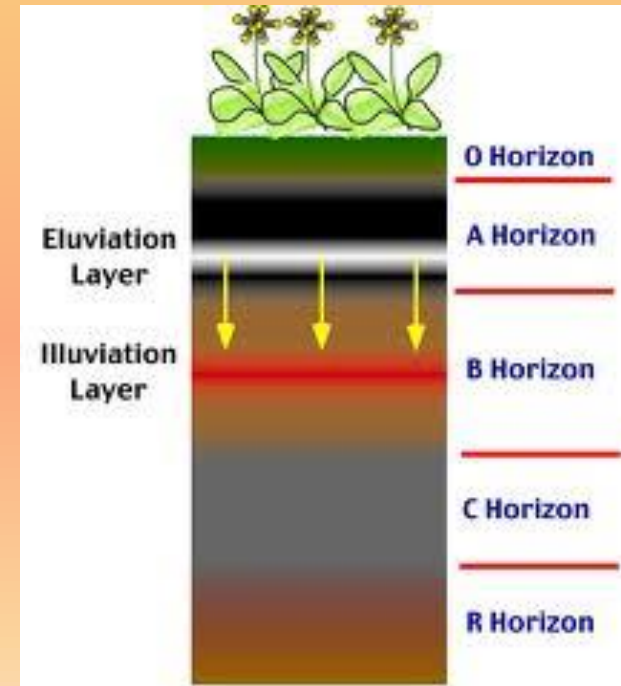
C Horizon: loose or weathers rock material

R Horizon: Unweathered Rock

Calcification

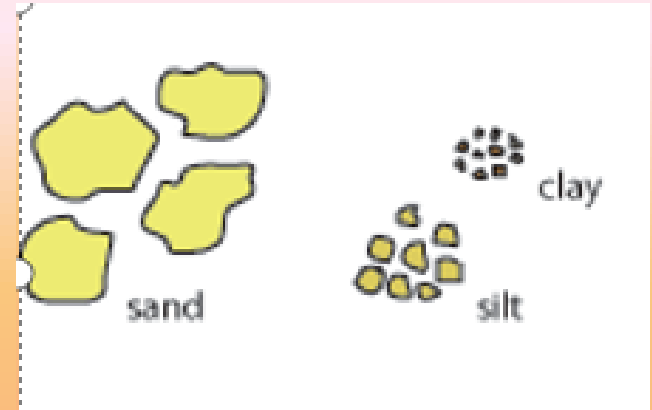
Hardpan: Layer of impervious to water

Plowpan



Soil Texture : Size particles

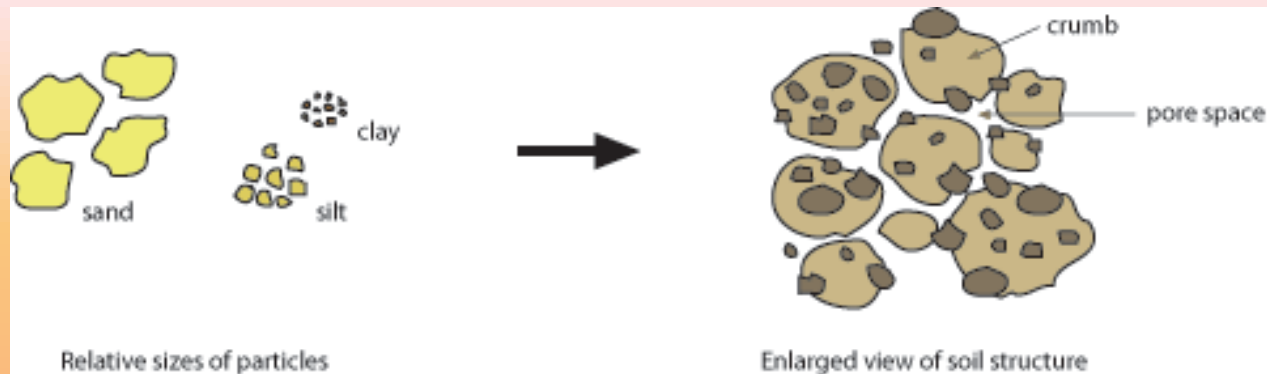
Sand : Large
Silt : Medium
Clay : Small (dust)



Structure : Aggregation (Clumping)

Structure : Aggregation (Clumping)

Function as a unit of many particles



Clay : good at aggregating
Sand and Silt : poor at aggregating

Friable Soil: 'Well-aggregated' soils can have good drainage, aeration, root penetration, and retain water and nutrients.

Two Simple Tests

- **Hand Squeeze**
- **Ribbon**



Checking backfill soil moisture. (a) The soil contains too much water; you are overwatering. (b) The soil moisture is just right; check for root ball dryness. (c) The soil is too dry; increase watering.

Two Simple Tests

- **Hand Squeeze**
- **Ribbon**



- Movie

Organic Matter and Micro organisms

ORGANIC MATTER

The living, the dead and the very dead



Roots, micorrhizae
and bacteria



Crop residues, dead
roots, microbial biomass



Humus
stabilized OM

**Cultivation increases aeration
of soils and causes excessive
organic matter decomposition.**



Soil Damage

Principle of Too's

Too Much
Too Little
Too Bad



Soil Damage

Most Common:

Break Structure
Reduce Porosity
Chemivcal imbalance

- Excessive Cultivation
- Compaction
- Working when wet
- Working when dry
- Heat
- Sun
- Flooding
- Mineral Imbalance



Improve Soil

- Add Organics – Short term fix (opens soil)
- Annually Add Organics
- Limit Cultivation
- Improve Drainage: Surface and Depth
- Mulch
- Amendments: Ask Why?
- Predict outcomes based upon soil/ root knowledge.

Soil Chemistry

Fertility:

Cation Exchange Capacity (CEC) – Nutrient Holding

Fine textured soil – High CEC

Coarse textured soil – Low CEC

Organic Matter and Clay particles

pH – Nutrient Availability

Nitrogen is most often the Limiting Factor

Soil Chemistry: pH and Nutrient Availability

Most Soils Adequate Nutrients Know Your Area pH

Good for most plants

pH **5.5** – **6.5**

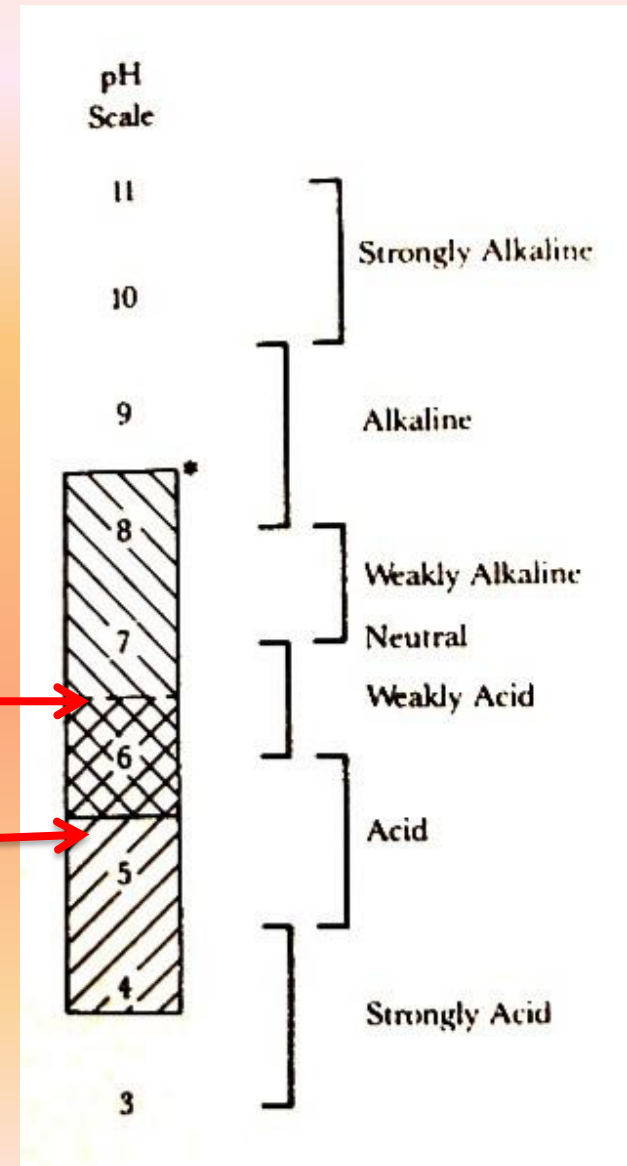
Below 5.5 Use acid plants

Above 6.5 Use basic plants

Acid Soils reduced Microbe activity

Basic Soil Iron and Manganese deficiency

Acid Soil: Aluminum toxic,



- If soils are (**Low pH**) <5.5 **Acid**
 - amend with Lime
 - Desire **Dolomitic Lime**. It has a balance of Calcium and Magnesium



- If soils are (**High pH**) >6.5 **Basic**
 - amend with **sulfur products**
 - amend with **acid organics** such as peat



- Chemical manipulation is **temporary** and the native soil will return to its native pH over time.

Nutrients

Limiting Factors

Nitrogen:

Improper pH

Iron Deficiency



Biologic Properties Soils

Soil Animals:

Earthworms

Protozoa

Good and Bad Micro-organisms

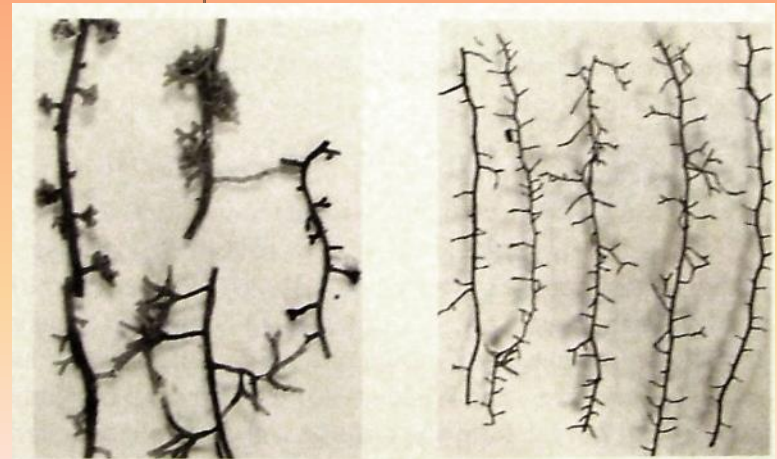
Bacteria – Rhizobium (legumes)

Mycorrhizae



Ecto – Exterior Root

Endo- Interior root



Mulch

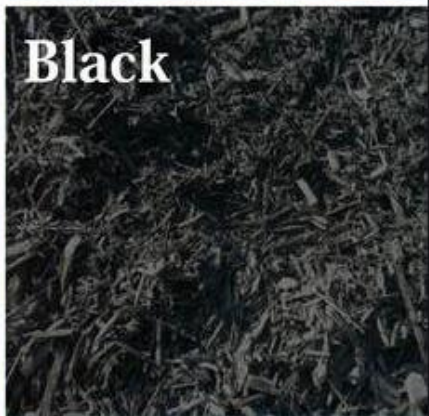
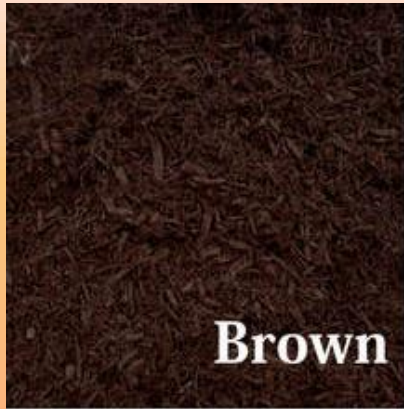
Benefits:

- Conserve Soil Moisture
- Prevent Erosion and Water run-off
- Increased fertility of Soil
- Reduced weed competition
- Soil Structure improved
- Soil compaction is reduced
- Improve surface for traffic
- Clay soil less cracking under mulch
- Reduce salt build-up
- Moderate Soil temperatures
- Reduce disease
- Reduce light reflection and heat gain

Problems:

- Nitrogen Deficiency with decomposition
- Excessive moisture with heavy soils
- Air temperature just above mulch extreme
- May delay winter hardening
- Mulch may carry disease
- Rodents
- Fire Hazard
- Toxic chemicals
- Affect rooting depth

Types of Mulch



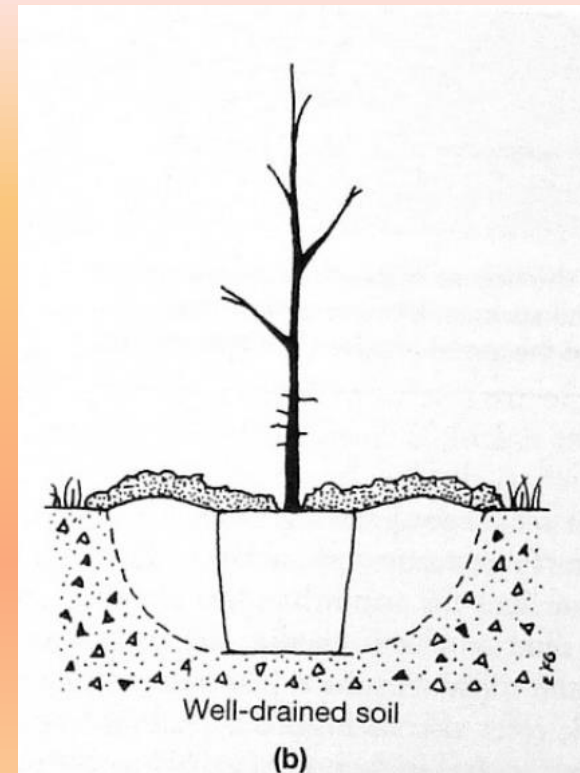
Problems: (Too's)

Too thin: Encourage Weeds

Too thick: trap moisture
Nitrogen Robbing

Too raw: Composting heat

Too 'Dirty': disease, weeds



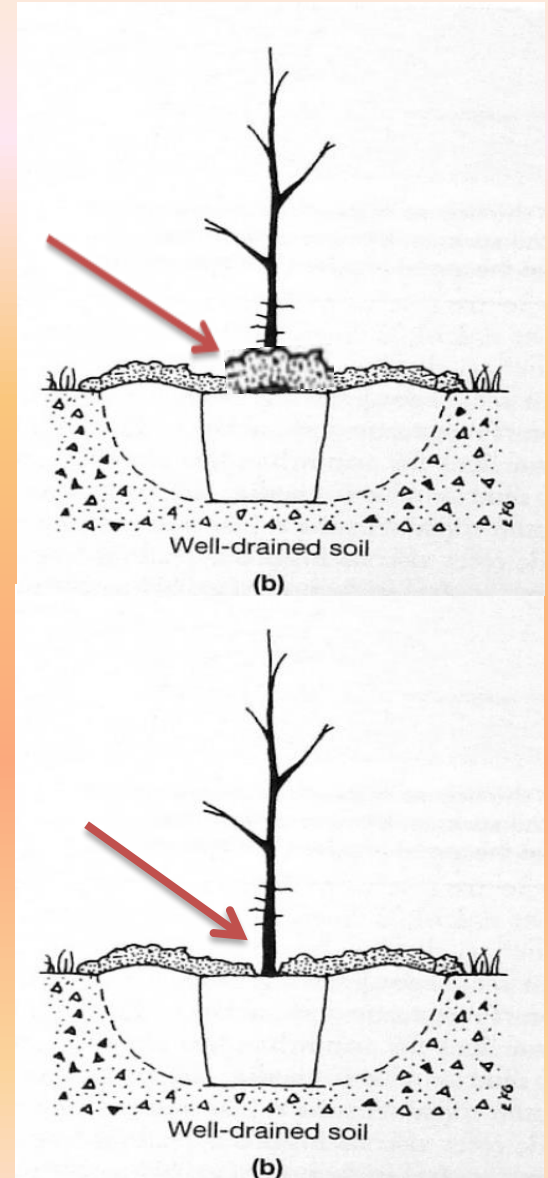
Stem Protection

Maintain an open,
unmulched stem.

Air available to stem and
roots is important.

Covering encourages
stem rot.

Covering limits oxygen to
roots and stem.

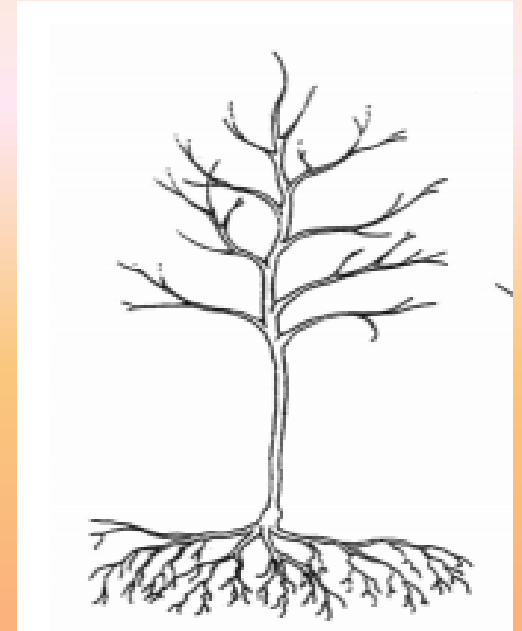


- **Get Soil Right Everything Follows**
 - Trees are very different
 - Trees in trouble.
 - Plant must grow out of it.
 - Only option is plant must get bigger.
 - Understand soil to fix situation.

University Florida Dr. Ed Gilman



Soil / Water / Roots



Principles to remember

- **Healthy plants actively resist pests and disease**
- **Roots health is the best measure of overall health.**
- **Right plant, right place.**
- **Being Aggressive causes problems.**
- **Principle of the Too's**
 - Too Much – Too Little -Too Bad
- **“Every solution causes a problem.”**



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