Sustainable Fruit Tree Care

Tips and Techniques for Promoting and Maintaining Tree Health

KEEPING PLANTS HEALTHY

The Right Plant In The Right Place

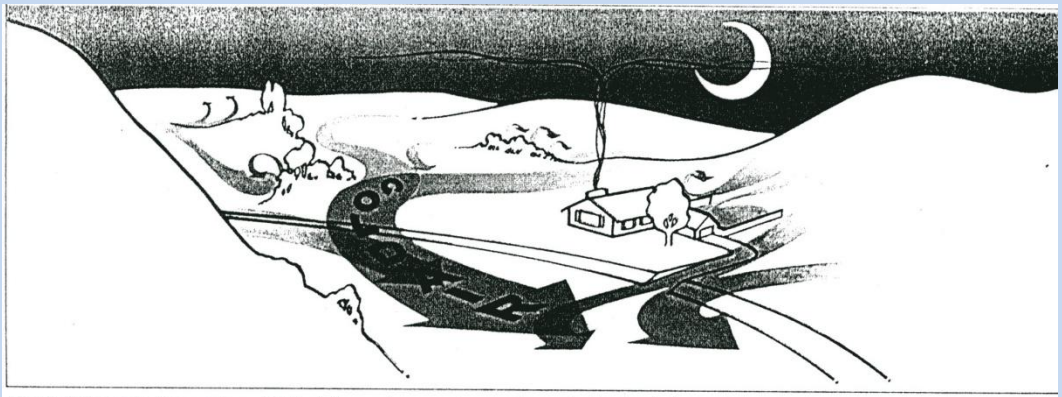
MICROCLIMATE

Geographic Location

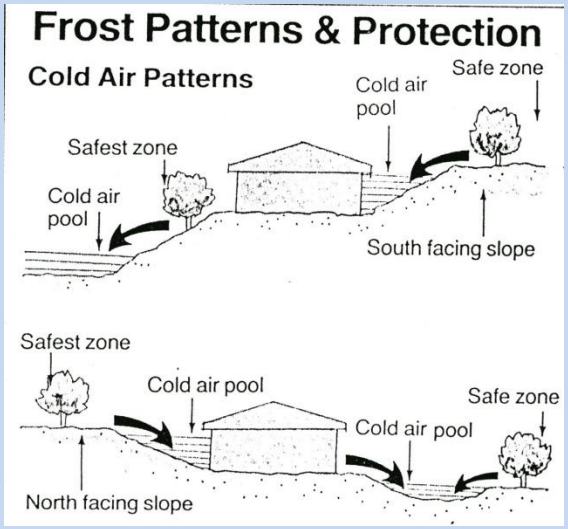
Elevation

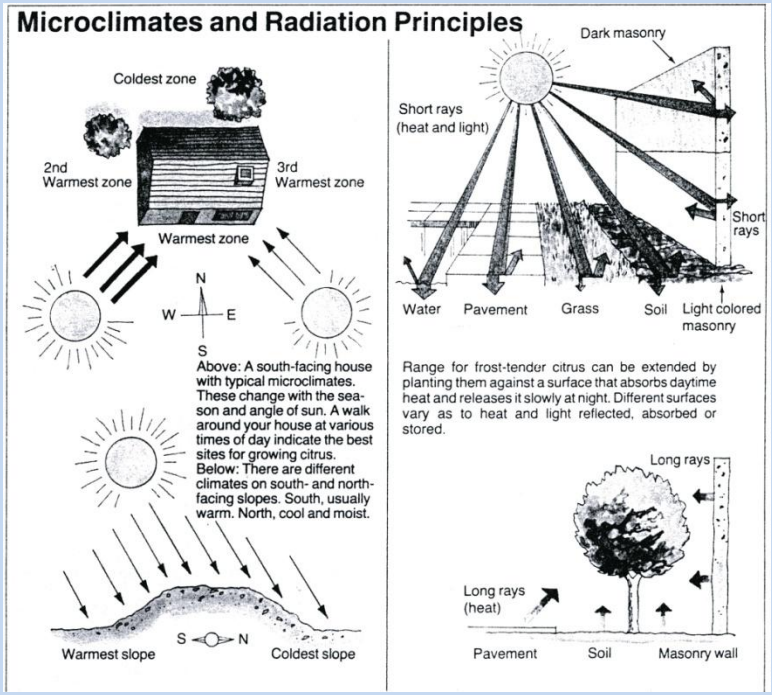
Topography

Exposure



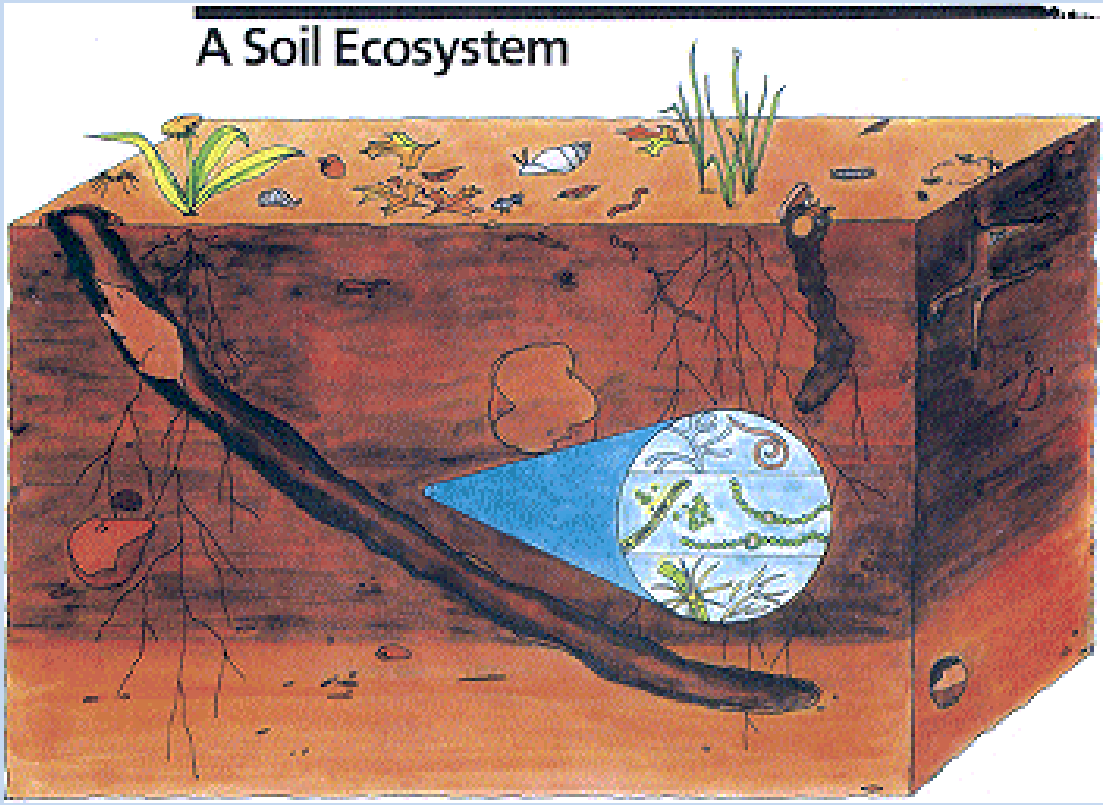
Cold air travels like water—Cold air flows down and away from sloping land, damming up behind objects and settling in low spots. Plant frost-sensitive fruit on sloping land where cold air will drain away.





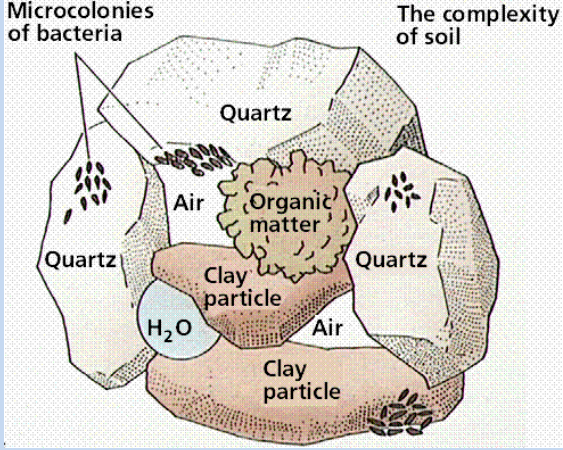
The Soil as an Ecosystem

- The soil is a living, breathing ecosystem, made up of:
- Air ,Water & Minerals
- Plants & plant parts – alive & dead/decomposing
- Animals – vertebrates & invertebrates – alive & dead/decomposing
- Fungi & bacteria – alive & dead/decomposing



- **Tilling the soil disrupts this ecosystem and damages plant roots!**
- **The health of the plants in our soil is directly dependant on the health of the soil!**

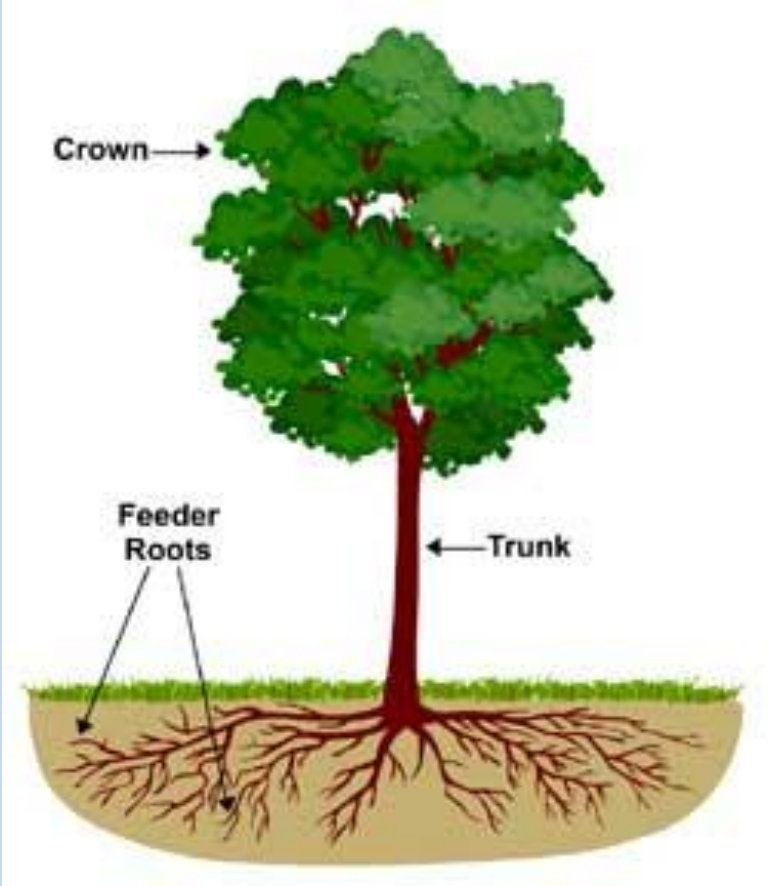
Soil Facts



- **It takes 100 to 600 years to form an inch of topsoil.**
- There are more organisms in one shovelful of dirt than there are people on the planet!
- The top 1 inch of the forest floor contains an average 1,400 living creatures for each square foot. Also, in one teaspoon of soil there are 2 billion bacteria and millions of fungi, protozoa and algae.
- There are 5000 to 7000 different species of bacteria in one gram of soil and the number of bacteria ranges from 100,000 to several billion.
- The total living matter in an acre of soil ranges from 5000 to 20,000 pounds.
- Each year, 15 tons of dry soil per acre pass through earthworms. Earthworms eat soil to get the organic materials in it. The rest passes through them.

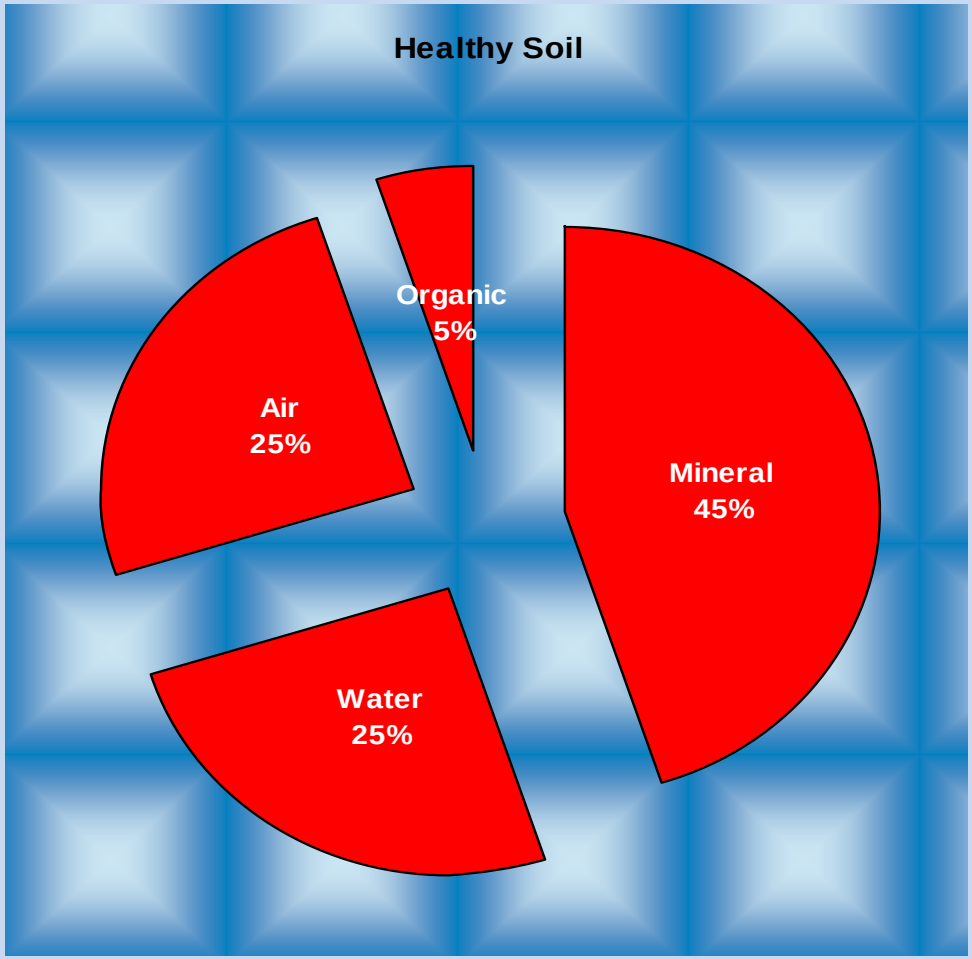
How Plant Roots Grow

- The small feeder roots constitute the major portion of the root system's surface area.
- Feeder roots are located throughout the entire area under the canopy of a tree. As much as 50 percent of the root system grows beyond the drip line and may extend as far as two to three times the height of the tree.
- A Trees feeder roots grow out from large woody roots and usually grow up toward the soil surface. At the surface, feeder roots mix with lawn and shrub roots and compete for the water, oxygen and minerals that are more abundant near the surface.



Proper Soil Structure

- Soils with good soil structure contain 50% solid and 50% pore space.
- The pore space will have half of the area filled with water and the other half with air.
- Saturated soils have no air as all pore spaces are filled with water.
- **The proper balance of water and air in a soil is critical to healthy root and plant growth and to life in the soil.**



Alkaline Soils

- Besides affecting life in the soil, Alkaline soils have three problems that can result in poor plant growth:
  - **excessive salts**
    - A soil may be rich in salts because the parent rock from which it was formed contains salts. Sea water is another source of salts in low-lying areas along the coast. A very common source of salts in irrigated soils is the irrigation water itself. Most irrigation water contains some salts. **Most alkaline soils have problems with excessive salt accumulation due to low rainfall in the area as they are not leached from the soil.**
  - **soils which "seal off"**
    - Soils with excessive sodium can break down soil aggregates and result in a dispersed, sealed-off soil surface.
  - **high pH which ties up certain nutrients**

Reclaiming Salty Soils

- **Mulches on the surface slow upward evaporation which can aid in reducing the surface salts. As organic mulches decompose, they form humic acid which helps to lower the soil pH, therefore making salts more soluable.**
- Leaching
  - Soil is flooded with water and the salts are leached through the root zone. This is only practical if water low in salt is available & the soil drainage is moderate to fast. Unfortunately, most saline soils are clay-like and have poor drainage.
  - For leaching, 12" of water is needed to remove about 70-80% of the salt in the top 12" of soil.
- Gypsum $CaSO_4$
  - Gypsum works like this: $CaSO_4 + H_2O + 2Na^+ = Ca^{++} + Na_2SO_4 + H_2O$
  - **gypsum will slowly replace the sodium and over time will improve soil structure - the calcium cations bond together soil particles into larger aggregates.**
  - **the sodium sulfate is now more easily leached from the soil.**

Liquid "Gypsum" and "Liquid Thrive"

- **Liquid "Gypsum"** and **"Liquid Thrive"** contains a high level of soluble calcium which displaces the sodium. This then creates pore spaces in the soil. The effectiveness of the calcium is compounded by the use of a polyacrylamide (PAM) that attaches to the soil particle and remains in the soil for years, helping the soil structure to resist collapsing. The effect of the PAM is cumulative and long lasting.

- **Benefits:**
- Improves clay soils by displacing sodium immediately.

- Releases salts, lowering soil EC

- Improves soil drainage

- Reduces crusting and improves infiltration of water and nutrients

- 32 oz. = 200 lbs. dry gypsum

Soil Amendments and Mulches

Soil amendments and Mulches can be Inorganic or Organic. The same products can be used as either a soil amendment OR a mulch. The difference is not so much what the product is, but HOW it is used.

Amendments are mixed into the soil. Mulches are laid on top of the soil.

- Organic and Inorganic
- Organic mulches are preferred. As they decompose they improve the soil ecosystem.

- Organic soil amendments **are not** recommended when planting trees. AT Best, they do no good, and at worst they impair the development of roots into the native soil as well as make drainage issues worse.
- If soil amendments are used, inorganic amendments are preferred. These include gypsum, soil acidifiers (such as soil sulfur) and starter fertilizers.

SOIL - Amendments and Mulches

Mulches are laid on top of the soil. Anything that covers the surface of the soil can be considered a mulch. This can be inorganic, such as rock, concrete, asphalt, carpet or sand, etc. or it can be organic such as compost, bark, planter mix, ground wood and bark, green waste or cover crops,etc.

Mulches have Many benefits. Some of these are: They reduce evaporation from the soil, they keep the soil cooler during hot weather, they can help to suppress weeds, and organic products can provide nutrients to the soil, can supply food for soil organisms and can produce humic acid.

Amendments are mixed into the soil. The practice of amending the soil for trees , shrubs, vines or drought tolerant plants IS NOT RECOMMENDED! At Best, these products do no good. Frequently they reduce the plants ability to develop roots into the native soil, they can decompose and cause the plant to settle or can cause drainage and root rot.

The Organic Component

- Organic matter is an important soil component because it:
- a) holds soil particles together and stabilizes the soil, thus reducing the risk of erosion;
- b) aids crop growth by modifying soil structure and improving the soil's ability to store and transmit air and water;
- c) stores and supplies many nutrients needed for the growth of plants and soil organisms;
- d) prevents or minimizes soil compaction;
- e) retains carbon from the atmosphere;
- f) reduces the negative environmental effects of pesticides, heavy metals, and many other pollutants;
- g) can affect soil pH, making a soil more acidic or alkaline. is responsible for most of the soil N, 5-60% of the soil P, up to 80% of the soil S, and a large portion of the B, Mo, and K.

The Organic Component

- **Soil organic matter is in a constant state of flux, decomposing and being added to the soil by natural and human processes.**

- **In order to maintain the benefits of the soil organic materials and the nutrient cycling system, the rate of addition from plant and animal residues and manures must equal the rate of decomposition.**

- Soil organic matter (SOM) includes **primary components** that are inherited from plant and animal residues entering the soil. These primary components may be dead plants, dropped leaves and stems of plants, composts, manures, dead animals or animal products .

- Primary components are relatively easily decomposed by microorganisms and they persist in soil for a brief time (e.g. several months or years). They make about 20-30% of total SOM.

- Primary components can be classified either as mulches or soil amendments.

The Organic Component

- SOM also includes **secondary compounds**, compounds formed within the soil by breaking down organic structures and synthesizing new ones. These secondary components include **humic substances**, which are rather different from most primary components.

- **Humic substances are products of biochemical decomposition.** They are complex substances of high molecular weight, which are resistant to further decomposition. Consequently they tend to accumulate in the soil. Most are dark and are hence responsible for the dark soil color that is commonly associated with soils of high organic matter content. Humic substances make up 60-80% of total SOM.

- The humic substances posses carboxyl groups (*R-COOH), which give them their acidic character and make them effective in buffering soil pH.

- Humic substances can also affect soil structure by causing soil particles to bind together into larger aggregates, thus increasing soil porosity.

Organic Mulches

- Organic material which falls or is applied to the surface of the soil and decomposes is all considered organic mulch.

- There, organisms feed on them and mix the organic material with the upper soil layers; these organic compounds become part of the soil formation process, ultimately shaping the type of soil formed.

- **Mulches gradually incorporate into the soil profile from the top down. Applying organic mulches to the entire surface of a soil can affect the soil in the entire growing environment.**

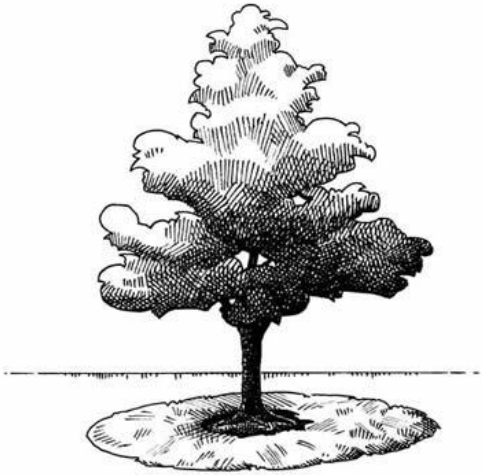
- Mulches can also help to moderate the soil environment by affecting soil surface temperature and moisture level.

Mulches

- Mulching a large portion of the feeder root zone is one of the most beneficial things you can do for your trees.

- Mulch should be at least 2 to 3 inches deep and should not touch the trunk of the tree or plant. It should extend beyond the drip line.

- Mulch will decompose and needs to be reapplied at least annually.



Organic Amendments

- Animals and micro-organisms mix soils and organic matter to form burrows and pores allowing moisture and gases to seep into deeper layers.

- Humans can also mix the different soil layers, restarting the soil formation process as less-weathered material is mixed with and diluting the more developed upper layers.

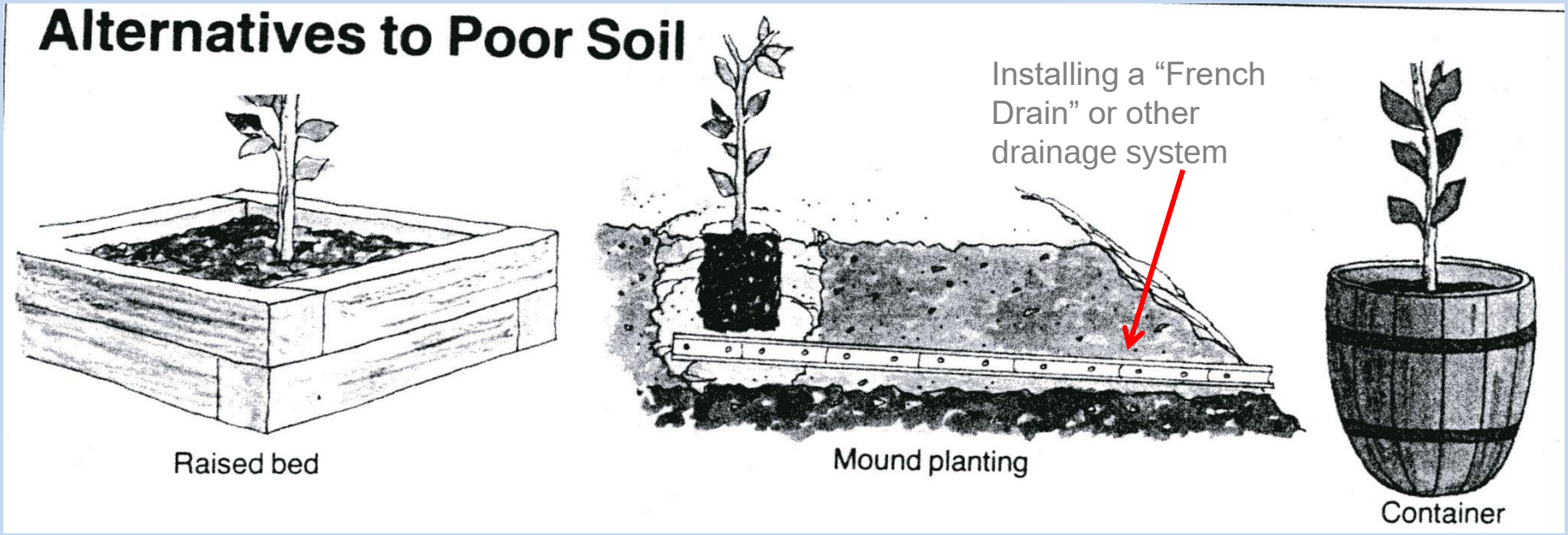
- Organic amendments only affect the soil environment in the area of the soil that they are mixed. **To be beneficial to plant growth, amendments must be mixed into a large enough area to support a substantial portion of the root system of the mature plant or plants.**

- **Turning or mixing soil can disrupt the soil ecosystem and have detrimental effects on the organisms living in the soil.**

- **Organic amendments are only recommended or useful when preparing an area for planting annuals and small perennials.**

Percolation / Drainage

Percolation or drainage is the movement of water vertically into the soil. A slope does not ensure good drainage. **Soil amendments <u>do not</u> improve percolation or drainage!** Often a "bathtub" affect results causing roots to drown or root diseases.



- Percolation test:

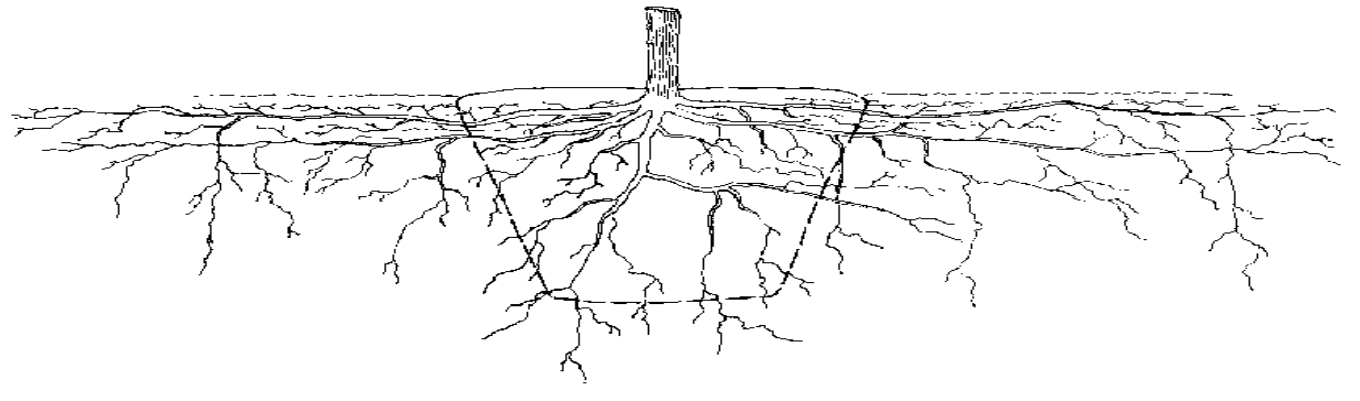
  Dig a hole 2-3 feet deep and fill the hole with water twice. Time how long it takes for the water to drain completely away after the 2nd filling. If it takes longer than 12 hours to drain, the soil has poor drainage and the drainage should be corrected.

Organic Amendments

Mixing organic amendments into planting holes for trees and shrubs is generally <u>not</u> recommended or beneficial.

- At best, these amendments do no good as the root system on healthy plants will develop well beyond the amended planting hole.

- At worst, amendments in a planting hole can:
  - Restrict or inhibit the development of roots into the non-amended “native” soil.
  - Restrict the movement of water into the non-amended soil, forming a perched water table and causing the soil in the planting hole to become saturated and soggy.
  - Will decompose over time, causing the amended soil to compact and the crown of the plant to settle below surface of the non-amended soil. This settling frequently causes crown rot and can kill the plant.



Two Rules for Adding Soil Organic Matter

1. Use a lot.

- Recommendations for mulches are to keep 2-4 inches of SOM on the surface of the soil across the entire planting area or across a significant portion of the plants feeder root zone.
- Recommendations for soil amendments are to amend the mineral soil by 20-30%.

2. Keep doing it.

- Soil organic matter decomposes over time and as it decomposes the benefits are lost.

Planting in Containers

- All container soils compact over time and need to be replenished. Always add fresh soil to the bottom of the root ball, never on top of the original soil.

- Use container or potting soils that are low in organic material or that have organics that decompose slowly to reduce the frequency of repotting.

- Container soils are generally sterile and plant health can benefit from the addition of mychorizzae or other beneficial soil organisms to the growing medium.

- Container soils leach nutrients more rapidly than soils in the ground and must be watered more frequently due to the limited root area of the container.

- All growing containers MUST have drainage holes to provide adequate water drainage and aeration.

Container Soils

- Potting or container soils are mixtures of organic and inorganic components designed to provide optimum water, air and nutrients for plant root growth.
- Primarily organic soils, container soils are subject to the same processes of decomposition and compaction as in-ground soils.
- Container soils high in wood and bark products decompose more quickly than those with a higher mineral content .
- Container soils should be considered as **temporary** and need to be refreshed as they decompose and compact.
- Always add fresh soil to the bottom of a root ball and never bury the crown of a plant by adding more soil to the top of a potted plant unless the roots of the plant are exposed.

Container Soils

- Commercially available “cactus soils” are low in organic materials. They decompose less and they decompose more slowly than soils with a high wood and bark content.

- Mix cactus soil 50-50 with a potting soil that has rice hulls (which decompose much more slowly than wood and bark products) and organic nutrients, such as Kellogg’s ‘Patio Plus’, for a long lasting container soil.

Mycorrhiza

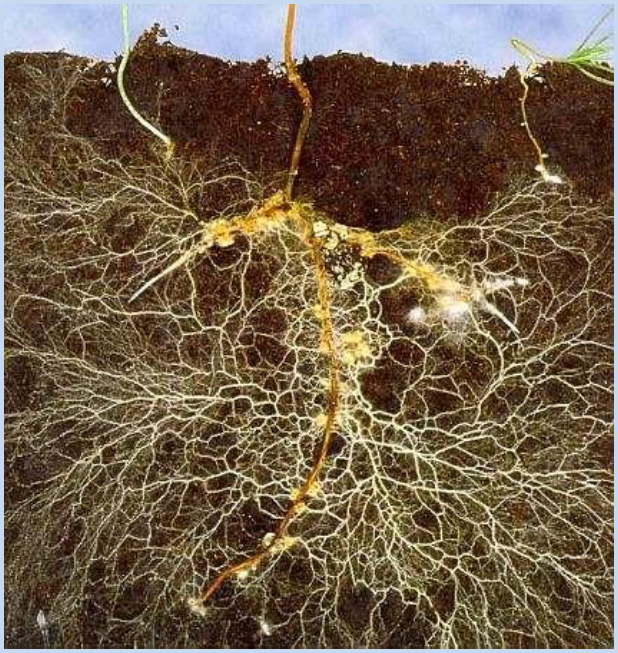
- Mycorrhiza have formed associations with plant roots for over 400 million years.
- Mycorrhiza are present in 92% of plant families (80% of species).
- Present in most undisturbed soils, mycorrhiza may be missing from areas where the top layers of soil have been removed, where soils have been compacted, where fungicides or excess fertilizers have been applied or in container (soilless) soil mixes.
- **Mycorrhiza MUST come into direct contact with a plant's root to form a symbiotic association with the plant!**

Types of Mycorrhiza symbiotic Fungi:

- **Ectotrophic** - fungal threads (mycelium) grow into root from soil and grow **between** the root cells. They take up nutrients from the soil and deposit them directly in the root.
- **Endotrophic** - same except fungal threads **penetrate directly into** the cell itself. Upon death of fungal threads, nutrients are deposited right in the cell protoplasm.

Benefits of Mycorrhiza:

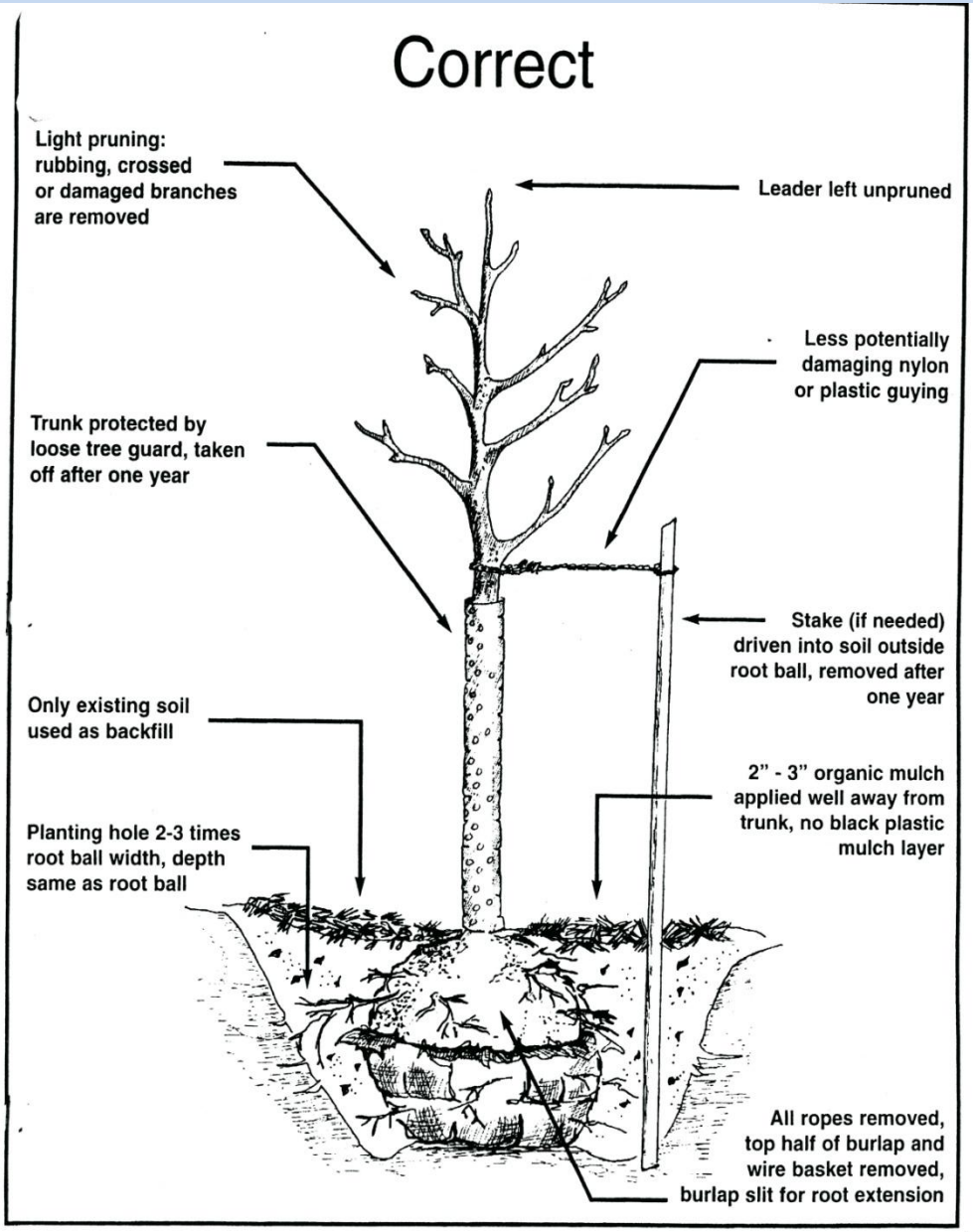
- Enhanced plant efficiency in absorbing water and nutrients **(especially phosphorous)** from the soil.
- Reduces fertility and irrigation requirements.
- Enhances plant health, vigor and drought resistance and minimizes stress.
- Increased pathogen resistance/protection.
- Enhances seedling growth, rooting of cuttings, and plant transplant establishment.



Planting in the Ground

Little pruning is done during the 1st year. The more branches that are left, the more leaves for the tree to produce food to grow.

DO NOT add soil amendments when planting trees! These do no good in the long run and can deter root development into the native soil. They can also make drainage problems worse!

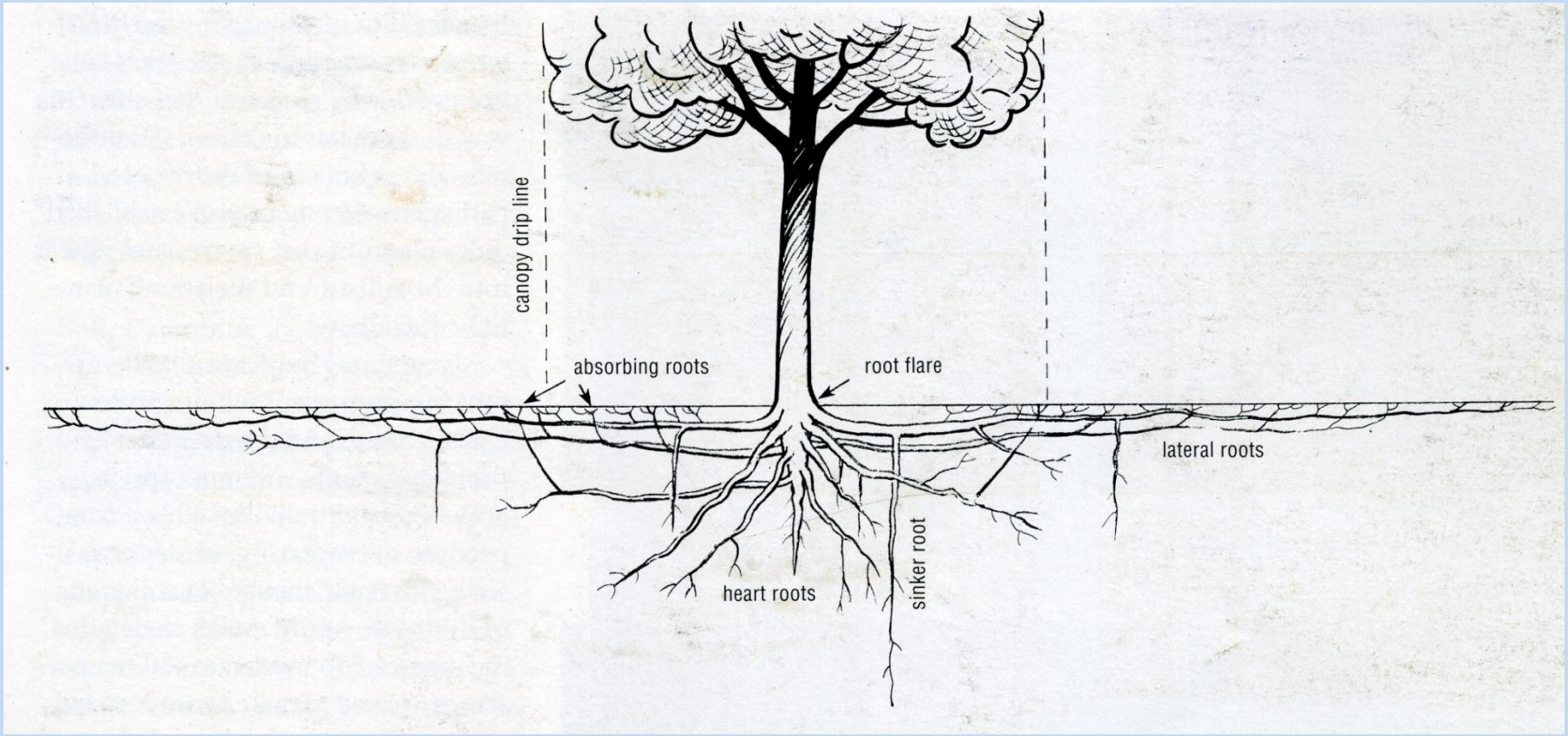


Where materials used to guy or stake trees comes into contact with the bark, the material should be at least 1" wide.

Never leave stakes tied tightly to the trunk. Instead place stakes away from the tree trunk and tie the tree loosely in 2 or 3 opposing directions if necessary to keep the tree upright.

Mulching the soil surface with an organic mulch is one of the BEST things you can do for your trees. Do not place mulch directly against the trunk of the tree.

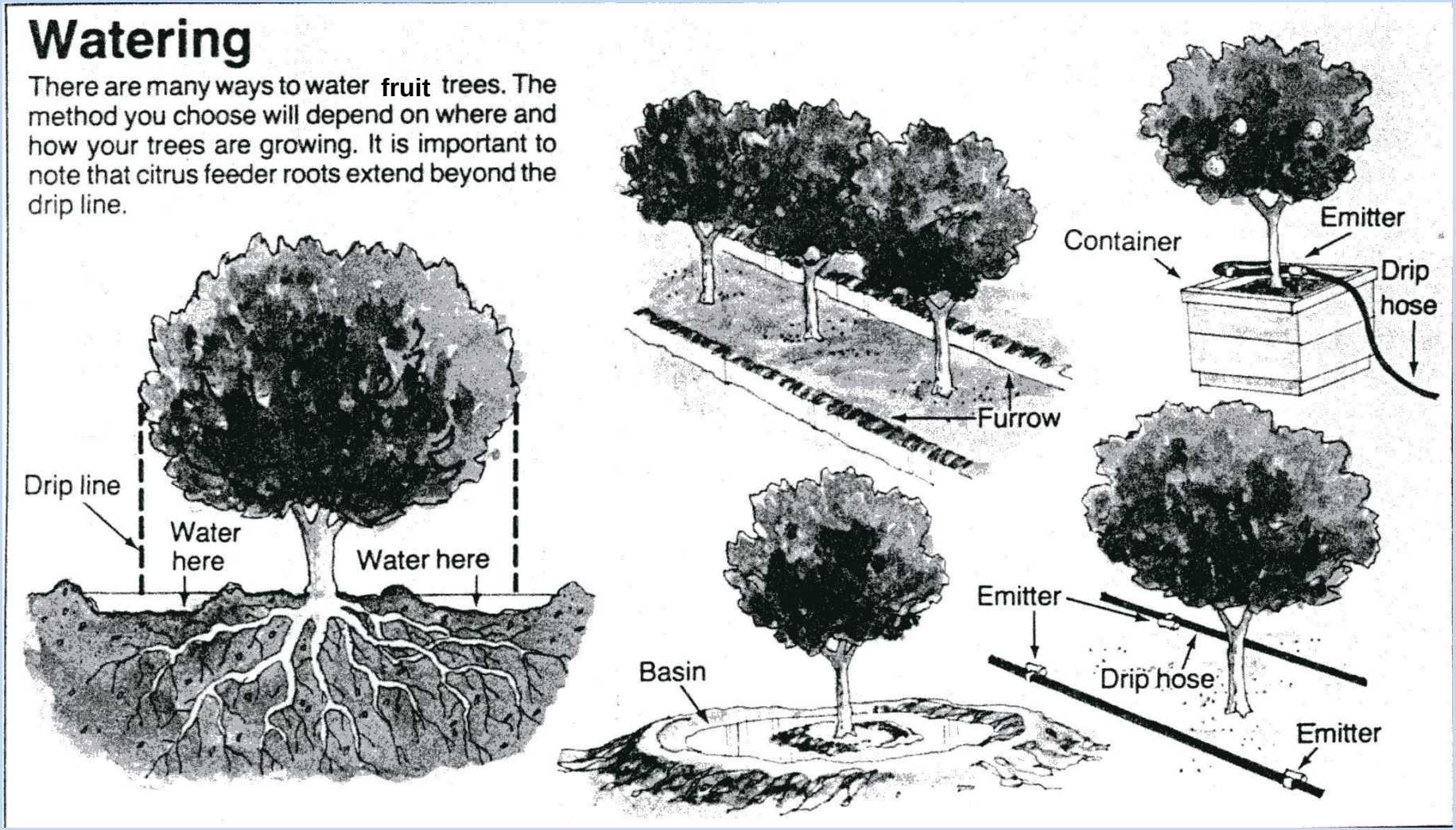
Tree Roots



A plants root system has three primary functions: anchorage, food storage and absorption. The root hairs or Feeder Roots are the roots which function to absorb water and nutrients.

A healthy plant has feeder roots which extend two to three times the height of the plant in radius and extend down into the soil 1-3 feet. 90% of all tree roots are within the top three feet of soil!

Watering



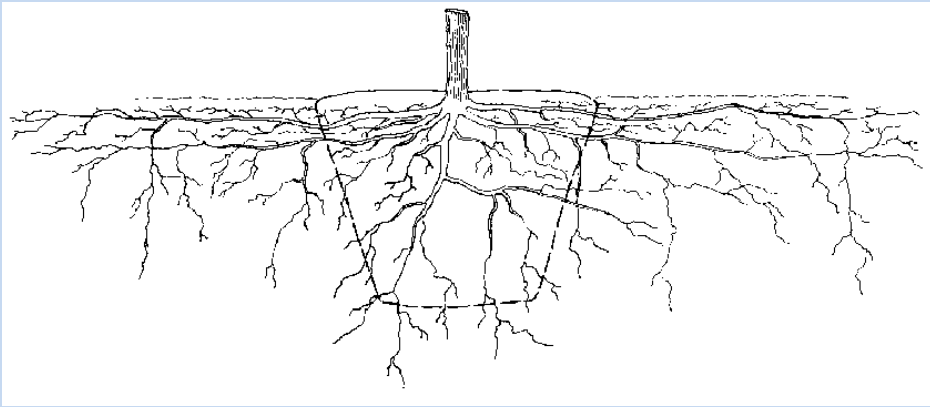
- The trees age and size as well as the soil, climate, season and other factors affect watering. There are three key principles to proper watering.

KEYS TO PROPER WATERING

Water the proper area – the Feeder Root Zone!

Water near the trunk or stem on newly planted plants so that you wet the original root ball.

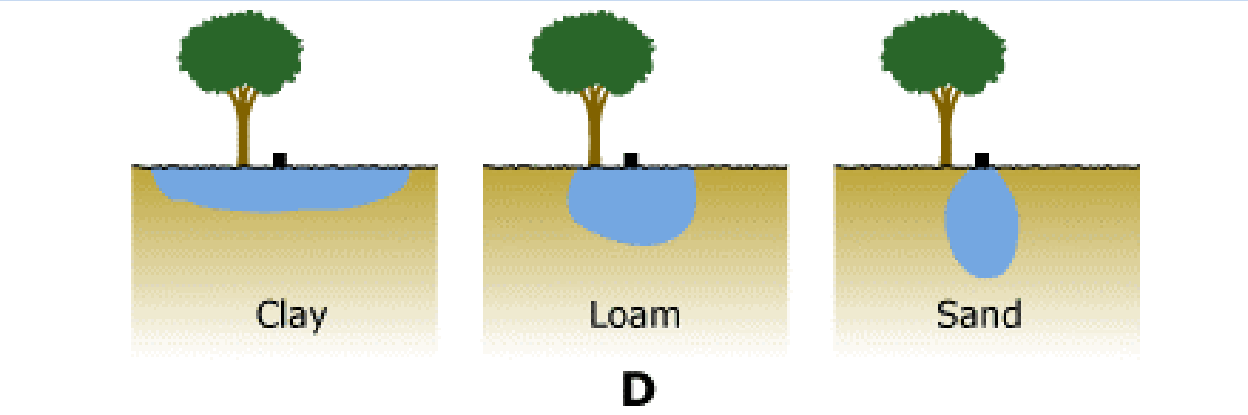
Water at the dripline **and beyond** on plants which are established in the ground. (The plant may take from a few weeks to a one year or more to become established depending on the type and size of the plant, the time of year that it was planted, soil conditions, cultural practices and other variables.)

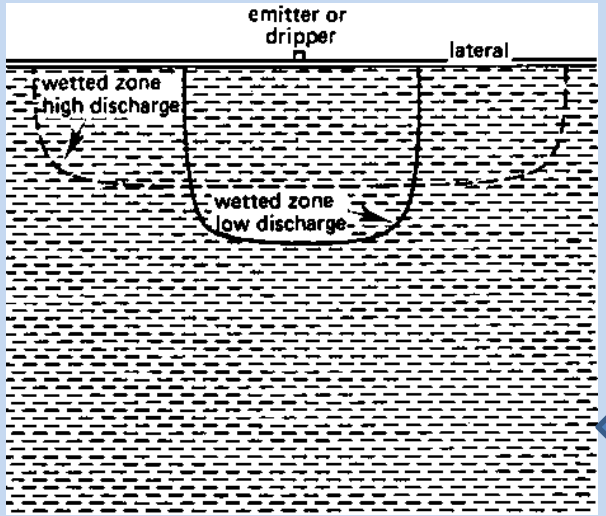


Water further away from the trunk or stem as time progresses and as the plant grows larger in diameter.

How water disperses in the soil

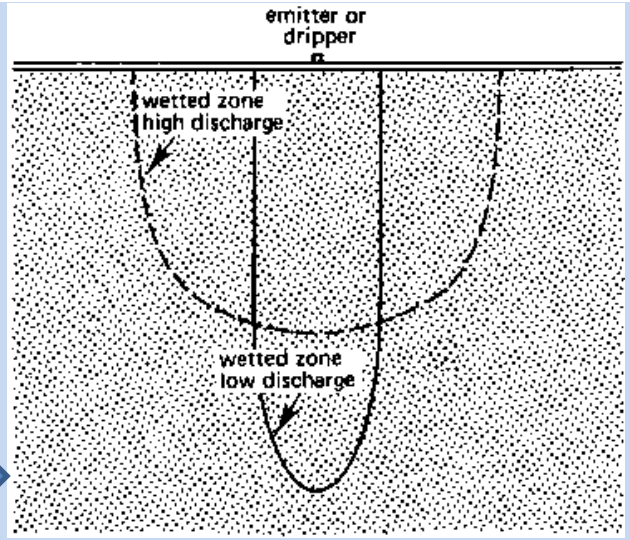
- The wetting patterns of irrigation water in clayey, loamy, and sandy soils.





Water applied to clay or organic soils

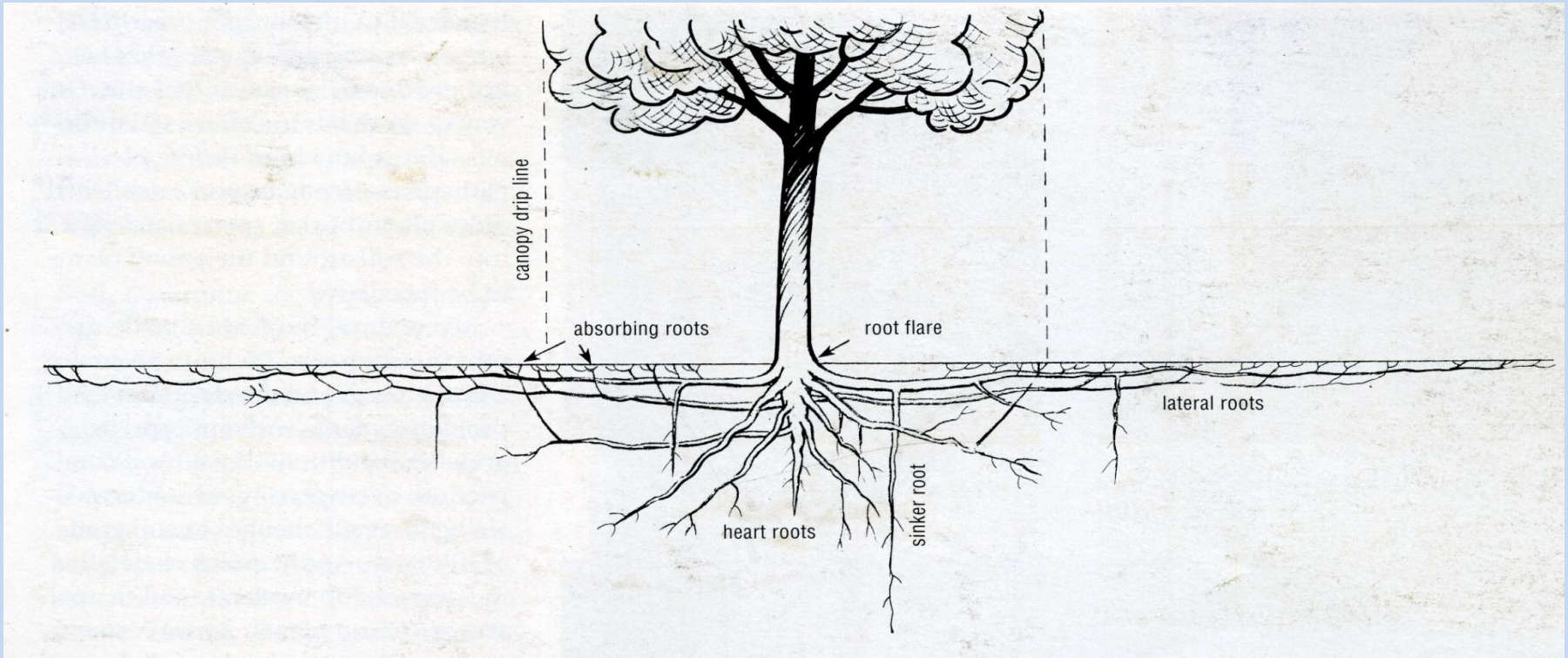
Water applied to sandy soils or soils low in organic materials



- **Soil texture and structure directly affects the movement of water through the soil. Water spreads out more horizontally when traveling through a soil higher in clay or organic components and travels more vertically though a soil higher in sand or lower in organic materials.**

Depth of Water Extraction by Roots

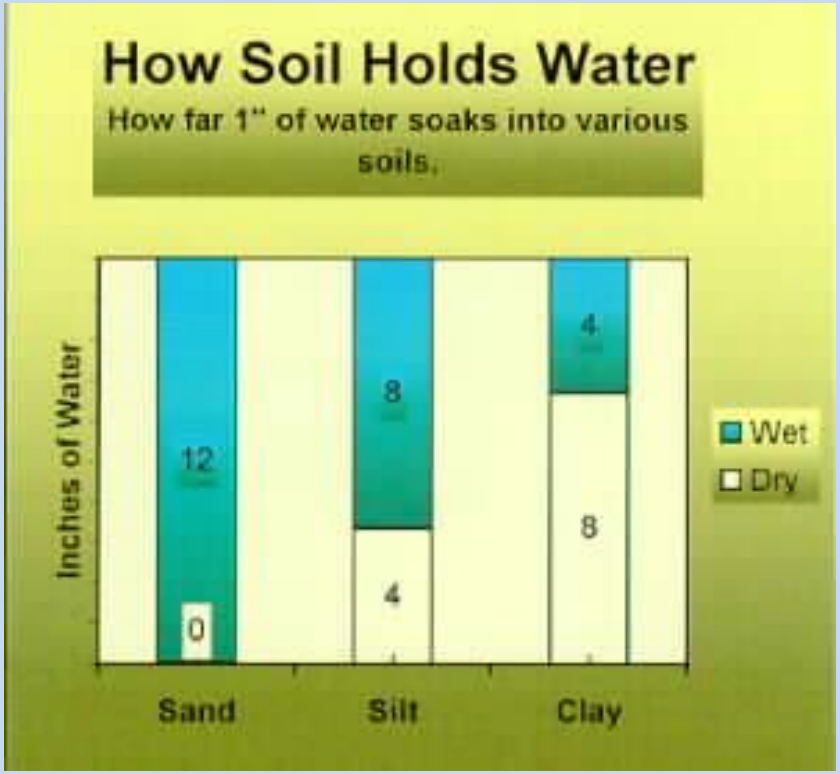
- Most water is taken up by roots from the top 12” of soil (40% - 70% or more).
- Up to 90% of the roots that take up water and nutrients are located in the top 36” of soil.
- Watering methods can determine root depth:
  - Light, shallow watering encourages shallow roots. This results in plants that dry out easily and can blow over in storms.
  - Deep, infrequent watering is best to encourage roots to penetrate deeply in the soil.



Soil texture and Water Penetration

Inches of water per one foot soil depth:

- 1” of water penetrates the ground 1’ in sandy soil.
- It takes 2”-3” of water to penetrate the ground 1’in clay soil.



Textural Class	Available Water Capacity (Inches/Foot of Depth)
Coarse sand	0.25–0.75
Fine sand	0.75–1.00
Loamy sand	1.10–1.20
Sandy loam	1.25–1.40
Fine sandy loam	1.50–2.00
Silt loam	2.00–2.50
Silty clay loam	1.80–2.00
Silty clay	1.80–2.25
Clay	2.25-3.00

KEYS TO PROPER WATERING

Water with sufficient amount of water – enough to thoroughly wet the entire depth of the Feeder Root Zone.

1” of water penetrates the ground 1’ in sandy soil, it takes 2” of water to penetrate the ground in clay soil.

90% of feeder roots are found in the top 3’ of soil! (70% are in the top 1’ of soil.)

Water to an average depth of 1’ to 3’ at each watering for plants that have been established in the ground. Smaller plants generally have shallower root systems than larger plants. As a general rule, water to a depth of 6” to 1 foot for plants 1’ or less in height, to a depth of 2 foot for plants 1’ to 4-5 feet in height and to a depth of 3’ for plants larger than 5 feet in height.

For plants in containers, water with enough water to leach excess salts out of the container and to thoroughly wet the entire root ball at each watering.

KEYS TO PROPER WATERING

Water at the correct interval – often enough to keep the plant from wilting, but infrequently enough to allow air to penetrate the soil.

Roots can drown if the soil is kept constantly wet!

Watering frequency will vary with the time of year, location, size of the plants, soil, weather conditions and many other variables.

On average:

Water new plants in the ground 1-2 times per week.

Water older established plants in the ground 1 time per week to 1 time per month depending on the variables.

Water plants in containers 1-3 times per week.

There are very few exceptions where plants should be watered every day! Watering too frequently will exclude oxygen from the soil and cause roots to drown as well as promote diseases!

Soils and Plant Nutrition

- There are 17 elements that plants need in order to successfully grow and complete their life cycle. These elements are called the “Essential Elements”.

- 14 of the elements are minerals taken in by roots from the soil.

- These essential elements are broken down into two categories: macro elements and micro elements.

- The macro elements that are minerals taken in by roots from the soil are nitrogen, phosphorus, potassium, calcium*, magnesium*, and sulfur*.

- The micro elements are Boron, Zinc, Manganese, Chlorine, Iron, Molybdenum, and Copper and Nickel.

- **The availability of these nutrients for plants to absorb from the soil is affected by the soil pH and the microorganisms which live in the soil.**

Types of Fertilizers

- Organic – Most rely on soil organisms to convert them to nutrients which are available for absorption by plant roots.

- Conventional ie. Synthetic
  - Fast release
  - Slow release
  - Time release

Fertilizers are not plant foods!

- Micro-organisms can directly affect nutrient absorption by plants. The nutrients that are most affected include **Nitrogen and Phosphorous**.

- **The application of soil amendments or fertilizers that are high in salts, release high levels of nutrients too quickly, modify soil pH outside a desirable pH range, or cause soils to become too soggy, excluding adequate aeration, can kill soil micro-organisms!**

Nitrogen (N)

- The most critical element in plant growth. **This is the nutrient that is most commonly lacking in soils and most frequently needs to be added to soils.**

- Can be absorbed into roots in only two forms: NH_4+ (ammonium) & NO_3- (nitrate). **The nitrate form of nitrogen is very prone to leaching.**

- Sands and well drained soils tend to lose NO3- very easily during high rainfall or frequent irrigation.

- Fertilizing with the ammonium form of nitrogen (NH4+) is less prone to leaching as the + charge tends to bond with the negatively charged clay particles.

- **Ammonium Volatilization** occurs when ammonium fertilizers are applied to the surface of alkaline soils. These soils, typically high in calcium and carbonate, can react with the ammonium fertilizer and result in losses of up to 30% to the atmosphere. **Ammonium fertilizers should be incorporated into the soil to lessen this loss.**

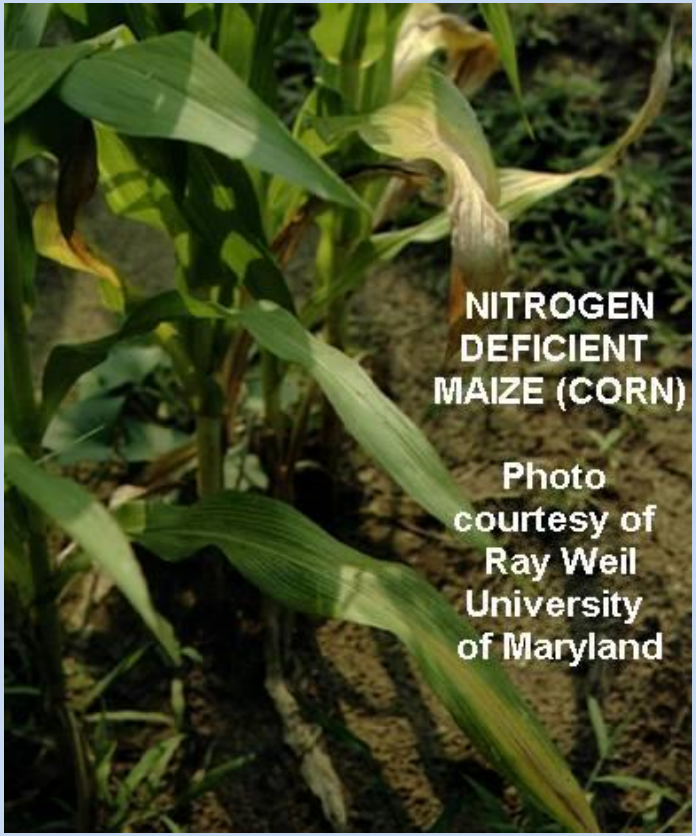
- **The addition of some form of nitrogen type fertilizer is most often needed to maintain plant health on most types of plants!**

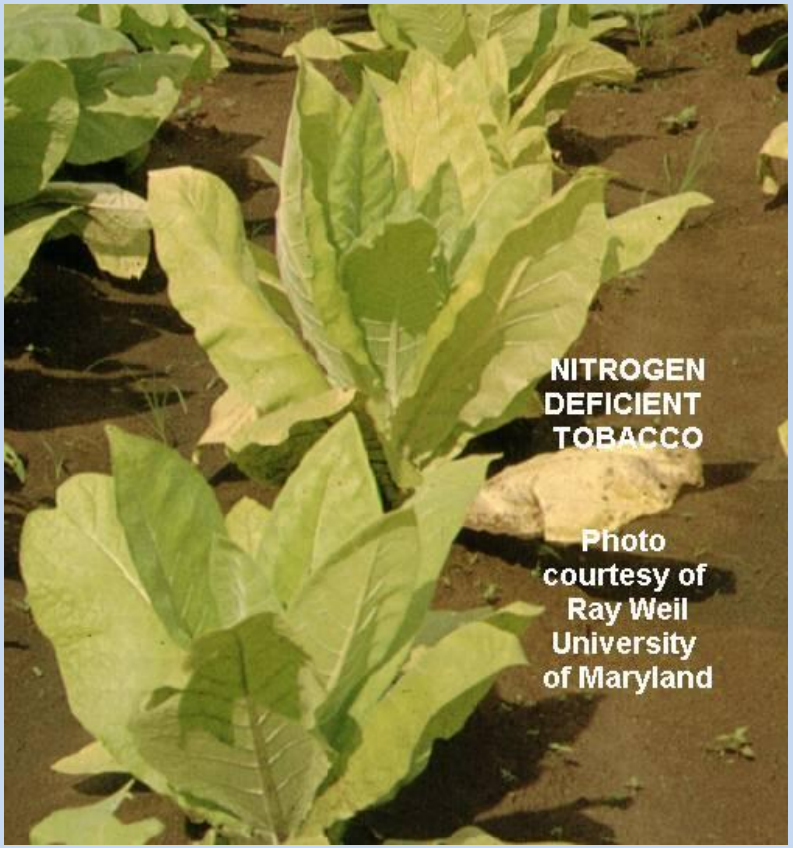
Nitrogen Deficiency Symptoms

- Light green to yellow color on leaves. Older leaves show symptoms first

- Leaves may go completely yellow but still be alive. Yellowing occurs from the tip of the leaf downward and may later dry up.

- Plants are spindly and stunted





Phosphorus (P)

- The second most needed plant nutrient. It is the least mobile in soil and minimally affected by the leaching processes.
- **Most plants get phosphorus by organic matter breakdown near the roots.**
- Even though phosphorus may be present in the soil, it can be easily tied up by iron, aluminum, and calcium depending on the pH of the soil.
- **Mycorrhiza which have formed associations with plant roots can greatly increase the ability of the plant to absorb phosphorous.**
- Addition of phosphorus fertilizer is often necessary due to the high need of plants and the ease of phosphorus tie-up. It is best when it is worked lightly into the soil.

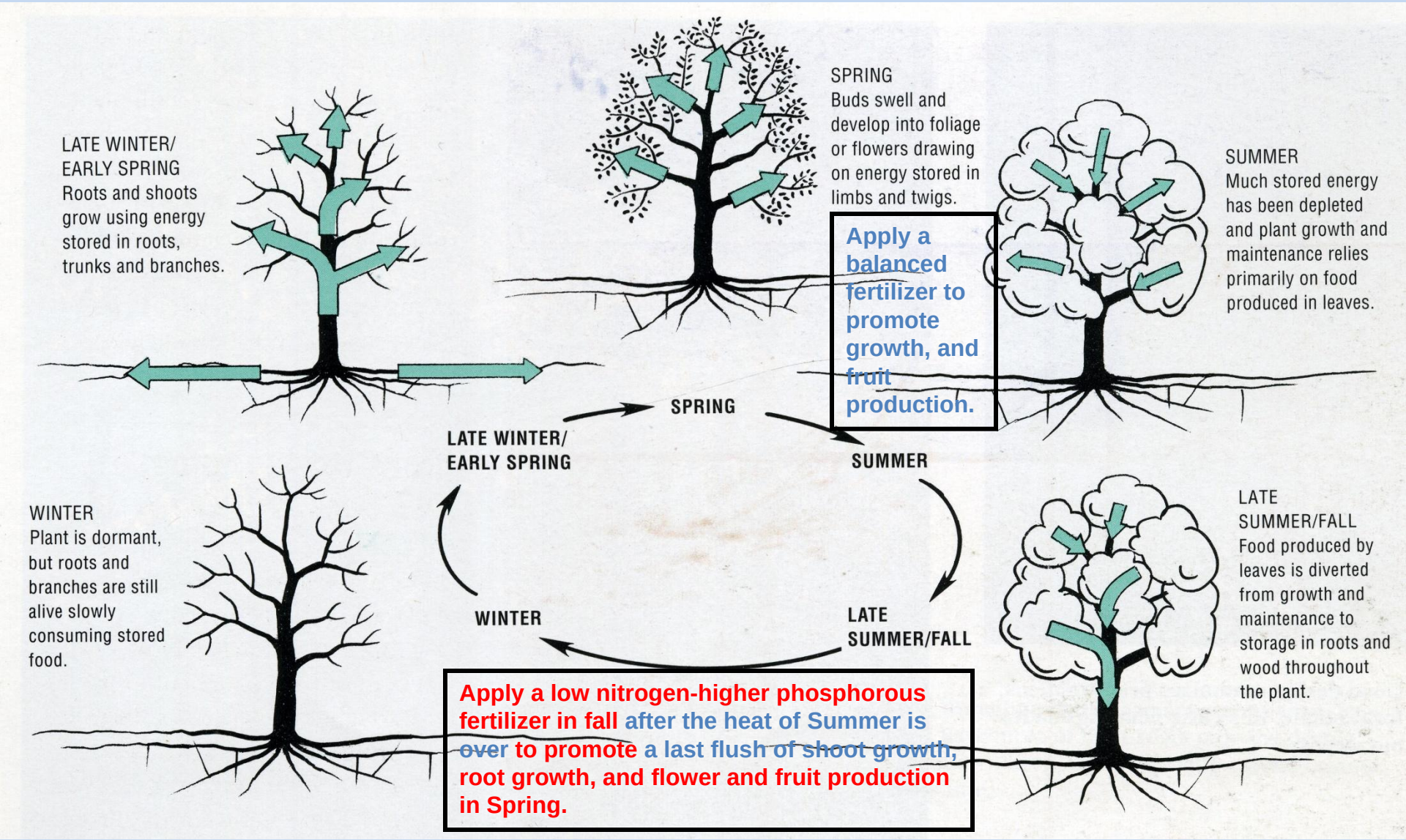
Iron (Fe)

- Generally found in most soils but can be tied up on alkaline soils.

Iron Deficiencies

- Symptoms show on young leaves first.
- Leaf show yellowing between the veins with the veins staying green (call iron chlorosis).
- In severe cases, leaves turn whitish and then can blacken.
- Eventually, shoot tips may die.

Timing Fertilizers to Seasonal Growth



Soil Temperature

- Warm Soils: (Temperatures 70-90 degrees F.)
  - Increases biological activity which increase nutrient availability to plants.
  - Aids in the germination of seeds.
  - Increases availability of nitrogen and phosphorus.
- Cool Soils: (Temperatures below 65 degrees F.)
  - Can slow or entirely stop biological activity.
  - Can tie up certain plant nutrients.
  - Can result in freezing and thawing which breaks up soil aggregates.

Pruning for structural strength, tree health, fruit production and size

Traditional pruning methods have frequently emphasized fruit production while sacrificing tree health and long tree life. Skills needed to prune trees properly take time to learn and training to develop.

Instead of following pruning principles that promote tree health and long tree life, it is a standard practice and is often considered easier and more “cost effective” to replace the trees after a relatively short period of time (10 – 20 years).

Recent research on pruning by Richard Harris and Alex Shigo (among others) has taught new principles and given new insights on how plants respond to pruning and how pruning affects tree health.

This research has been adopted by the International Society of Arboriculture to establish new and better pruning standards for the way we should prune trees.

Using these principles to prune fruit trees can increase tree longevity and fruit production while reducing maintenance costs as well as help to reduce pest and disease problems on our fruit trees!

PRUNING:

- A pruning cut is a wound that is a possible entry point for decay, diseases or insects.

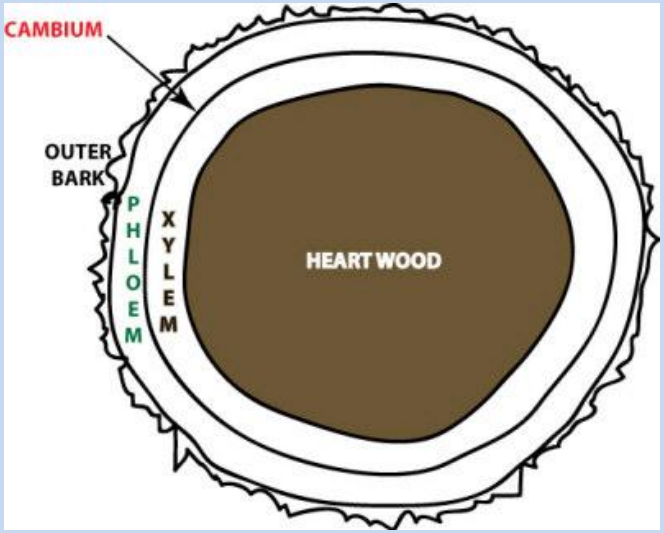
- Plants "heal" a wound by a process called compartmentalization. This process surrounds the wounded area both internally and externally with tissue that has greater resistance to decay. The wounded area never grows back together and this wound remains a weakened area for the life of the plant.

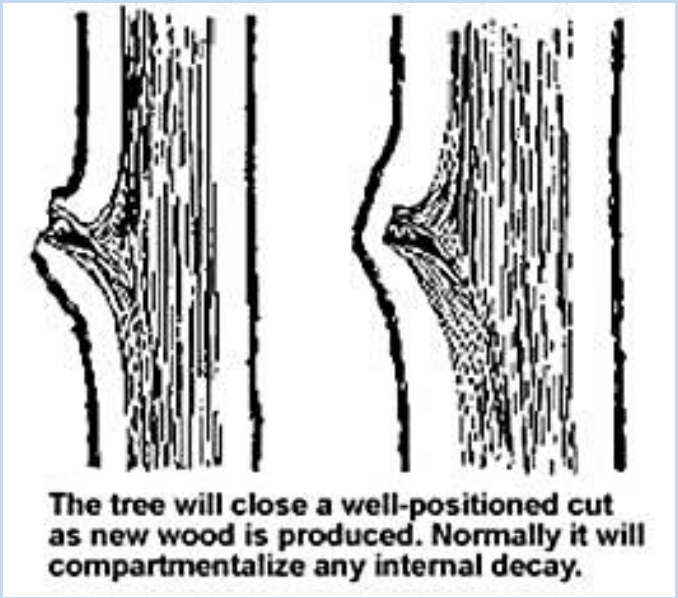
PRUNING:

- Cutting a small branch and making a small wound is always more desirable than cutting a larger branch and making a larger wound. Larger wounds take longer to "heal" (or compartmentalize) and have greater potential for attack by decay organisms, diseases and insects.

Healing Response to Pruning

- Healing naturally follows pruning or wounding. It starts in the cambium, a thin layer of cells between the wood and bark.
- Two areas of the cambium, the *bark ridge* at the junction of two limbs, and the *branch collar* function to close off the wound between the plant and the pruning cut.
- For fastest healing, prune close to the main branch without injuring the bark ridge or branch collar areas.




The tree will close a well-positioned cut as new wood is produced. Normally it will compartmentalize any internal decay.

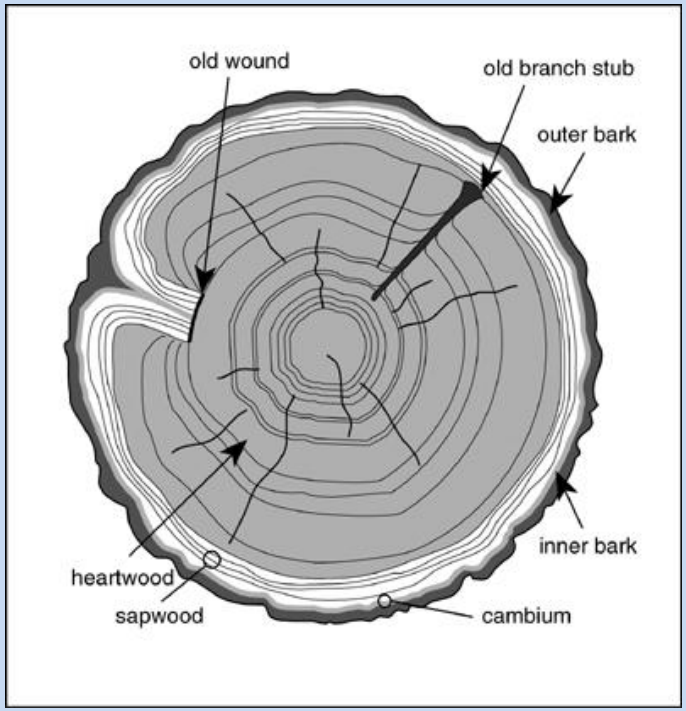
Healing Response to Pruning

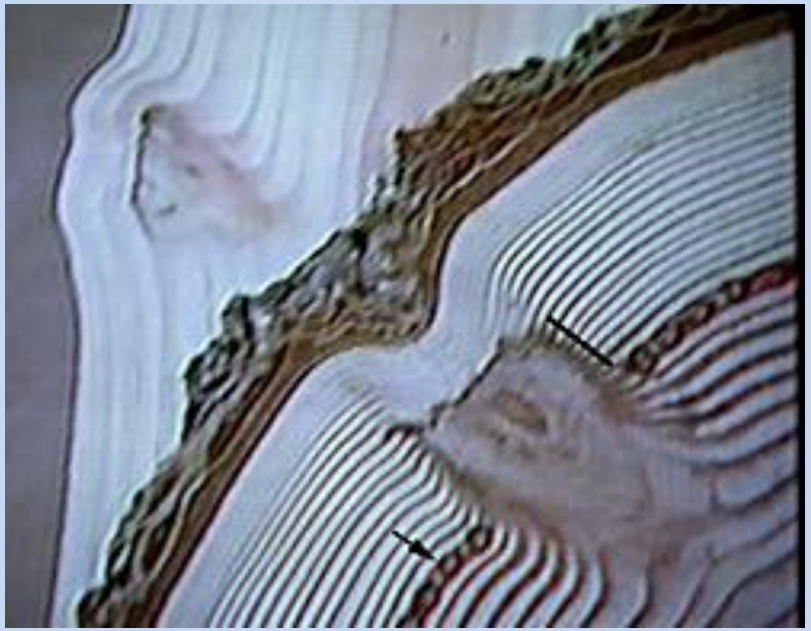
- Natural target cuts start to seal over quickly as *woundwood*, sometimes called *callus*, forms at the wound edges (callus forms first and becomes woundwood as it matures and becomes woody).

- Woundwood usually forms in a continuous ring around a natural target cut, eventually sealing over the wound as it grows together.

Healing Response to Pruning

- The term “seal,” rather than “heal,” is used to describe tree wound closure, since the wound still exists inside the tree even after it no longer shows on the outside.





Pruning Sealers

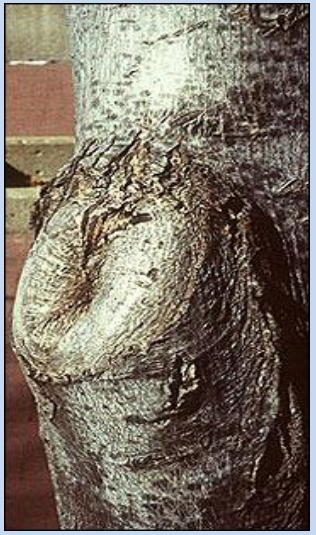
- Although pruning sealers have commonly been recommended to use on pruning wounds, studies have shown that **these products are not beneficial and should not be used!**

- At best, they are purely cosmetic and do no good.

- At worst, they trap disease organisms against the wounded area and encourage disease and decay as well as impair the ability of the tree to grow over the wounded area and compartmentalize the wound!

- **Do not use these products when pruning your trees!**

Natural Target Pruning



Making Proper Pruning Cuts

Natural Target Pruning - Definition

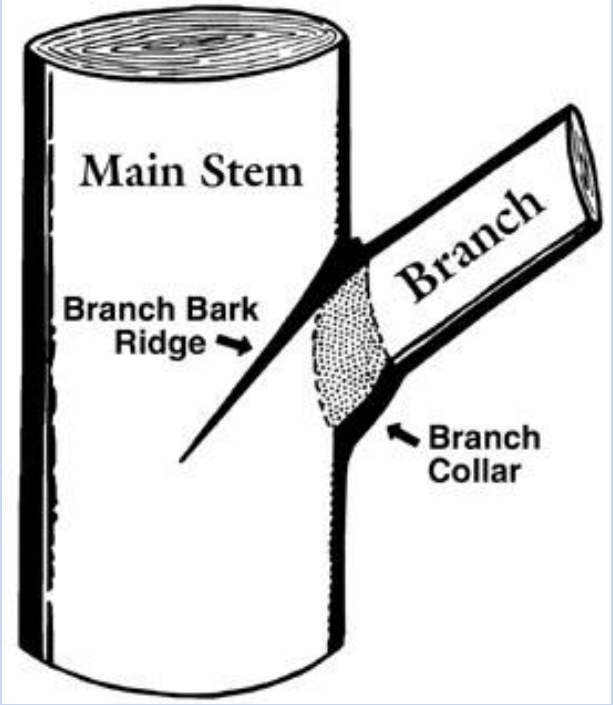
- Natural target pruning, as defined and described by Alex Shigo is a radical change from the conventional method used by arborists since the advent of the chain saw to remove branches from hardwood and coniferous trees.

- In natural target pruning the objective is to leave the branch collar on the primary stem or tree trunk while removing the remainder of the branch.

Where to Cut: Natural Target Pruning

- Good pruning cuts are called *natural target cuts* by arborists, who use two targets on the tree to show them where to make the cut.

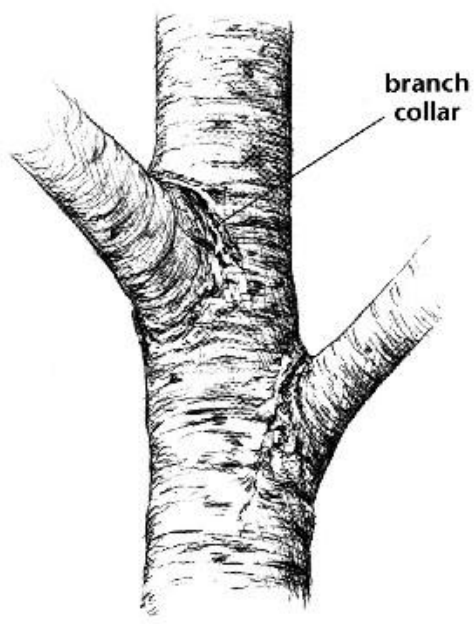
- These targets are the *branch collar* and the *branch bark ridge*.

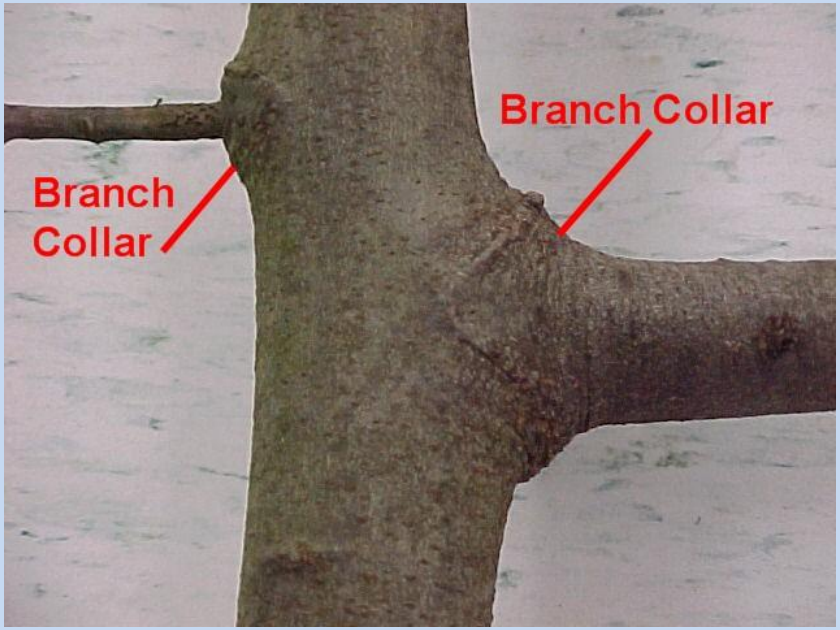


The Branch Collar

- The branch collar is evident on many species of tree, some more than others. It is the base of the branch where the natural branch taper begins to flare out as it connects to the limb or trunk.

- The branch collar is (typically) a swollen, wrinkled area at the branch base where branch and trunk (or branch and branch) tissues come together.



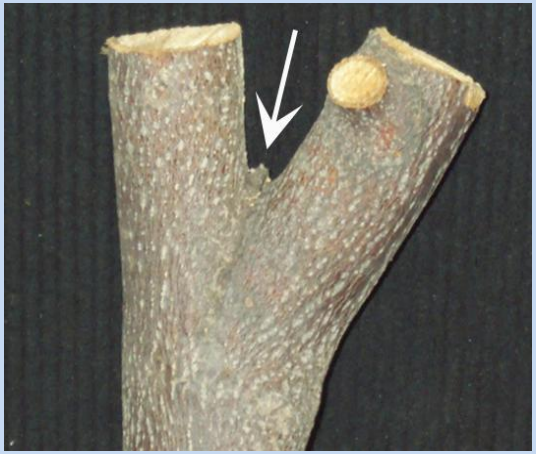


The Branch Bark Ridge

- Every branch has internal tissues that separate it from the trunk. These tissues are instrumental in the process of wound closure and self-defense and must be protected and maintained during pruning.

- As this internal branch tissue forms, the bark is forced upward to form a raised ridge on the trunk that separates the branch from the trunk. It extends down the branch or trunk on either side of the branch crotch.

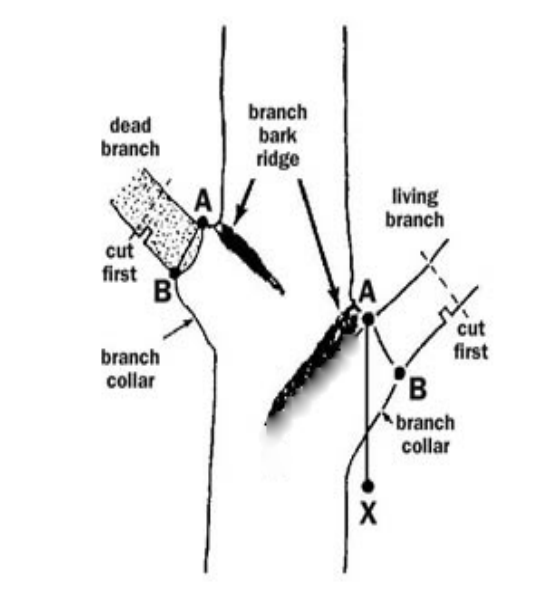
- This raised area is the branch bark ridge.



A Natural Target Cut

- A natural target cut leaves the branch bark ridge and branch collar on the tree without leaving a stub.

- The cut passes just outside the branch bark ridge on top and usually slants out and down, leaving a bump but no stub (from A to B on the diagram). The cut is made on the outside of the branch collar.



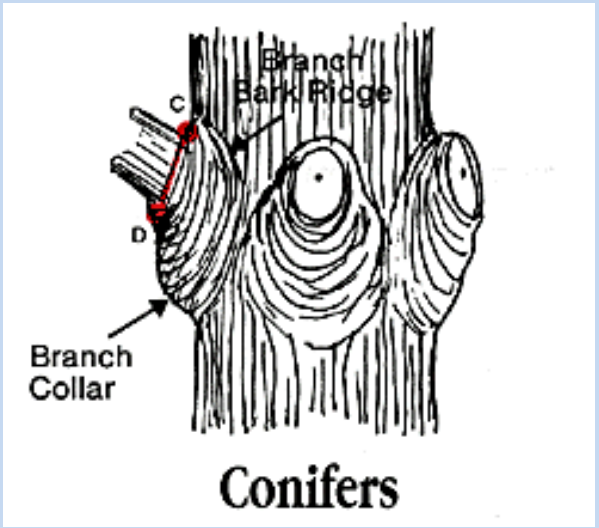
- **The branch collar should never be injured, cut into or compromized in any way.**

A Natural Target Cut

- Though the “targets” usually are easy to see on most broadleaved trees, some trees like sycamore constantly lose bark and don’t accumulate a branch bark ridge.

Do not injure the branch collar when pruning

- Conifers also may not accumulate a typical branch bark ridge. In both cases, cut outside any swollen or wrinkled branch collar.



Conifers

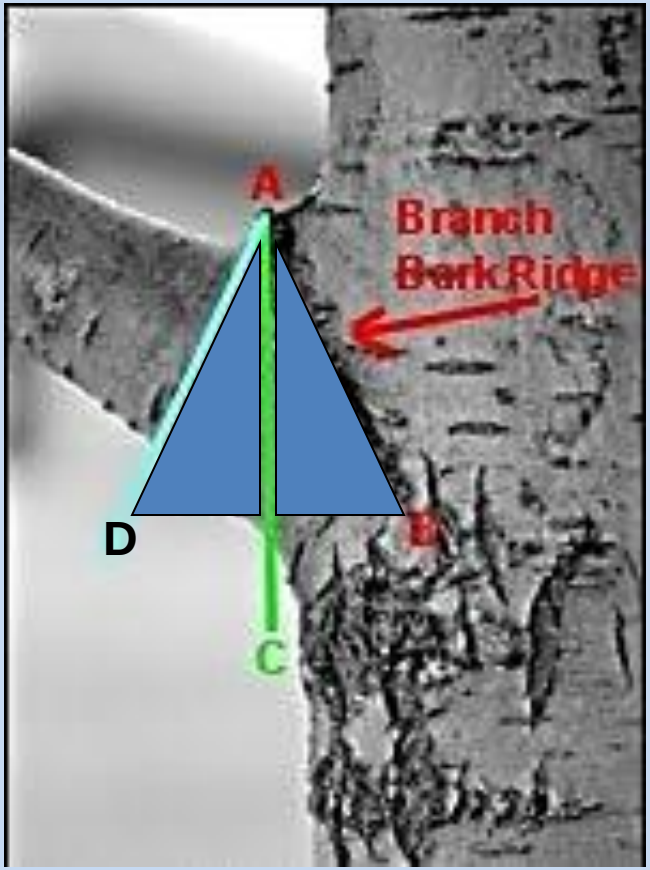
A Natural Target Cut

- Some trees make it a little harder on us to find the branch collar and the target cut, but for them there is another rule of thumb generalization developed by Dr. Alex Shigo.

- Find the top of the branch bark ridge (A). The top of the cut is made at the top of the branch bark ridge.

- Make an imaginary vertical line from the top of the branch bark ridge straight down to the ground (line A-C). Now determine the angle between this vertical line and the bottom of the branch bark ridge (angle C-A-B).

- Reverse this angle on the opposite side of the vertical line A-C (angle C-A-D). The natural target cut is made along the line of this reversed angle (line A-D).



Making a Natural Target Cut

- Proper pruning means removing the branch so that the branch collar is not injured or removed. No cuts should start behind the branch bark ridge.

- When removing dead branches, never cut into the callus tissue which has formed at the base of the branch. Remove the branch beyond the callus ridge so that no living material is severed or detached.

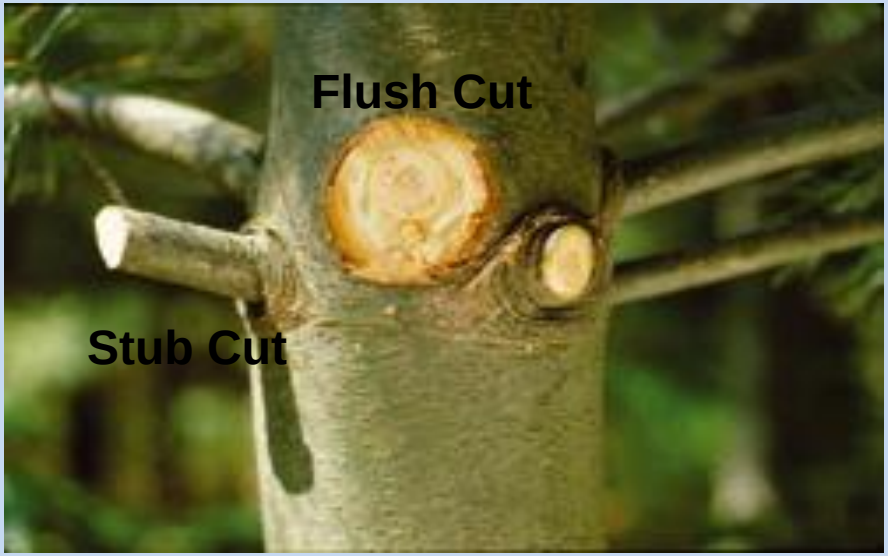
- Three things contribute to the desired result of making a natural target cut:
  - 1. The Branch Bark Ridge is retained.
  - 2. The Branch Collar is intact.
  - 3. The final cut line correctly aligned.

- **There are no set pruning angles applicable to every tree - only targets - the branch bark ridge and branch collar. Correctly using the targets as guides should ensure the right final cut every time!**

Natural Target Pruning
Making Proper Pruning Cuts

- **Good pruning involves removing as much of the branch as possible without leaving a stub or flush cutting.**

Stub Cut



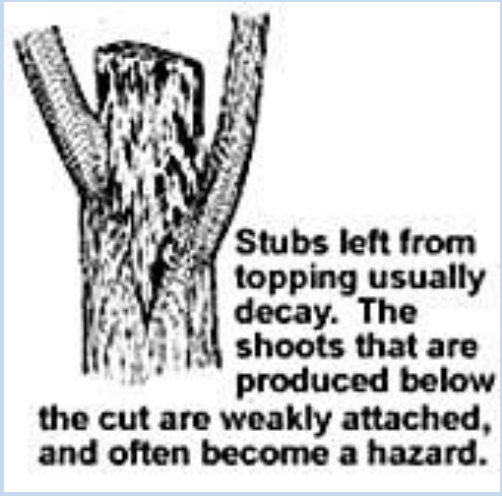
Flush Cut

Stub Cuts

- Stub Cuts are pruning cuts that are made too far outside the branch bark ridge or branch collar. These cuts leave branch tissue attached to the stem.

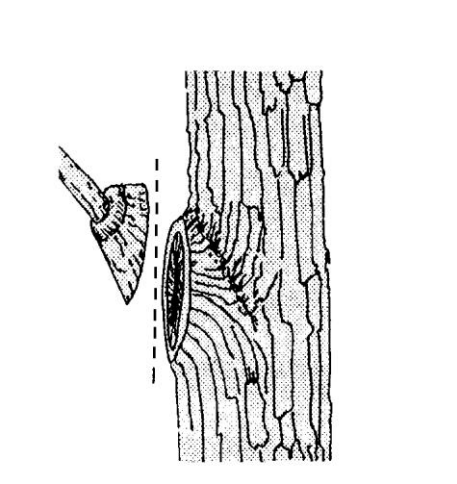
- Disease organisms “incubate” on the dying stub that remains. Eventually the stub becomes a pathway for decay organisms to enter the tree trunk and cause serious wood decay.

- Heading cuts are pruning cuts that shorten a branch or stem so far back that a large stub is created. In this case, the stub decays, creating health problems for the tree.



Flush Cuts

- Flush Cuts are pruning cuts that originate inside the branch bark ridge or the branch collar, causing unnecessary injury to stem tissues.
- Flush cuts can, and usually do, lead to a myriad of defects, including radial cracks, circumferential cracks, discolored wood and wood decay.
- Flush cuts are improper and may break the protective chemical barrier and allow decay organisms to colonize stem tissue. The spread of this decay will eventually end in the demise of the tree.



Included Bark

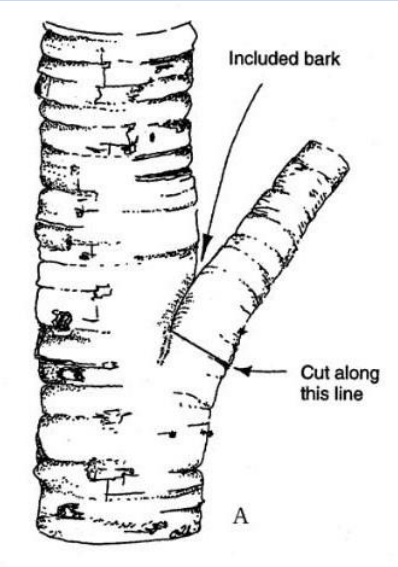
- Sometimes the bark where two branches meet turns in instead of out, forming a seam of *included bark* inside the tree instead of a branch bark ridge. Areas of included bark often die and become decayed.

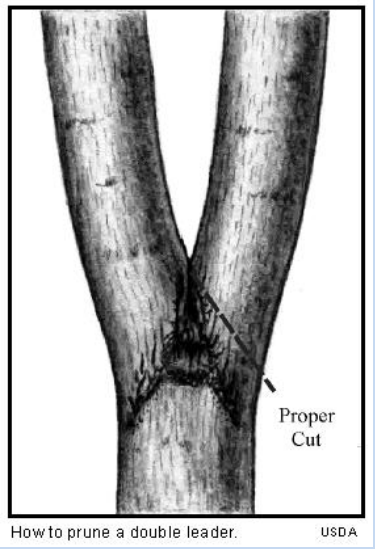
- These areas are naturally weaker than branch attachments with normal branch bark ridges.

- Included bark can be found on any tree. It is more common where branches attach to one another at a very narrow angle, but it can occur with wide attachment angles as well.

Included Bark

- Included bark prevents strong attachment of branches, often causing a crack at the point below where the branches meet.
- Codominant stems that are approximately the same size and arise from the same position often form included bark.
- Remove a branch that has included bark by cutting from the open crotch down and out (or cut up to the crotch).
- This actually leaves a small stub on or in the tree, but cutting farther down may cause serious trunk wounds.





Pruning Leaders or Co-dominant Stems

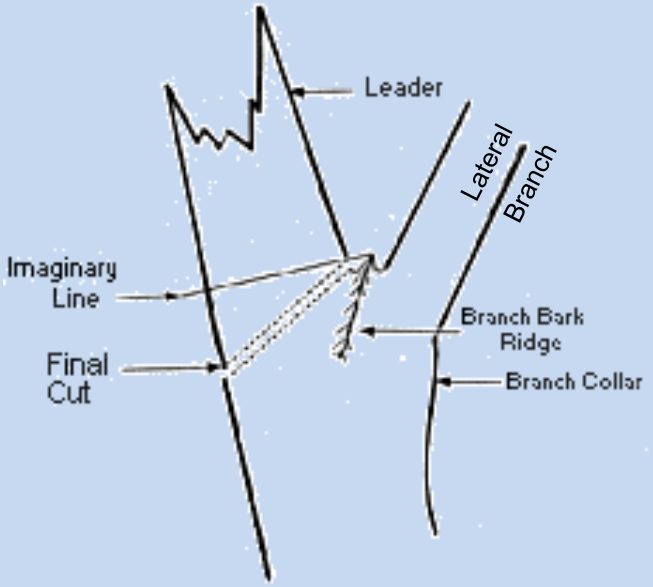
- When cutting back to a lateral branch, a natural target pruning cut is made by bisecting the angle between the branch bark ridge and an imaginary line made perpendicular to the leader or the branch being removed.

- The cut should slope out and down away from the branch bark ridge, with the bottom of the cut straight across from the bottom of the branch bark ridge.

- A leader can be pruned off where another branch is attached if the remaining branch is healthy and vigorous and at least 1/3 the diameter of the leader to be removed (so a 6” leader could be removed at a 2” branch).

- No more than about one-quarter of the foliage should be removed from the branch that is being shortened.

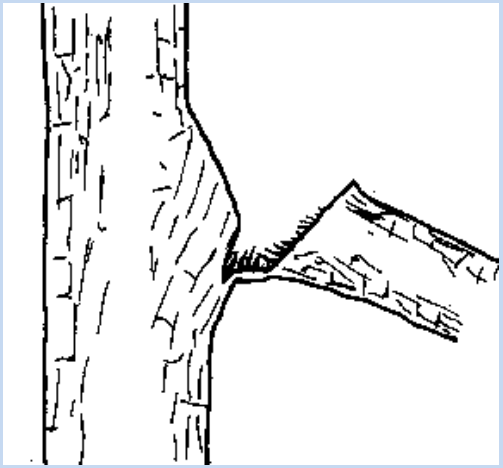
- Co-dominant stems are pruned similarly. Removing some of the lateral branches from a co-dominant stem can reduce its growth enough to allow the other stem to become dominant.



Pruning Large Branches

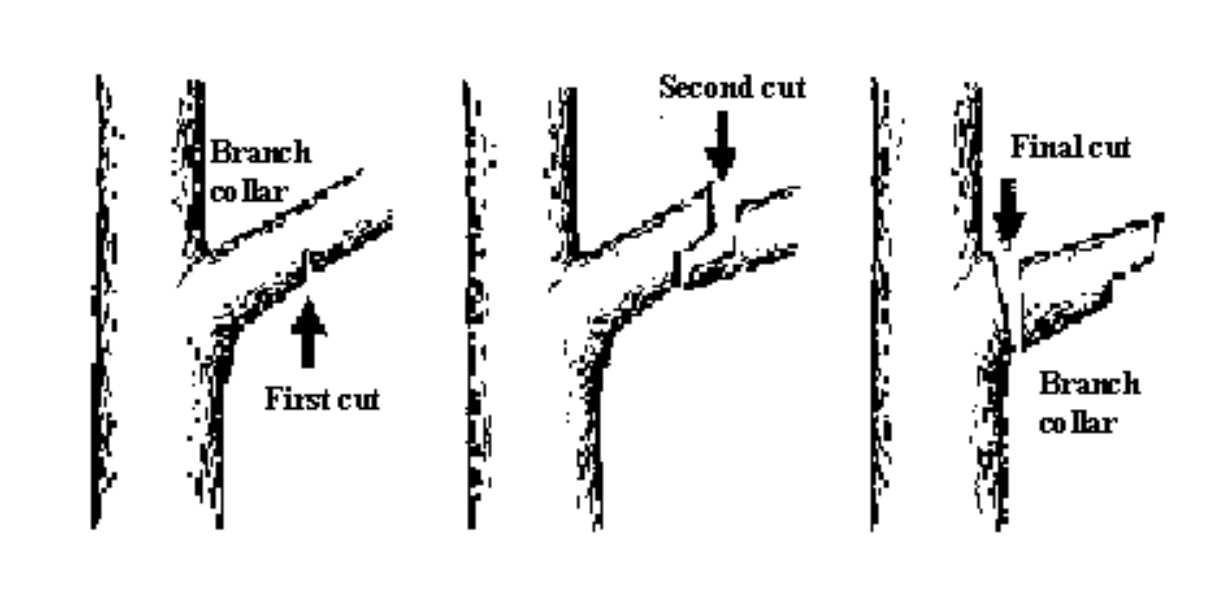
- To remove large branches (over one inch in diameter) use the three-step cutting method.

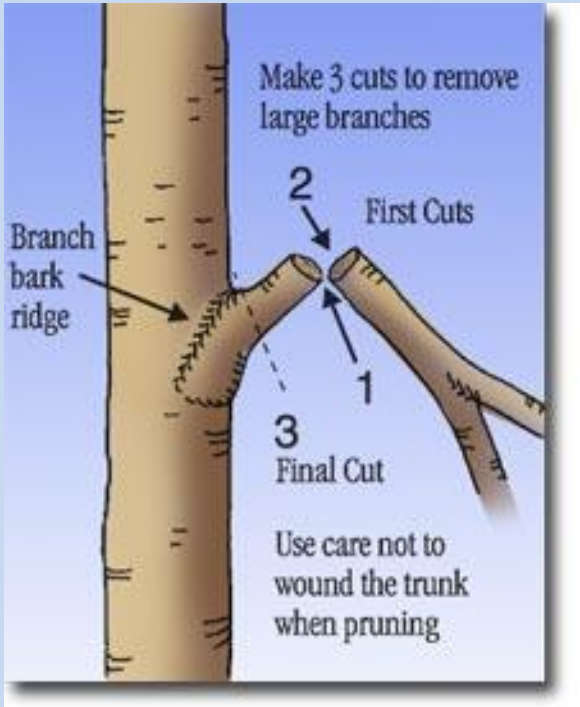
- This removes the weight of the limb before the final cut and eliminates the possibility of stripping the bark down the side of the main trunk.



The three-step cutting method:

- 1. Undercut one-third of the way up through the branch one or two feet out from the trunk to prevent bark stripping.
- 2. Cut down and remove limb. A top cut directly into or slightly outside of the undercut will remove most of the branch weight.
- 3. Trim branch stub at branch collar. Make a final natural target cut that removes the stub. Final cuts can be made from the bottom up to the crotch if the branch angle is tight and tools won't fit in the crotch.





Natural Target Pruning

- Natural target pruning is a way to minimize the detrimental effects caused by pruning wounds.

- Remember, that a wound on a tree is a wound forever. Trees seal or compartmentalize a wound, they do not heal a wound.

- The goal of any responsible pruner is to reduce the harmful effects of their pruning wounds. This is done by pruning in such a way as to facilitate the closure and compartmentalization of these wounds as quickly as possible by following the principles of natural target pruning.

- **Do not:**
  - make flush cuts behind the branch bark ridge.
  - leave living or dead stubs.
  - injure or remove the branch collar.
  - paint cuts.

Types of cuts:

Heading cuts / Topping cuts:

- Cuts made to remove a portion of a branch, stem or trunk. Cuts are made without regard to the position of the cut or to lateral branch attachment.

- Heading cuts usually result in excessive branch development below the cut. These branches are usually poorly attached and frequently break off damaging the branch or trunk they were attached to.

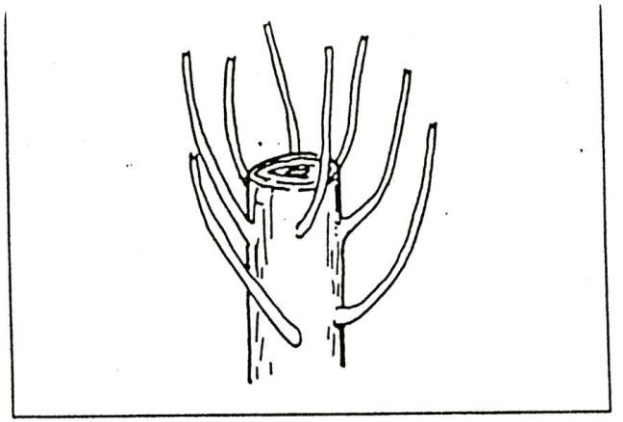
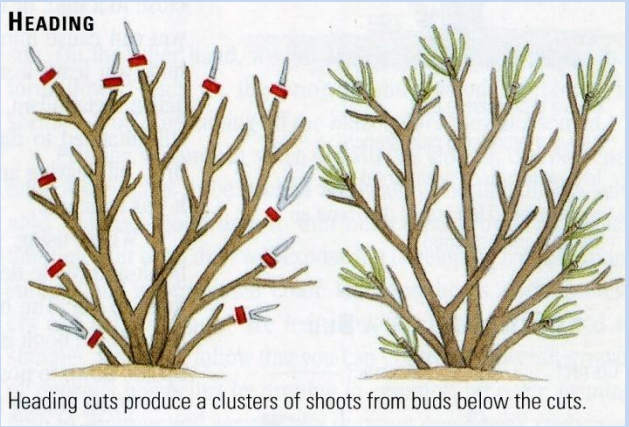


Fig. 8.11 Watersprouts develop profusely following a heading cut.

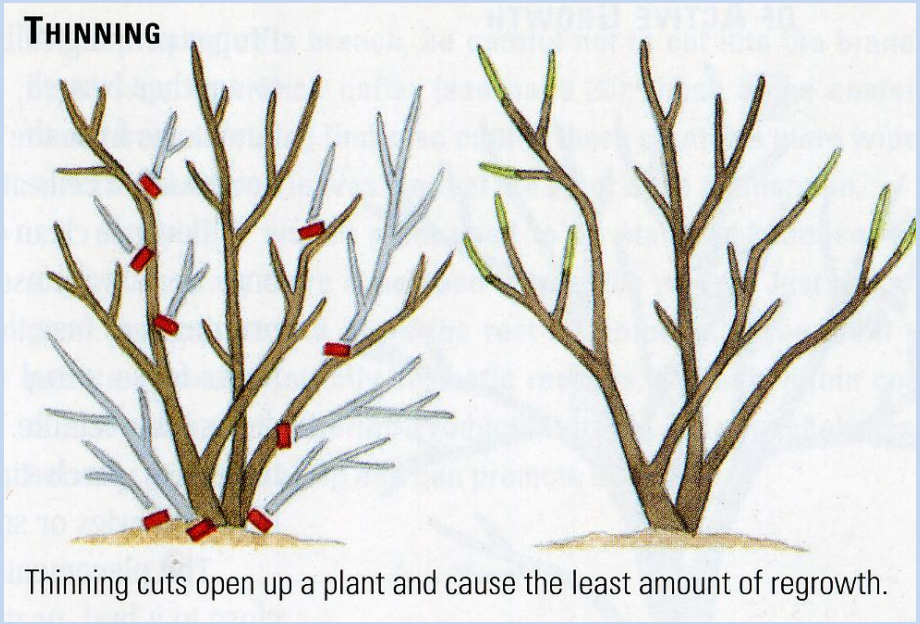


Heading cuts produce a clusters of shoots from buds below the cuts.

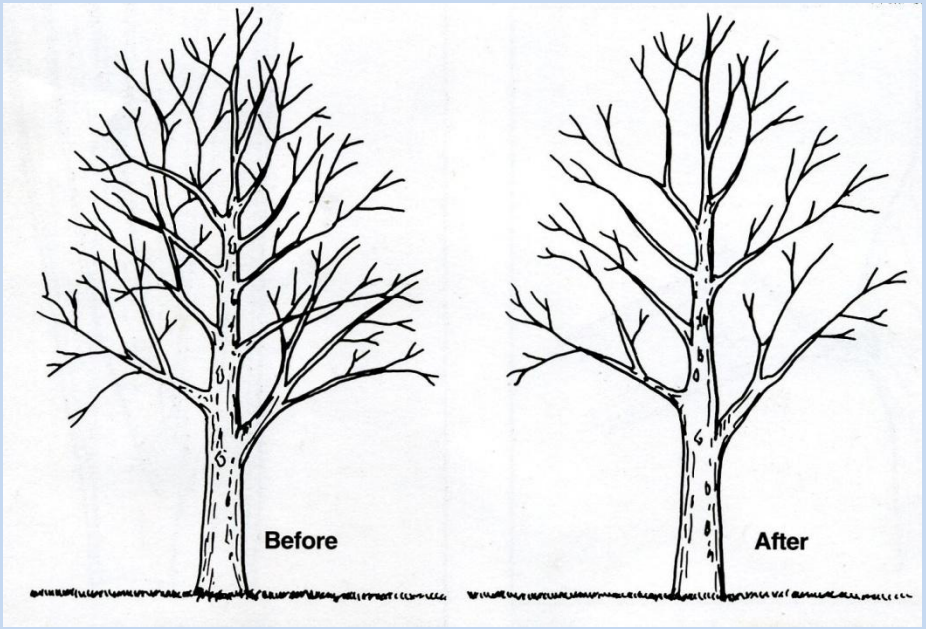
Types of cuts:

Thinning cuts

- Thinning cuts - Cuts used to remove an entire branch or stem at the point of origin, or to remove a portion of a branch or stem by cutting back to the crotch of a branch which is at least 1/3 of the diameter of the branch that is being removed, (drop crotching).

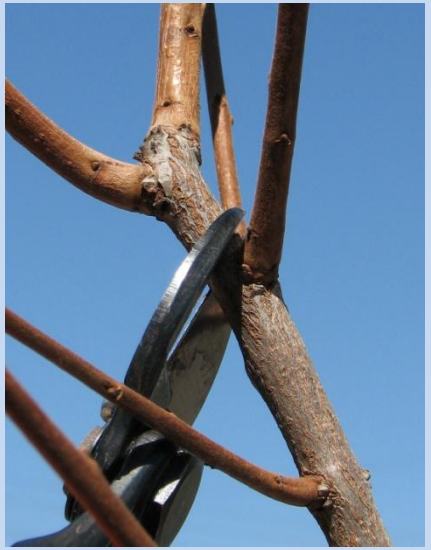


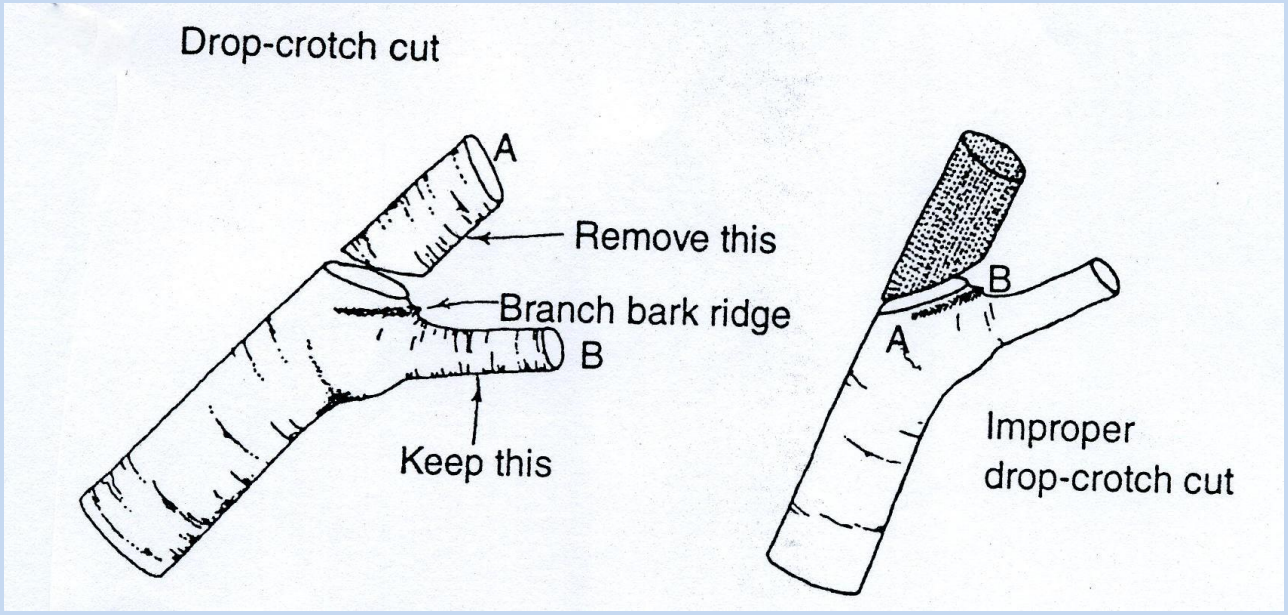
Thinning cuts open up a plant and cause the least amount of regrowth.



Types of cuts:
Drop Crotch cuts

- Drop crotch pruning is a type of thinning cut and is a recommended method for reducing the size of a plant in both height and width.





Making Cuts with Bypass Hand Pruners and Loppers

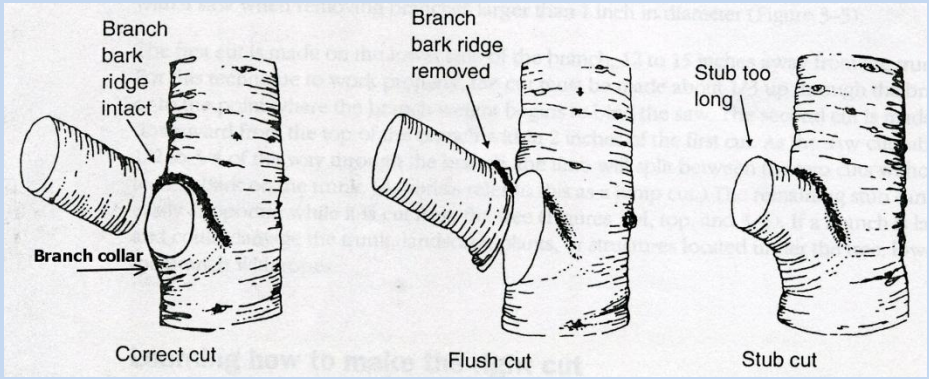
- Place the cutting blade at the top of the collar to make a correct cut.

- Placing the cutting blade on the outside of the cut will leave a stub above the remaining branch collar.

Making proper cuts:

- Never leave stubs...

  The cut will not compartmentalize, and decay and disease will enter the wound.



- Never make flush cuts.

  This makes a larger wound which takes longer to compartmentalize and also removes the collar or shoulder which is helpful in triggering the wound response.

- Never make ripped or torn cuts.

- When removing a larger branch, follow the three cut process to prevent damage to the bark.

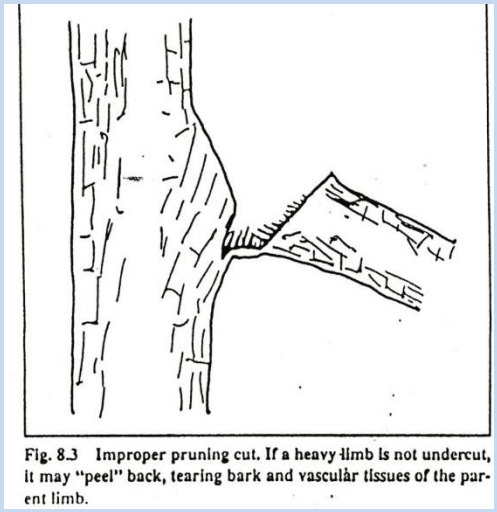
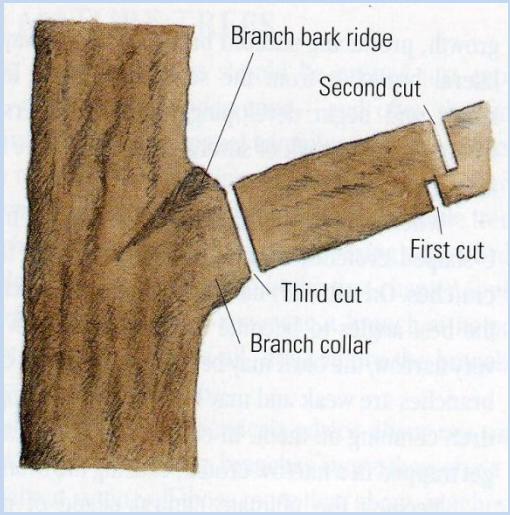


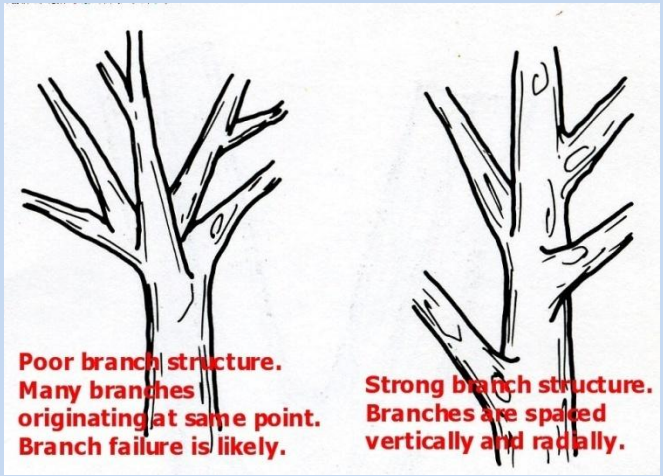
Fig. 8.3 Improper pruning cut. If a heavy limb is not undercut, it may "peel" back, tearing bark and vascular tissues of the parent limb.

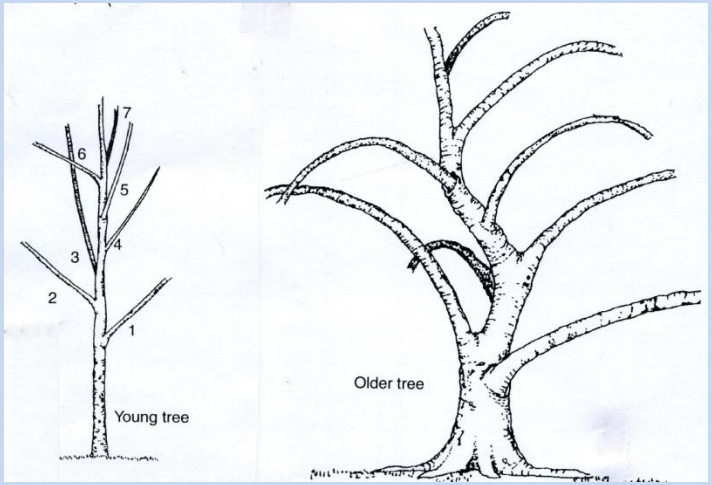


REASONS TO PRUNE
Structural Strength:

- Pruning for structural strength is especially important on fruit trees. Heavy crops of fruit can easily break branches, severely damaging main scaffold limbs or splitting trunks. Basic guidelines for structural pruning are as follows:

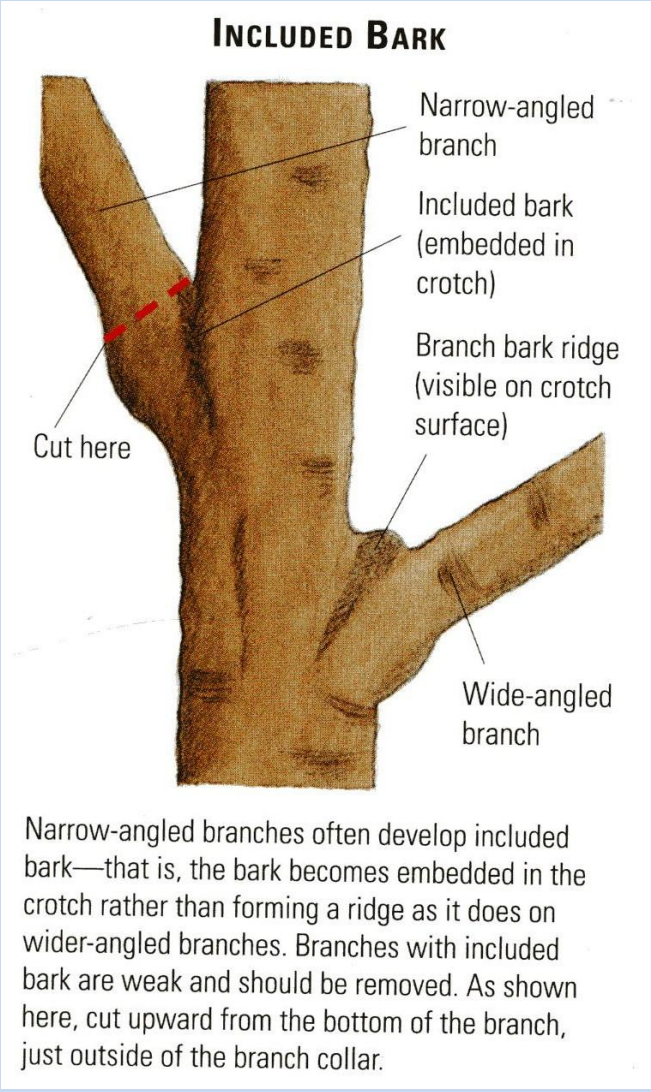
- Train scaffold branches to be spaced along the trunk both vertically and radially when trees are young.





REASONS TO PRUNE
Structural Strength:

- Increase the crotch angle of branches to greater than 30 degrees by spreading branches apart or by pruning off one of the branches.



Narrow-angled branches often develop included bark—that is, the bark becomes embedded in the crotch rather than forming a ridge as it does on wider-angled branches. Branches with included bark are weak and should be removed. As shown here, cut upward from the bottom of the branch, just outside of the branch collar.

REASONS TO PRUNE
Structural Strength:

- Remove co-dominant leaders by removing or reducing one of the branches.

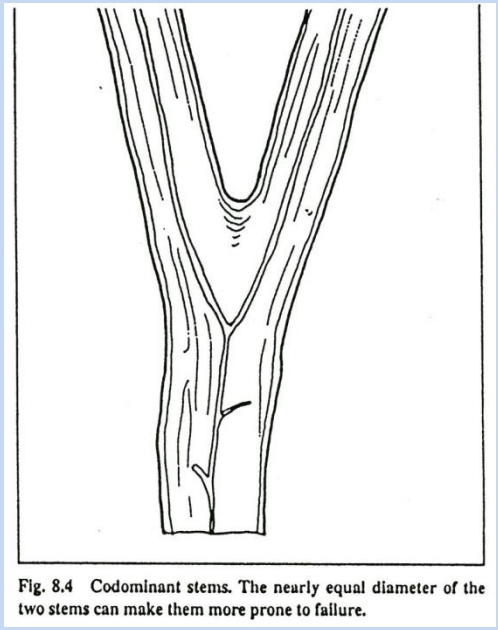
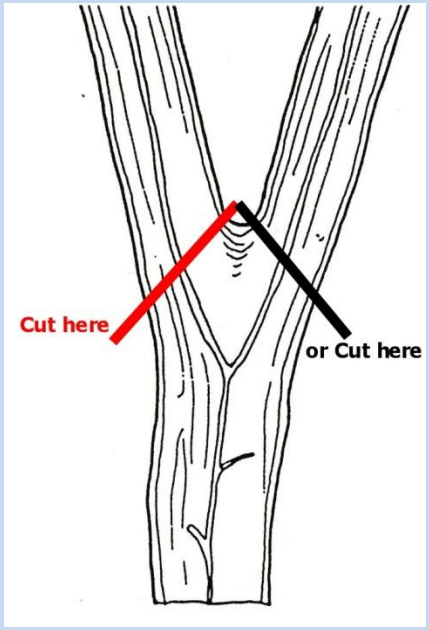
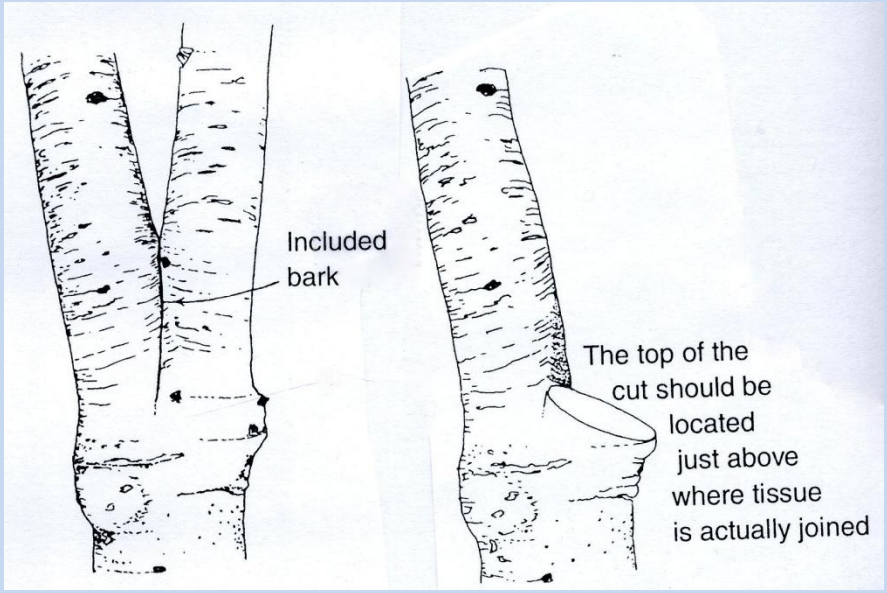


Fig. 8.4 Codominant stems. The nearly equal diameter of the two stems can make them more prone to failure.



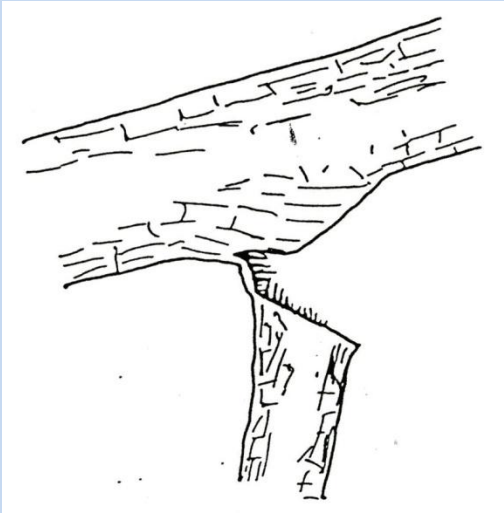


- Occasionally one of the branches can be redirected into a lateral branch by spreading the branch. This redirected branch will no longer be co-dominant. The crotch angle should be spread to 30 degrees or larger.

REASONS TO PRUNE
Structural Strength:

- Prune off branches which are attached to the bottom side of attached branches. (Unless this is going to become the new terminal end of the branch.)

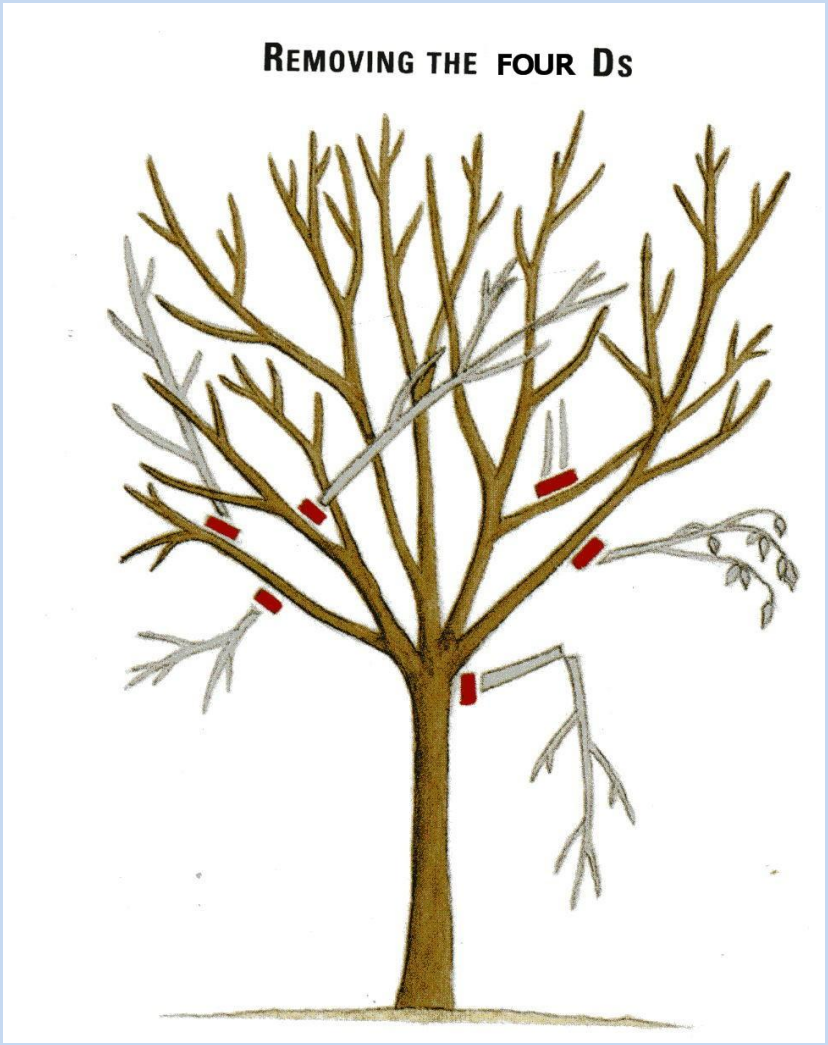
- If these branches break, ripping or tearing of the bark of the supporting branch often results.



REASONS TO PRUNE
Health:

- Prune off the four D's: Dead, Damaged, Diseased and Dysfunctional branches.

- Dysfunctional branches are branches which are pointing towards the ground or are crossing or rubbing other branches.



REASONS TO PRUNE

Fruit or Flowers:

- Prune to leave flowering and fruiting wood for specific fruit types. (Fruiting spurs, last season's growth/ one year old wood, or current season's growth.)

- Thin branches and fruiting wood to allow adequate light penetration and air circulation for proper fruit development for each fruit tree type.

REASONS TO PRUNE
Shape:

- Prune trees to specific shapes for best fruit production.
- Open vase or modified open vase for trees in the genus Prunus.
- Central leader or modified central leader for all others.

REASONS TO PRUNE
Shape:

- Many fruit trees can also be pruned or shaped for specific function in the landscape such as shade or patio trees, hedges, screens or espaliers.

REASONS TO PRUNE
Direct or redirect growth

- Manage the growth in the tree so that one branch or side of the tree does not overgrow the other portions of the tree and so that the tree keeps a balanced shape.

- Prune to a terminal branch to direct growth in that direction.

- As branches bend downward from the weight of fruit, foliage, or wood, they often need to be pruned back into an upright growing position. Use drop-crotching pruning techniques to a side or top branch to redirect growth.

REASONS TO PRUNE

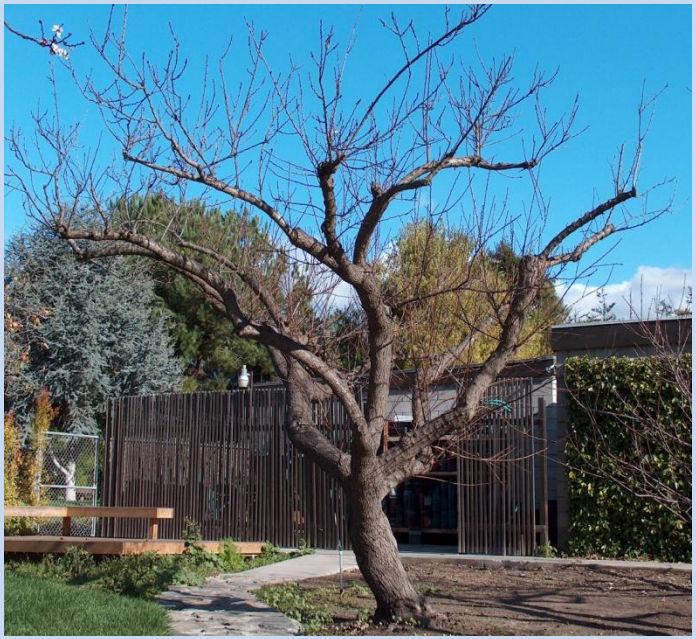
Direct or redirect growth

- As branches bend downward, redirect growth using drop-crotch pruning techniques to a side or top branch to redirect growth upwards.

REASONS TO PRUNE

Size:

- Fruit trees which are pruned to their maximum size will produce the greatest amount of fruit. These trees are pruned into central leader or modified open vase shapes.



- To keep fruit trees smaller for ease of picking the fruit, to get more trees into an area, or because of space limitations, prune to modified central leader or open vase shapes.

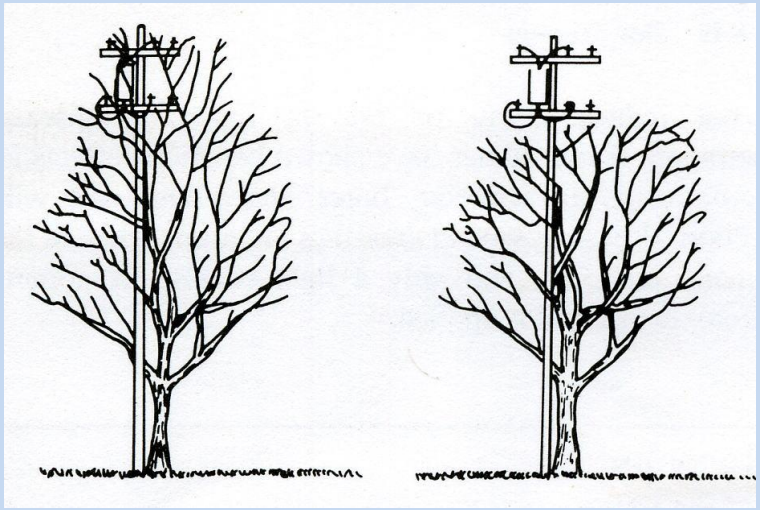
Never top or head branches or trees!!!

- Topping or heading has many harmful effects on tree growth and tree health. The results include excessive, poorly attached branch growth, disease and decay, and starvation among others and never results in reducing the size of the tree long term!

- The only exception is when you are pollarding a tree or creating a hedge.

Never top or head branches or trees!!!

- Reduce the height or width of a tree, or the length of a branch with thinning cuts by the pruning technique known as drop-crotching.



REASONS TO PRUNE :
Managing Suckers (Root Suckers)

- Most deciduous fruit trees are grafted.

- All growth arising below the graft or from the root system should be removed to prevent the root stock from dominating and dwarfing out or killing the desired grafted tree.

REASONS TO PRUNE :
Managing Water Sprouts:

- Water sprouts are vigorously growing upright shoots arising from above the graft union on grafted trees.

- In some cases, water sprouts can be trained to form strong branches and may be beneficial.

- If water sprouts are excessively crowded, have narrow crotch angles, are crossing or rubbing, or are causing poor branch or tree structure, they should be removed.

REASONS TO PRUNE:
Managing Fruiting Spurs

• As time progresses, fruiting spurs and fruiting wood becomes excessively crowded. This often results in small, poor quality fruit and broken limbs.

•Thin out spurs and fruiting branches to improve light penetration and air circulation, reduce overcrowded fruit , reduce the risk of broken branches and to improve the quality of the remaining fruit.

Identifying Fruit-bearing wood

- Fruit trees may bear fruit on short-lived (3-5 years) or long-lived (5-10 years or more) fruiting spurs, on last years growth, or on current season growth.

- It is extremely important to know the fruiting habits of the fruit tree you are pruning in order to be able to prune correctly and to maximize fruit production.

- Each type of fruiting plants bears fruit on wood of a specific age.

- Fruit wood should be managed to keep trees productive as well as to prevent over production and to help prevent limbs from breaking.

FRUITING HABITS OF COMMON DECIDUOUS FRUIT AND NUTS

Current-Season's Shoots

- Che
- Fig — second crop
- Mulberry
- Persimmon
- Quince
- Walnut

Previous-Season's Shoots

- Fig — first crop
- Filbert
- Nectarine
- Peach
- Pistachio
- Quince

Previous-Season's Spurs and Shoots

- Apple — minor
- Cherry, sour
- Pear — minor
- Pomegranate

Long-lived Spurs

- Almond
- Apple
- Apricot and Aprium— short-lived spur
- Cherry, sour
- Cherry, sweet
- Pear
- Pecan
- Plum,
- Plumcot
- Pluot
- Pomegranate

Current-Season's Shoots

Fig

Avocado

Citrus

Surinam Cherry

Previous-Season's Shoots

Peach and Nectarine

Pomegranate

Fig

Mulberry

Loquat

Fruiting Spurs - Apricot

Fruiting Spurs - Plum

Fruiting Spurs -Apple

Fruiting Spurs - Pear

REASONS TO PRUNE
Reduce Pest Problems

- Skirting trees so that lower branches do not touch the ground will greatly help in being able to control ants and the insects that they “farm” as well as snails and rodents.

Timing:

- Improper timing can predispose plants to attack by insects, diseases, or damage from sunburn or sunscald.

- Most pruning should be done during the winter months on deciduous fruit trees when the trees are dormant and when insect populations are suppressed by the winter cold.

- In some cases, lighter summer pruning can be beneficial for keeping trees smaller, however many bark boring insects are promoted by summer pruning. If these insects are common in your area, keep summer pruning activities to a minimum.

Training

- Training branches to grow in specific directions is often a viable option to pruning. This can take advantage of growth which has already developed instead of pruning off already grown branches and waiting for new branches to grow.

- Using training techniques can avoid the wounds made by pruning and therefore reduce the problems associated with those wounds.

Training

- Training should be done when branches are young and flexible enough to bend into shape without breaking or splitting the branch or trunk. Weights, guy wires, stakes or spreaders can be used to train branches.

- If ties are used, the tie material should be at least 1" wide wherever it comes into contact with the bark of the tree to prevent damage to the bark.

Pest Control - Ants

- Ants “farm” many honeydew producing insects. Controlling ants and keeping them out of your trees can greatly help to reduce insect pest problems.
- Ants can be kept out of trees by banding tree trunks with sticky substances such as Tanglefoot.
- Trim branches to keep them from touching structures or plants so that ants are forced to climb up the trunk to reach the foliage.
- Protect young or sensitive trees from possible injury by wrapping the trunk with a collar of heavy paper, duct tape, or fabric tree wrap and coating this with the sticky material.
- Check the sticky material every few days and stir it with a stick to prevent the material from getting clogged with debris and dead ants, which will allow ants to cross.


Applying tanglefoot to trees

Pest Control

- Tolerance to low levels of plant pests is a key ingredient to successful pest control.
- When pest numbers become large and damage to your plants becomes unacceptable, control measures often become necessary.
- Proper timing is essential for control measures to be successful!
- Most soft bodied insects can be controlled by using insecticidal soaps.
- Soaps also help to clean your trees and remove honeydew, sooty mold, and dirt and dust.

Pest Control

- Most pest control products used on fruit trees are contact killers. They kill what they touch.

- The key to successfully using pest control products are to be complete and through with your applications and to be consistent with your follow up applications!

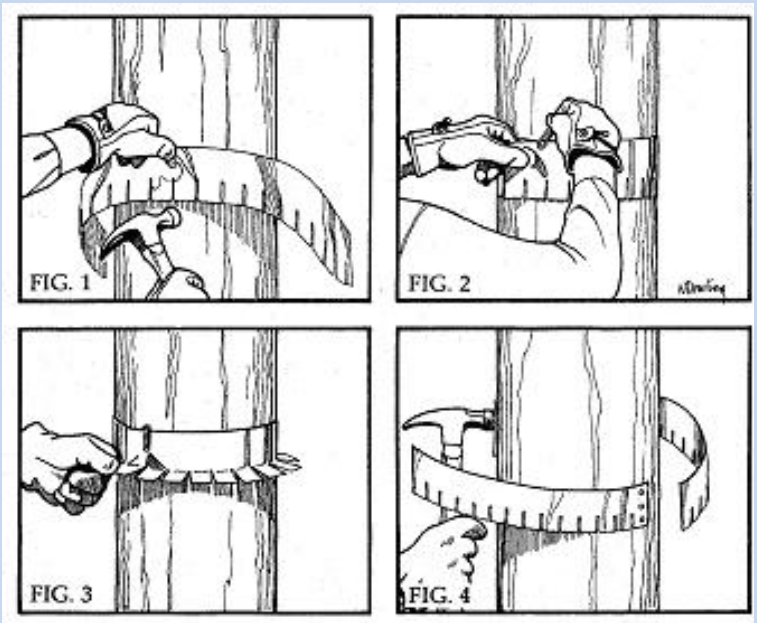
Snail and Slugs

- Most snail and slug baits have mateldehyde as the main active ingredient.
- Mateldehyde is very toxic to mollusks as well as dogs, cats, wildlife, fish and people.

- Baits containing Iron Phosphate kill snails and slugs but are of very low risk to dogs, cats, wildlife and people. They are also less toxic to fish than conventional snail baits.
- As these baits break down they become plant nutrients in the form of iron and phosphorous.

Snail and Slug Control

- Snails and slugs cannot crawl over copper.



Controlling Weeds

- Weeds and groundcovers compete with tree roots for water and nutrients. Keeping the soil free of vegetation and covered in mulch beyond the drip line is best for tree health.

- Weeds may also harbor plant pests and diseases.

- Control weeds and vegetation by using mulches and herbicides (organic or inorganic).
  - Pre-emergent herbicides
  - Post-emergent herbicides
    - Contact
    - Systemic

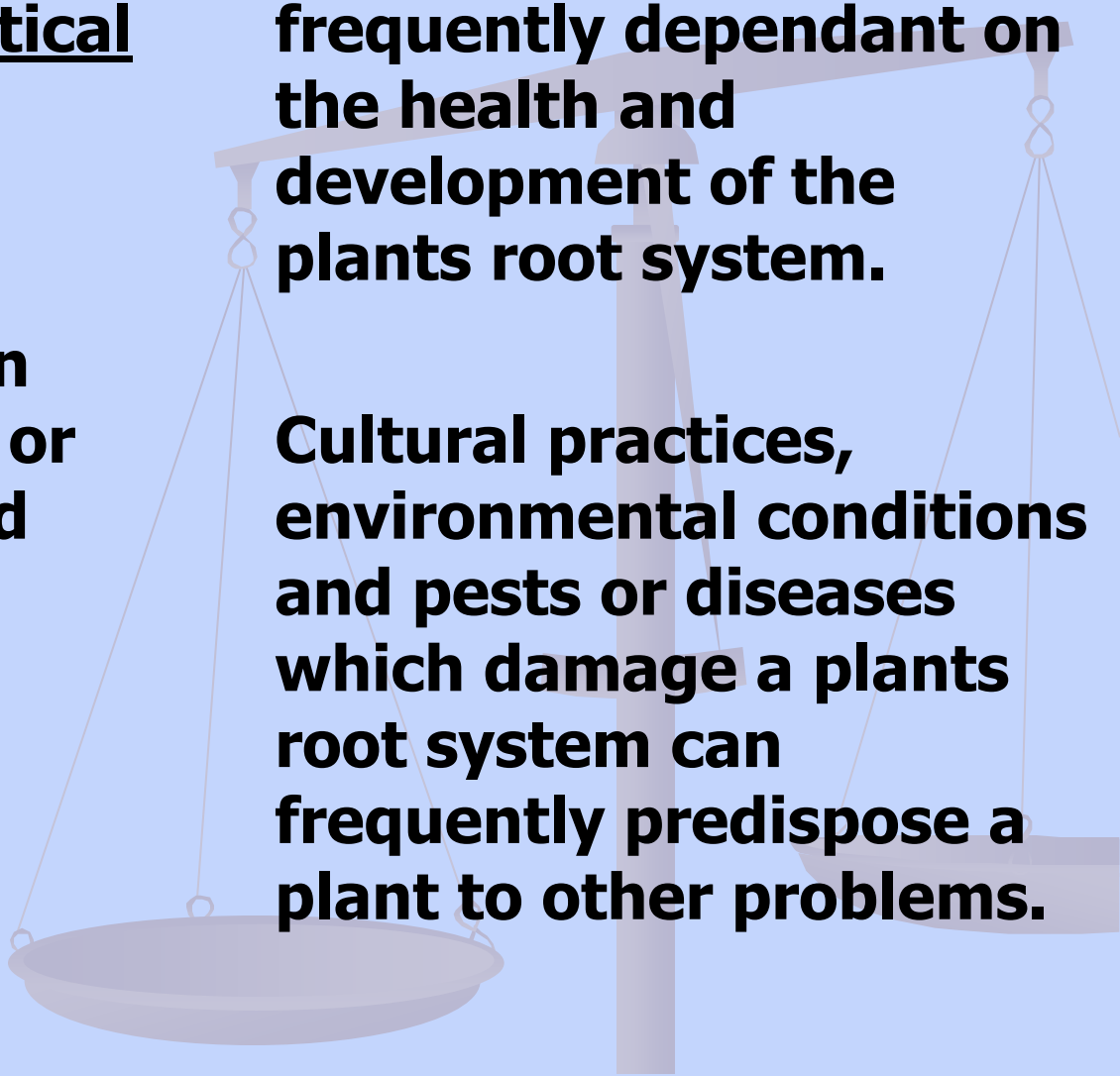
KEEPING PLANTS HEALTHY

Selecting the right plant for the location is critical to reducing pest and disease problems!

Cultural practices can prevent, predispose, or cause plant pests and diseases!

The health of a plant is frequently dependant on the health and development of the plants root system.

Cultural practices, environmental conditions and pests or diseases which damage a plants root system can frequently predispose a plant to other problems.



Sustainable Fruit Tree Care

Tips and Techniques for Promoting and Maintaining Tree Health

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