HOW A TREE GROWS

A tree has three main parts - roots, trunk and branches, and leaves. The roots anchor the tree and take up water and minerals from the soil. The minerals and water are transported to the leaves by the trunk and branches. The leaves manufacture the food needed by the tree. The food is distributed throughout the tree where needed.

There are two types of trees - evergreen and deciduous.

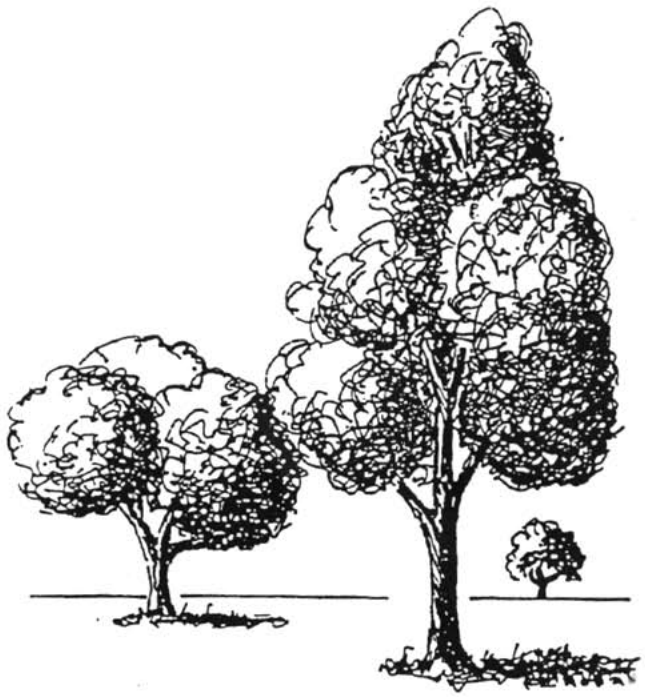
Deciduous trees retain or hold their leaves during the growing season only and go through a dormant period without the leaves. Evergreen trees hold their leaves (needles) all year round. From the list below, you will see that both types have the same characteristics except for one - the evergreens retain their leaves all year round.

Evergreen Trees:

The leaves stay on the tree winter and summer.
The leaves transpire (lose moisture) winter and summer.
Roots take up water when the ground is not frozen.
The leaves manufacture food.
The leaves are usually needles.

Deciduous Trees:

The leaves stay on the tree only during the growing season.
The leaves transpire (lose moisture) only while the leaves are on the tree.
Roots take up water when the ground is not frozen.
The leaves manufacture food.



ROOTS

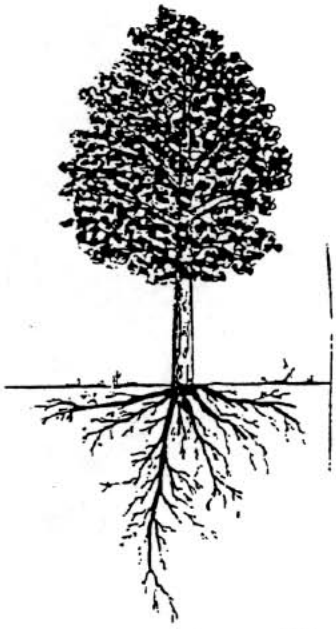
The type of root system and the soil in which the tree grows determines the ease or difficulty you will experience in moving the tree. Each species of tree will have a typical type of root system. For example, the nut trees normally have long, deep tap roots, while the sugar maple typically has a shallow, wide spread root system. The type of root system affects the anchorage of the tree.

The soil in which the tree grows and the proximity of other trees will influence the depth and spread of the root system, and may change it from the typical pattern for that particular species.

In general the more fibrous the root system, the easier it would be to transplant that particular tree. The long tap root trees have less fibrous root systems and are generally much harder to transplant successfully. Following is a partial list of tree species according to the root systems they normally would produce if grown in an unrestricted soil suitable for good root development of the species.

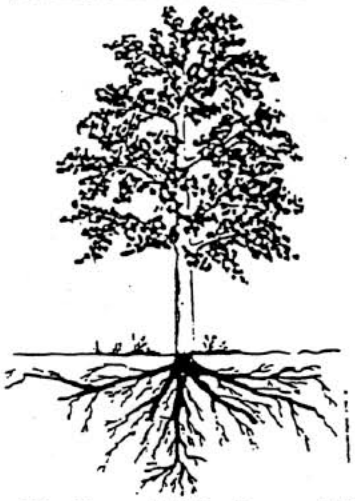
ROOTS (CONT.)

Tap Root or Deep Root Systems



Hickory
Pecan
Walnut
Butternut
Persimmon
White Oaks
Sassafras
American Hornbeam

Deep, Wide Spread Root Systems



Red Oak
Scarlet Oak
Tuliptree
Honeylocust
Linden (Basswood)
Magnolia
Pines
Sycamore

Shallow, Wide Spread Root Systems

Birch
Fir
Spruce
Hackberry (fibrous deeper than most in this group)
Sugar Maple
Black Maple
Silver Maple

Variable Root System, Depending on the Soil

Ash
Pin Oak (shallower than most oaks)
Redbud

An important point to remember about native trees in wooded areas is that the root system is more sparse and spread out; therefore, the maximum trunk diameter selected should be 30% to 40% smaller in proportion to the ball size.

The other function of the root system, besides anchoring the tree, is to take up water and minerals from the soil. The minerals from the soil are first dissolved in the soil water so that the roots can pick them up. While the large roots of the root system serve to anchor the tree and to transport the water and minerals, the small roots function to produce new roots and to take up the water and minerals from the soil. The tiny roots that actually pick up the water and minerals are called root hairs. These tiny root hairs, often called feeder roots, will die with just a few seconds exposure to sunlight and air. All transplanted trees must produce new roots as well as new feeder roots before they can begin to survive the shock of transplanting. These root hairs are the critical part of the root system. For these root hairs to function properly, there must be a certain amount of oxygen present in the soil. If there is not sufficient oxygen in the soil, the root hairs cannot properly take up the necessary water and minerals for the root system to transport through the trunk and branches to the leaves. This is one of the reasons that trees have difficulty in developing good root systems in heavy clay soils. This is also the reason why you find most of the feeder root systems in the better soil toward the surface of the ground. If the tree is growing in a deep, rich soil, then the root system is well distributed.

ROOTS (CONT.)

Figure A represents a tree which has been transplanted. When the ball of soil is dug, the machine cuts through many roots, large and small. Once the tree is planted in its new location, with proper watering and soil preparation, the tree will soon begin to produce new roots. These new roots will go through the modified soil next to the tree ball, then grow into the surrounding soil where the tree has been planted. These new roots must start from the food reserves in the tree and its remaining root system. If we look closely at the growing tip of the roots, we can see that at the very tip of each tiny new root there is a root cap. This cap pushes its way through the soil while covering and protecting the area which we call the area of cell division. Here the cells divide to produce new growth for the root.

Immediately behind this area, still in the very tip of the roots, we have an area of cell enlargement, where the cells get larger and larger. This actually pushes the root through the soil. Behind this area of cell enlargement is an area referred to as the area of cell differentiation. This means that the cells are dividing into specialized groups so that some of them will be the interior part of the root, some of them will form the tubes for conducting water and minerals to the top of the tree while others will form the bark or cover on the roots.

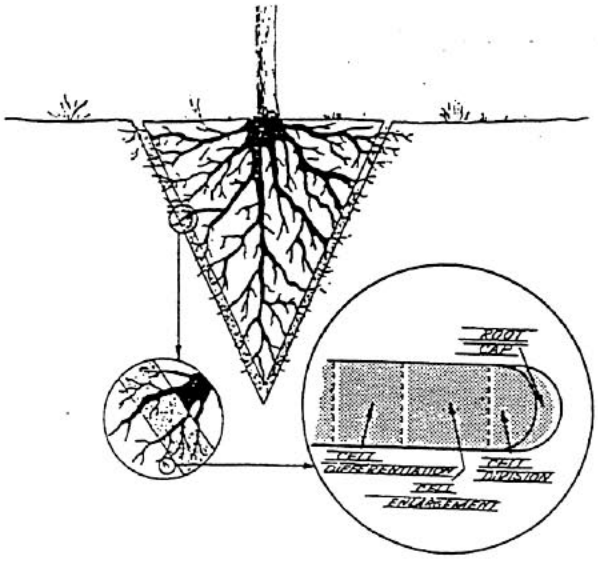


Figure A

TRUNK AND BRANCHES

The trunk and branches consist of five layers - bark, phloem, cambium, xylem, and heartwood as shown in Figure B.

The bark serves to protect the tree. It helps keep out moisture in rain and prevents the tree from losing moisture when the air is dry. It insulates against cold and heat and wards off insect enemies.

The phloem carries food from the leaves to the rest of the tree. The bark is actually dead phloem cells.

The cambium is the growing part; it produces new xylem and phloem cells.

The xylem, or sapwood, carries water and nutrients from the soil to the leaves.

The heartwood gives strength to the trunk and branches. The heartwood is dead xylem cells. Although dead, the heartwood will not decay while the outer layers are intact.

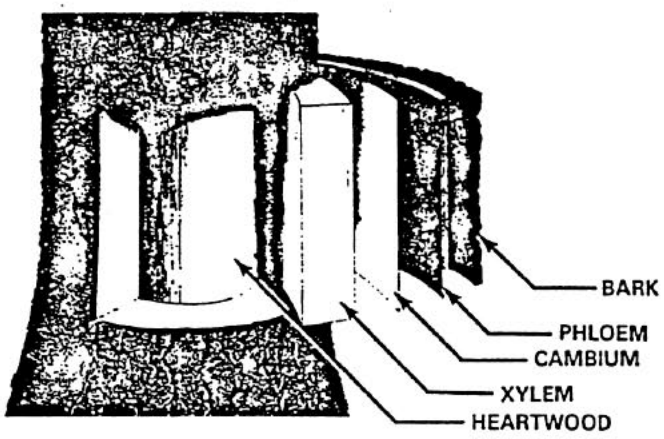


Figure B

LEAVES

The leaves manufacture food for the trees. The leaf structure and function is as follows.

The top of the leaf has a waxy covering and a single layer of cells called the upper epidermis. The upper epidermis is transparent, allowing light to pass through while limiting water evaporation. Refer to Figure C.

The bottom layer of the leaf, called the lower epidermis, is structurally much the same as the upper epidermis. Scattered over the lower epidermis are many tiny openings, called stomates. Stomates let carbon dioxide in, water and oxygen out. The stomates open and close to control the rate of exchange.

Just under the upper epidermis is a layer of tubular cells called the palisade layer. The palisade cells house chloroplasts - tiny structures saturated with chlorophyll. The chlorophyll absorbs solar energy for use in producing food. It is the chlorophyll which gives the leaf its green color.

Beneath the palisade layer is the spongy layer. The cells of spongy layer are loosely arranged so that air can circulate between them, bring carbon dioxide into contact with water and minerals. Within the spongy layer are the veins. The veins distribute the water and minerals from the roots throughout the leaf.

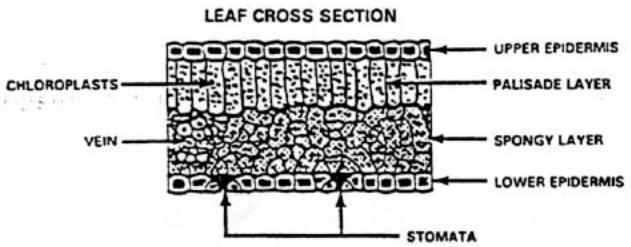


Figure C

Chlorophyl converts water and minerals to food (sugar) and oxygen. This process, termed photosynthesis, functions only when light shines on the leaf. The process is depicted in Figure D and is summarized in the equation below.

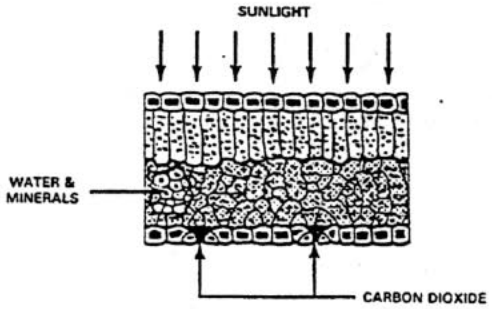


Figure D

The sugar in solution is moved back into the tree through the veins and down to the root system or is converted to other foods which are stored. The oxygen escapes through the stomates in the leaves. Moisture is lost with the oxygen.

It is through the loss of this moisture, referred to as transpiration, that the tree loses water. Very little of the water brought up from the root system is actually made into the food needed by the tree. Much of it is lost through the leaves by the action of transpiration after it has brought the minerals up to the cells for food manufacture. The use of anti-desiccant (so-called wilt-proof) sprays will help to reduce this moisture loss.

Once you have transplanted the tree, the leaves are essential to manufacture food for the root system to produce the new roots and new root hairs needed to keep the tree alive.

$$\text{Carbon Dioxide } (CO_2) \text{ \& Water } (H_2O) \text{ \& Nutrients} \xrightarrow[\text{Sunlight}]{} \text{Sugar } (C_6H_{12}0_6) \text{ \& Oxygen } (O_2)$$

LEAVES (CONT.)

Trees require large quantities of water during the growing season in order to carry on the vital life precesses. As mentioned, this water is lost primarily through the process called transpiration. For example, it would be possible for a large healthy elm tree to transpire or lose as much as 150 gallons of water in one day. A very large maple tree can lose as much as 600 or 700 gallons of water in one day. The amount of water lost is greatly influenced by the soil water available, temperature and wind. Temperature and wind will speed up the transpiration process. If there is not enough water in the soil to supply the root system, the tree will not be able to function properly. Symptons may include the sheading of leaves and die back of the tips on the topmost branches. The lack of moisture will first show up in the topmost branches.

Because of this water loss through the leaves, soil water must be periodically replenished. If this is not done by nature, then we must do it. A transplanted tree has lost alot of water absorbing capacity so there must be a good supply of water maintained around the remaining root system. Once the tree has regrown the lost root system, it can pretty well take care of itself, except in dry years.

CARE FOR YOUR NEW TREES AND SHRUBS

While all plants need water to survive, newly transplanted ones require even more. If your plant is growing in clay soil, water twice a week. If it is in sandy soil, or extremely hot, water 3-4 times a week. When the new tree is planted, a dam or saucer should be construced around the actual dimensions of the planted root ball. To water, simply place a garden hose on trickle and place it inside this saucer. Let water trickle on this tree or plant for approximately 15 minutes per caliper inch.

Continue to water flowering shrubs and deciduous trees until they are bare in the fall. For evergreens, continue even longer, from the time of the first frost until the ground is solidly frozen.

The amount of water lost through transpiration by a newly transplanted tree can be reduced by the use of an anti-desiccant spray. This material acts similar to a deodorant on humans. Thoroughly covering the leaves with an anti-desiccant spray reduces transpiration and significantly reduce transplanting stress.

The most important care you can provide is watering. Do not fertilze your tree during the first season. Fertilization would only enhance the stress conditions within the root mass. A newly transplanted tree may go through a period of stress from the loss of root mass, as a reaction to the transplant process and possibly some environmental conditions. New bio-stimulants, soil enhancements (peat, compost, etc.) and new injection systems are available that reduce transplant stress. These products have already been used in the transplant process. Any additional product should not be necessary unless remedial care is required.

You may initiate a fertilzation program during the second growth season. Implemented with a total plant care program - fertliztion, insect and desease montoring, selective pruning and water - your tree will begin to thrive in its new environment.

Lastly, some mature trees do require bracing to compensate for root loss. These cables should be monitored and adjusted as required for at least two years. At this time, the tree will have grown enough new anchoring roots for support.

Special thanks for this article to our friends at

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LARGE TREE TRANSPLANTING EXPERTS.

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