4.0 Tree Specification, Planting, and Care

This section of the Tree Manual will cover how to evaluate nursery stock before planting, how to plant a tree, and how to care for a newly planted tree.

4.1 Tree Identification

All trees must be properly identified. Each individual tree must have a weather-resistant label attached. The label must include scientific name, cultivar if applicable, and common name. This label shall remain on the tree until the project has passed all inspections and has been approved, at which time it will be removed.

Scientific Name

Botanists give each tree species a unique name. This name usually is a combination of Latin and/or Greek words that describe the species. A complete scientific name always has at least two words, a genus name first, and a specific epithet second. These words are always italicized. The genus name is always capitalized and the species name is always lower case, except in older reference works where some species names also are capitalized.

Some scientific names have three or four words. The third word may be a subspecies or a naturally occurring variety. In this case, the word is italicized and lower case. In other instances the third or fourth word may be a cultivar name, in which case it is not italicized and is capitalized and enclosed in single quotation marks. **Cultivar** means "cultivated variety" and is a form of the species which was selected and propagated by humans, and which is not normally found in nature. Cultivar names always appear last in a complete scientific name.

An example of a scientific name that has all four types of terms is the name of Oklahoma redbud:

Cercis	*canadensis*	*texensis*	'Oklahoma'
(genus)	(species)	(subspecies)	(cultivar)

Although scientific names are difficult to pronounce, spell, and remember, they are the most precise and accurate way to identify the species of the tree. Scientific names control the specification of trees for landscape use. When researching a tree species for any reason, it is important to use the scientific name to avoid confusion.

As scientific research continues, scientific names can change to reflect advancing knowledge. Fortunately new scientific names are cross-referenced with older names in the scientific literature. Trees should be labeled with the most current accepted scientific name, as given by International Code of Plant Taxonomy (IAPT) for the International Code of Nomenclature. The Tree List which accompanies this manual uses current scientific names to the greatest extent feasible.

Common Name

The common name of a tree species is the English word or words used to identify that species. While easier to use, common names have many problems. The same species of tree may have many different common names, with regional names often being inconsistent. Trees should be labeled with the accepted common name for your region or state. The Tree List which accompanies this manual uses accepted common names to the greatest extent feasible.

An example of the accepted common name and current scientific name of a native north Texas species is:

cedar elm *Ulmus crassifolia*

4.2 Tree Species Selection

"Plant the right tree in the right place." Almost everyone has heard this advice, but frequently it is not followed. Most problems with trees come from planting the wrong tree for the place where it is planted. To select the right tree, three things must be understood: site characteristics, the purpose of the tree, and aesthetics.

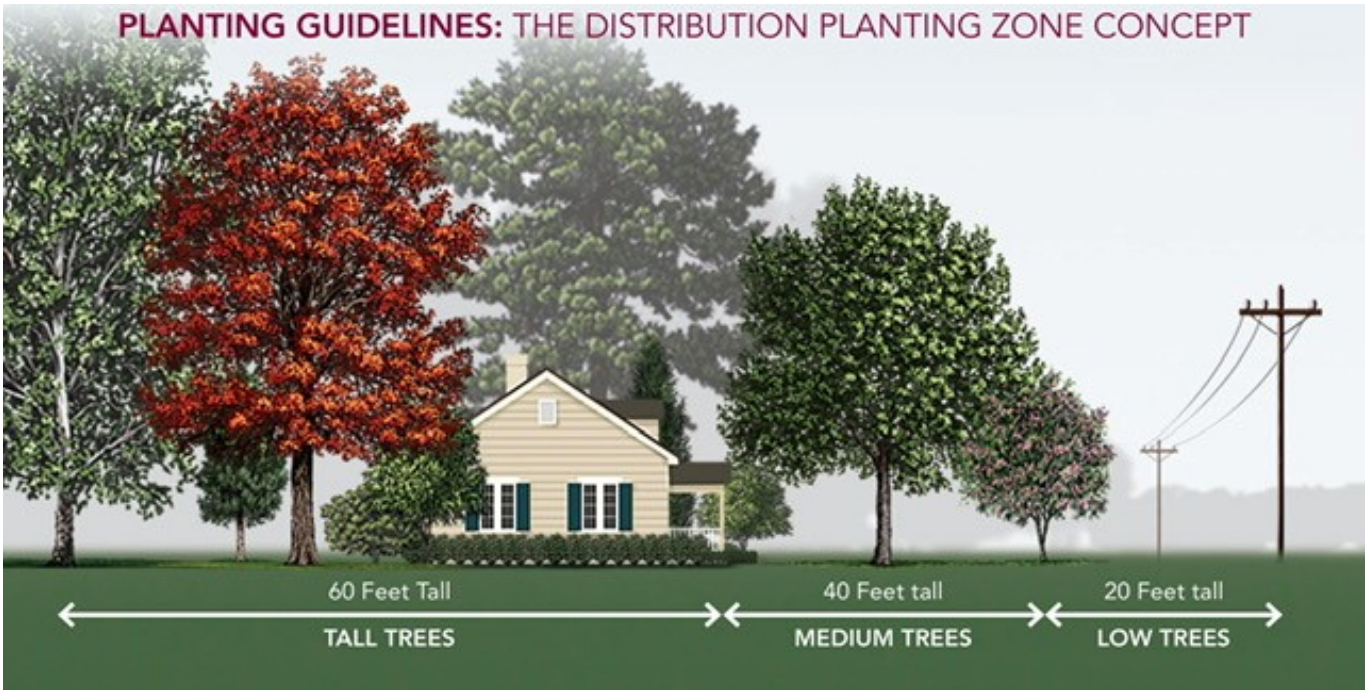
Site Characteristics

Most site characteristics cannot be changed to fit the tree, so the tree must fit the site. Critical site characteristics are size of growing space, and horticultural conditions.

Size of Growing Space

- What is the maximum height possible for the mature tree? Be sure to consider any overhead obstructions, especially utility lines.
- What is the maximum width possible for the mature tree? Will the mature spread of the canopy conflict with buildings, utility or lighting poles, or streets and sidewalks?

- What is the minimum branch clearance required? Will the tree grow large enough to allow necessary traffic under the canopy?
- How much soil is available for root growth? The soil must be suitable for root growth; compacted, infertile, trash filled, or toxic soil does not count. Large tree species planted where soil volume is insufficient will be stunted and short lived.



The distribution planting zone concept encourages the careful planting of the right tree in the right place. Keep large trees from the sensitive electric utilities and provide the larger trees in the open yard shading the house.

Horticultural Conditions

- How much light does the site receive? Will the tree be growing in sun or shade?
- What is the microclimate of the site? Is the site hot and dry, exposed to wind, or surrounded by pavement as in a parking lot? Or is it cooler and more humid, surrounded by other vegetation?
- What type of soil will the tree be planted in? Is it clay or sand? Is it well drained or wet? Is the pH acid or basic? Soil can be improved with amendments, but it is usually not feasible to greatly change soil characteristics for a large tree.

- How much water is available to the tree? Will the planting area be permanently irrigated, and how much?
- How much soil is available for root growth? The soil must be suitable for root growth; compacted, infertile, trash filled, or toxic soil does not count. Large tree species planted where soil volume is insufficient will be stunted and short lived.

Purpose of the Tree

Why are you planting this tree? What functions will it perform? This is what landscape architects refer to as the program or design goal. You can think of it as the practical value of the tree.

- Is this tree intended to shade a sidewalk or sitting area? Is it placed to cool a building during the summer? Is sun desired in the winter? Deciduous trees are better for these purposes.
- Will this tree screen a bad view? Do you want it to block cold wind in the winter? Are you trying to reduce noise? Evergreen trees are better for these purposes.
- Will this tree grow in a narrow space between buildings? Or will it have room to spread out? Different tree species have different natural forms or growth shapes. A naturally upright, narrow tree will work much better where horizontal space is limited.
- How quickly do you need for this tree to mature? How long do you want it to live? Fast growing species give quicker results, but generally do NOT live as long.
- How important is cleanliness? All trees produce some waste or litter, but the amount varies greatly. Tree that drop fruit, sticky sap, or an unusual amount of twigs and branches are best avoided for streets, parking lots, and pedestrian areas.
- Is this tree needed for some special environmental service? Does it need to slow storm water runoff, or control erosion? Is it part of a restored or constructed wetland? Will it improve wildlife habitat?

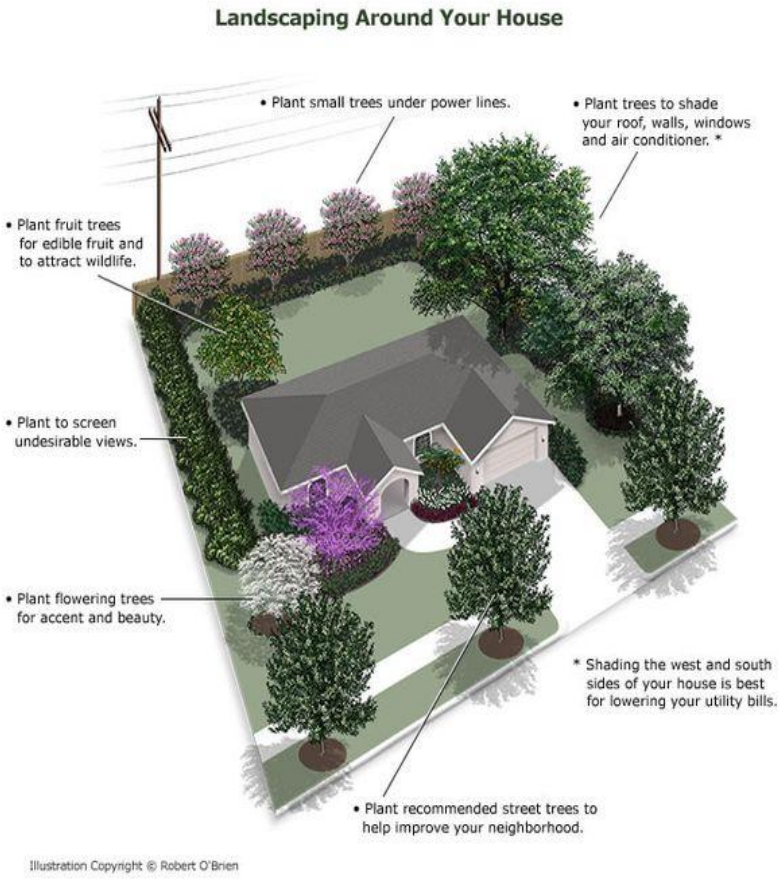


Image provided by the A&M Texas Forest Service

Aesthetics

Aesthetics is the sensory appeal of the tree for people. Usually this is visual, in the form of color, texture, and shape. But trees also have fragrance of foliage and flowers, and sound--think of cottonwood leaves rustling in the breeze. The aesthetic value of a tree is subjective and relative, dependent on personal taste and the context of the entire design. For these reasons, It is not possible to give aesthetic guideline in this manual.

Image provided by the A&M Texas Forest Service

The main point emphasized here is that aesthetics is considered last in tree selection. Aesthetics is important, but not as important as planting the right tree in the right place. A live oak planted close to a street where it is constantly mutilated by passing trucks is not beautiful, no matter how much one may admire live oaks. Any healthy tree is more aesthetically pleasing than any sick tree. And any live tree is better than any dead tree.

Refer to the City of Dallas Tree List **(Appendix A)** for suggested tree species, and choose trees suited to your site, program, and aesthetics.
Also see: ***http://www.arborday.org/trees/righttreeandplace/index.cfm***

Palms and Other Special Purpose Trees

Unique, unusual or marginally adapted species of trees may be included in a landscape design for specific aesthetic purposes. These species are often short-lived because of poor adaptation to environmental conditions, and are not considered permanent contributors to the urban forest. Frequent replacement is often necessary and should be planned as part of long-term maintenance.

At this writing, palms are popular special purpose trees. Only a few species of palms are marginally cold hardy in Dallas, and even these species are subject to damage from extreme weather events. The tree-like single trunked palm species have only one growing point or bud at the top of the trunk. If this bud is destroyed by cold or accident, the entire plant dies. For the same reason, it is impossible to effectively prune palms for size or shape. Some suggested species of palms are shown in the table below.

Common Name	Scientific Name	Notes
Needle palm	*Rapidophyllum hystrix*	Reputedly most cold hardy species, shrubby with multiple growing points, to 8' rarely taller, must have shade to part shade
Texas palm, Brazoria palm	*Sabal mexicana*	Single trunk to 30' in Dallas, native to costal Texas, used in original planting for the Centennial Exhibition in Fair Park, most were killed by extreme cold in 1980s, sun (Benny Simpson, personal communication)
Dwarf palmetto	*Sabal minor*	Only native palm in north central Texas, shrubby with multiple growing points, usually less than 6', sun or shade
Chinese windmill palm	*Trachycarpus fortunei*	Slender single trunk to 20' in Dallas, prefers shade
California fan palm	*Washingtonia filifera*	Single trunk to 30' in Dallas, do not confuse with the more common but less cold hardy Mexican fan palm, *W. robusta,* prefers sun

Although the palm species is not protected in the City of Dallas, and is not acceptable for use in required landscaping, it is still acceptable for private homeowners and property owners to install the palm tree in safe distances from public utilities, and away from neighboring trees, and while providing their own maintenance services for the trees.

Know before you grow.

4.3 Nursery Stock

The image below shows the "perfect tree"

Image provided by Texas A&M Forest Service

Trees for landscape use are grown and are available in four different conditions:

Bare Root Trees

Bare root trees are field grown. When harvested for planting, soil is washed from the roots and the tree is sold with a light weight wrapping on the roots to retain moisture. Bare root trees are available only in small sizes, and can be transplanted only when fully dormant. Bare root trees are not recommended for general urban planting.

Ball and Burlap Trees

Ball and burlap trees are also field grown. When harvested, a circular trench is dug around the tree, leaving a portion of the root system with soil intact. The soil ball is secured to the roots and trunk with fabric, rope, wire, or other materials, and the tree is removed from the ground.

Advantages of Ball and Burlap Trees

- Lower cost
- Wide range of sizes and species available

Drawbacks of Ball and Burlap Trees

- Must be transplanted during the dormant season only
- Only a small portion of the root system is attached
- Higher mortality rate than containerized and container grown trees

Common Problems of Ball and Burlap Trees

- Ball is too small for size of tree, ball should be 10" to 12" in diameter for each 1" of caliper inch
- Extra soil added on top of the root ball, remove excess soil to expose root flare
- Ball is loose or broken, causing separation of soil from roots
- Wire, rope, or excess fabric are not removed from root ball at planting

Containerized Trees

These trees are field grown and dug in the same way as ball and burlap trees. They may be balled and burlapped first, or may be transferred directly to a container. The container is larger than the root ball, and the space is filled with a prepared planting soil. New roots are allowed to grow into the soil.

Advantages of Containerized Trees

- Root system has time to recover from being dug
- May be held in nursery and transplanted outside the dormant season
- Container is more resistant to damage than a burlaped soil ball

Drawbacks of Containerized Trees

- Root system is small, although may be larger that ball and burlap trees
- Higher mortality rate than container grown trees

Common Problems of Containerized Trees

- Insufficient time is allowed for recovery of root system
- Small root system causes failure of trees transplanted in hot weather
- The tree has not been in the container for a minimum of 6 months, or more than 18 months.

Container Grown Trees

Trees grown in nursery pots or other containers for their entire lives. The tree is transplanted into larger containers as it grows until it is large enough to sell. Semi rigid solid plastic pots are the most common type of container used. Other types of containers have been developed to produce trees with better root structure, such as perforated plastic pots or even special fabric bags. Wooden boxes are also used.

Advantages of Container Grown Trees

- Entire root system is transplanted which increases survival rate
- May be transplanted into the landscape at any time of year if adequate post-transplant care is provided

Drawbacks of Container Grown Trees

- Higher cost (may be offset by lower mortality rate)

- May be more prone to root system defects (see below)

Common Problems of Container Grown Trees

- Tree is planted too deep in container (may be corrected at planting if not severe)
- Tree is more likely to develop girdling or circling roots (may be corrected at planting if not severe)

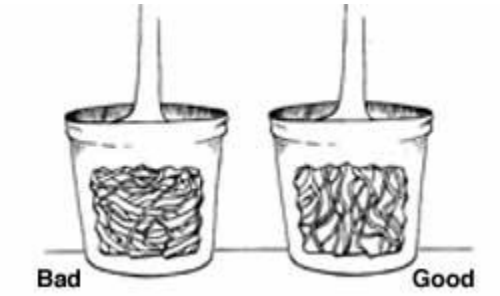


Image provided by Limbwalker Tree Service,
http://limbwalking.com/all-about-trees-and-shrubs/tree-selection-buying-high-quality-trees/

Size Measurement of Nursery Stock

Size of trees in the landscape is measured by caliper. For existing trees already established in the landscape, caliper is the diameter of the trunk measured 48" from the soil surface. This is often abbreviated D.B.H. for "diameter at breast height". For nursery stock not planted in a permanent location, caliper is the diameter of the trunk measured 6" above the soil up to and including 4" caliper, and at 12" above the soil for trees larger than 4" caliper. It is important to specify where the caliper is measured. More information about size measurement is found in the latest addition of American Standard for Nursery Stock (ANSI Z60.1-2014) ***make sure that definition of "caliper" matches the Ordinance definition***

Container Size (approx. gallons)	Appropriate Caliper Measurement
#5	0.5 to 0.75"
#15	0.75 to 1.5"
#30	?
#45	?
#60	?
24" box	1.5 to 2.5"

Tree Inspection

Before a tree is accepted for planting, it must be inspected for health and form. The tree must be typical in form for its species and/or cultivar, and free from damage, disease, pests, and structural problems. Trees with serious defects must not be planted and will be rejected.
Please refer to the illustration at the beginning of this section, "Selecting a Good Quality Tree at the Nursery".

Root Ball and Root System: Size of root ball must be large enough for the size of the tree. For ball and burlap trees, the root ball should be 10" to 12" in diameter for each 1" of caliper size. Container grown trees are usually the appropriate size for the container in which they are grown, but occasionally one finds trees that are over-grown for the size of the container. These trees are very likely to have girdling and circling roots, and should be rejected.

Soil in the root ball should be moist. Ball and burlap trees must have firm, intact root balls that are not lose at the trunk, cracked, or broken. Container grown trees should be firm in the pot, with a root system that extends to the wall of the pot, but not overly root bound. Occasionally, trees are sold that have been recently repotted and have not grown roots to fill their new container. This is usually obvious from the size of the trunk and canopy. Seriously under-sized trees must be rejected.

It can be difficult to inspect the root system of ball and burlap trees because it is usually completely covered by the fabric wrapping. The wrapping usually cannot be removed until the tree is ready to be planted. For this reason, the supplier of the trees must be made aware that if serious defects are discovered when the wrapping is removed, the tree will be rejected.

The **root flare** is a wider area at the bottom of the trunk where the major roots branch from the trunk. **It is critical for the long term health of the tree that the root flare is exposed and not covered with soil or mulch.** The root flare should be visible above the top of the soil in container grown trees. If the root flare is not visible, soil may be carefully removed from the top of the root ball until the root flare is visible. If the root flare cannot be found or if it is deeper than a few inches, the tree must be rejected. Because ball and burlap trees usually have the root flare concealed by fabric, it may not be possible to find the root flare during initial inspection.

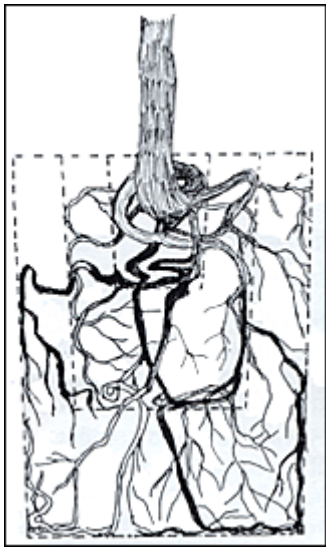
Major roots should spread evenly in a radial pattern from the root flare. Look carefully for girdling roots at the root flare. Girdling roots are roots that cross or encircle the root flare. If small, girdling

roots can be corrected at planting. If girdling roots are too large or are embedded in the root flare, the tree must be rejected.

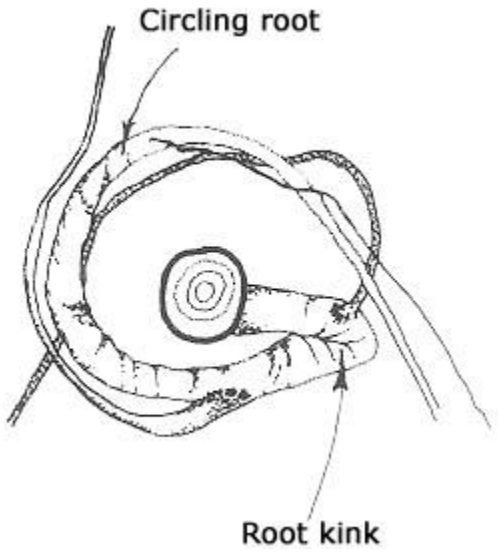
Inspect the soil surface and outer edge of the root ball of container grown trees for circling roots. Circling roots can become girdling roots as the tree grows and the trunk increases in diameter. Small circling roots can be corrected at planting. If the circling roots are large or extremely numerous and cannot be corrected, the tree must be rejected.

Common Root Defects

- Broken or lose root ball on ball and burlap trees
- Root ball too small for the size of the tree
- Root flare not visible or deeply covered
- Girdling roots
- Circling roots



Provided by the US Department of Agriculture Forest Service



Provided by the University of Florida

Trunk

Almost all large and medium sized tree species and most small tree species shall have a single trunk with a single dominant leader. Single-trunk specimens have fewer structural problems than multi-trunk examples, are less vulnerable to storm damage, and have longer lives in the landscape. Some small species of trees have a natural multi-trunk form, and this is acceptable in such species. Refer to the City of Dallas Tree List for a list of these species.

The terms "multi-trunk" and multi-stem" are synonymous. They refer to a trees with more than one major trunk growing from a single root system. Counterfeit multi-stem trees created by planting multiple smaller individual trees in the same container are not acceptable, and this practice is strongly discouraged.

Trunk diameter and taper shall be sufficient so that the tree will remain vertical without the support of a nursery stake. Trees with weak trunks that will not stand without staking seldom recover when planted in the landscape and often die back to the root flare.

The trunk shall be free of wounds (except properly-made pruning cuts), sunburned areas, conks (fungal fruiting-bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions. Remember, the living tissue (cambium) that moves nutrients and produces new growth is in a thin layer just below the bark and is easily damaged by even shallow wounds.

Common Trunk Defects

- Multi-stem on most species
- "Floppy" trunk that will not support itself
- Wounds and scrapes that damage the cambium.
- Girdling from wire or other stake attachments
- In grafted trees, a weak or poorly healed graft union between the rootstock and the trunk, can be seen in pecans, Japanese maples, and fruit trees

Branch Structure and Form

The form of the tree shall be symmetrical and typical in shape for the species and/or cultivar. For large and medium species, a single dominant leader is preferred unless the normal form of the species is otherwise. Small species often have several leaders or co-dominant branches.

Ideally, branches are less than two thirds the diameter of the adjacent trunk. The angle formed where a branch joins the trunk is a critical structural characteristic. Very narrow branch angles, especially ones where bark is trapped between the branch and the trunk (bark inclusions) are structurally weak and prone to storm damage. One or two narrow branch angles on a tree can be corrected by pruning at planting time, but many narrow branch angles shall cause the tree to be rejected.

Temporary branches are often present along the trunk below the first main branches, especially on young trees. These cause no harm and can be beneficial as long as they are less than one half the diameter of the adjacent trunk. Temporary branches support extra foliage useful to the young tree, and can be removed after establishment if the tree does not shed them spontaneously.

Occasional broken, damaged, crossing and rubbing branches can be removed at planting. But if such branches are so numerous that their removal damages the form of the tree or significantly reduces the size of the canopy, the tree shall be rejected.

Common Branch Defects

- Multiple leaders or co-dominant branches on large and medium size species
- Narrow branch angles, especially with bark inclusions
- Rubbing or crossing branches

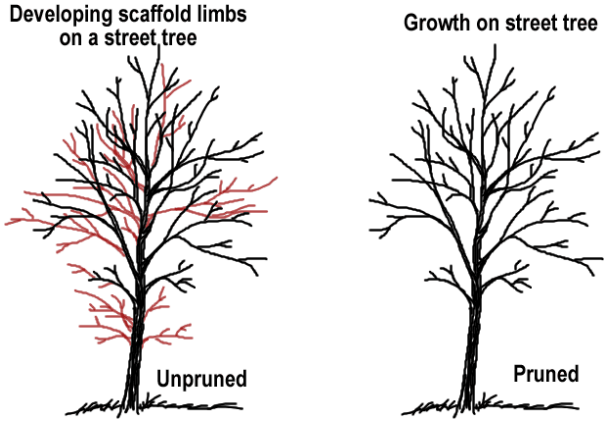


Image provided by Texas A&M Forest Service

Foliage (if present): Appearance of foliage is highly variable on most tree species depending on season and age of the tree. Trees are best planted when dormant, and deciduous species will have little or no foliage at that time. Evergreen trees may show changes in leaf color or texture with dormancy.

The best advice is to familiarize yourself with the normal appearance of foliage of the species you are inspecting, as it appears during the season when the tree is observed. Specimens with significantly abnormal foliage are suspect.

Common Foliage Defects

- Absent or very sparse foliage when the tree should be in full leaf
- Brown or scorched foliage, either entire leaves or parts of leaves
- Leaves with very abnormal color, shape, or size

4.4 TREE PLANTING

Planting Season: The best time of year to plant trees in north central Texas is November 1 to March 1. At this season, top growth has stopped, and deciduous species have lost or will soon lose their leaves. Although often referred to as the "dormant season", soil temperatures are usually still high enough to permit root growth. Ball and burlapped and bare root trees must be planted in this season. Containerized and container grown trees may be planted at other times of year, but will require more after-care for success.

Locate the Root Flare: The root flare is a swelling at the base of the trunk just above the major roots. The root flare controls the depth of planting, and must not be covered by soil or mulch. Locating the root flare is the essential first step in planting the tree. See **Root Ball and Root System** above.

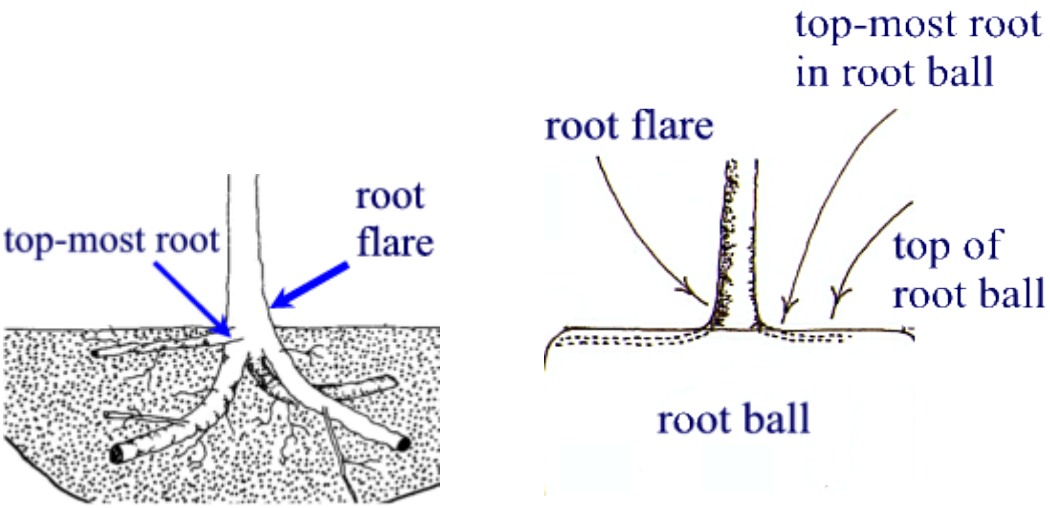


Image provided by University of Florida
http://hort.ifas.ufl.edu/woody/root-ball-dimensions.shtml

The Planting Pit: "Better to put a five dollar plant in a twenty dollar hole than to put a twenty dollar plant in a five dollar hole."
--Richard B. Myrick FASLA, pioneering Texas landscape architect, founder of the Landscape Architecture Program at the University of Texas at Arlington

A proper planting pit greatly increases the chance of success for any tree. The depth of the pit should be the height of the root ball from the root flare to the bottom, minus at least one inch. Trees settle after planting, and the shallower pit helps to prevent covering the root flare. It is better to plant a tree too high than too deep. The width of the pit should be at least two to three times the diameter of the root ball, with rough, gently sloping sides.

Drainage

Soil drainage conditions can greatly affect the survival and growth of the tree. Drainage can vary greatly depending on many factors. including soil type, slope, adjacent pavement or retaining walls, and many other site-specific conditions. It is important to distinguish between surface drainage and internal soil drainage, also called percolation or infiltration. Internal drainage is of most concern in tree planting.

One way to check internal drainage in the pit is to fill it with water when the soil is dry to moist, not wet or saturated. Allow the water to soak away, then fill again. If the pit does not drain the second time within 24 hours, drainage may need improvement. See Section 5.0 Soils for more information.

Placing the Tree

Containerized or container grown trees must be carefully removed from the container to keep the root ball intact. **Check the location of the root flare!** Check the roots, if they are tightly compressed or "pot bound", use fingers or a blunt tool to tease fine roots away from the tight mass, then spread the roots prior to planting. Avoid cutting or tearing roots as much as possible. Also look for and correct any defects in the root system, as described in **Root Ball and Root System**, above.

In the case of extremely woody compacted roots, it may be necessary to use a spade or other tool to open up the bottom half of the root system. The root system is then pulled apart or 'butterflied' prior to planting. Loosening the root structure in this way is extremely important in the case of pot bound container plants. Failure to do so may result in the roots circling or girdling and killing the tree years later. At the very least, the roots will have difficulty expanding beyond the dimensions of the original container. To further assist this expansion, lightly break up the soil outside the planting pit. This allows roots to grow out of the planting pit and into surrounding soil as quickly as possible.

After any preparations to the root ball are complete, lift the tree by supporting the bottom of the root ball and lower into the pit. Do not lift by the trunk.

Balled and burlapped trees require a different technique. Gently roll the ball into the planting hole, supporting the weight of the tree under the root ball and using the trunk to "steer" the tree. Remove wires, ropes, staples and fabric on the top of the root ball and around the trunk. **Check the location of the root flare!** Cut and remove enough of the basket and burlap so that the top 12 - 16 inches of the side of the root ball is free and clear. The tree can be rocked to the side if needed to expose and clear all sides of the root ball.

If the upper half of the basket is removed before backfilling, most future root problems will be prevented.

Image provided by the Morton Arboretum

Back Filling the Planting Pit: Check that the trunk is plumb and hold the tree in a plumb position as you back fill. **Check the location of the root flare!** What you take out of the hole, you put back into the hole. DO NOT add any amendments. If necessary, break up large soil clods before back filling. The soil should be settled with a thorough soaking, but do not compact the soil with tools or feet.

Image provided by the Morton Arboretum

Watering Saucer

Form a basin around the root ball with the extra soil. Build a raised circular dam about four to six inches high. The basin should be kept 2 to 3 feet away from the trunk to create a 4 to 6 foot circle. This will pool water right over the root ball, which needs to be kept moist during the first growing season.

Mulch

Spread a layer of mulch up to 4" deep over the mounded soil, and extending outward about 3 feet from the trunk. Do not place mulch directly over the root flare. Do not build a "mulch volcano" by heaping mulch against the trunk. **The root flare must remain exposed to air at all times.** Mulch is the best ground cover under newly planted trees. Mulch moderates soil temperature, conserves soil moisture, and reduces competition from other plants. Choice of mulch material is unimportant as long as it is organic matter and maintained at the correct depth.

Staking

Most properly planted trees do not need to be staked. Staking can actually do more harm than good by inhibiting caliper growth. Staking is especially harmful if stakes and guy wires are not removed as soon as possible. The trunk of the tree can be severely damaged if it out grows the attachment loop of wire or other material.

On some windy or very exposed sites, staking may be necessary. Stake each tree with two posts. Locate one post compass north of the tree, and one post compass south of the tree to protect from prevailing winds. Drive posts into undisturbed soil outside the planting pit. Top of posts shall be 48" minimum above soil level. Guy tree to posts no higher than 2/3 the height of the tree. The loop in the guy material at trunk of tree shall be three times the diameter of the trunk to avoid girdling, and shall be padded or constructed of soft material to prevent trunk damage. Guy straps shall be slightly slack to allow limited trunk movement, but not excessive movement in high wind.

In areas of public access, it may be necessary to pad post tops, and attach warning flags to posts and guys to prevent accidents. See the attached tree planting detail.

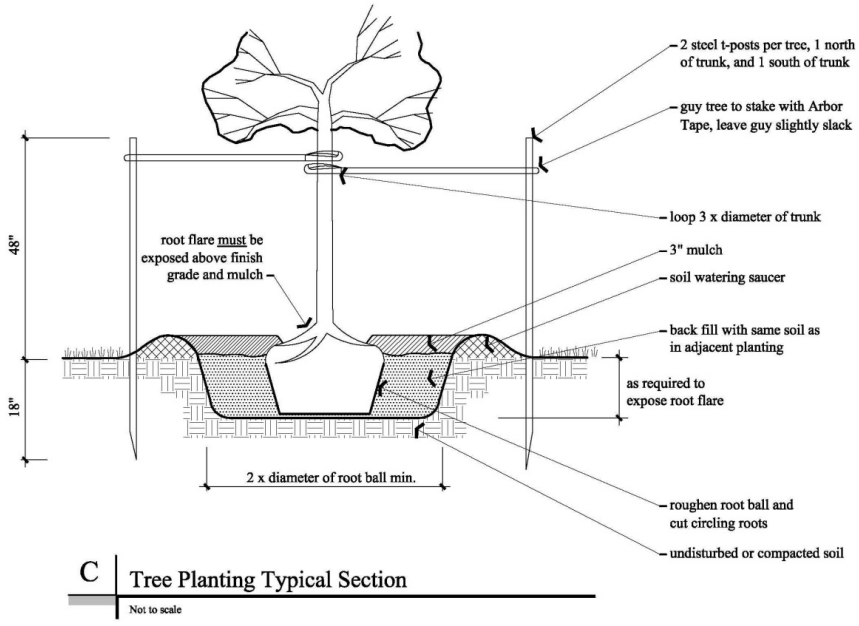


Image provided by Michael Parkey, ASLA

Remove all staking material after roots have established. This can be as early as a few months, but should be no longer than one growing season.

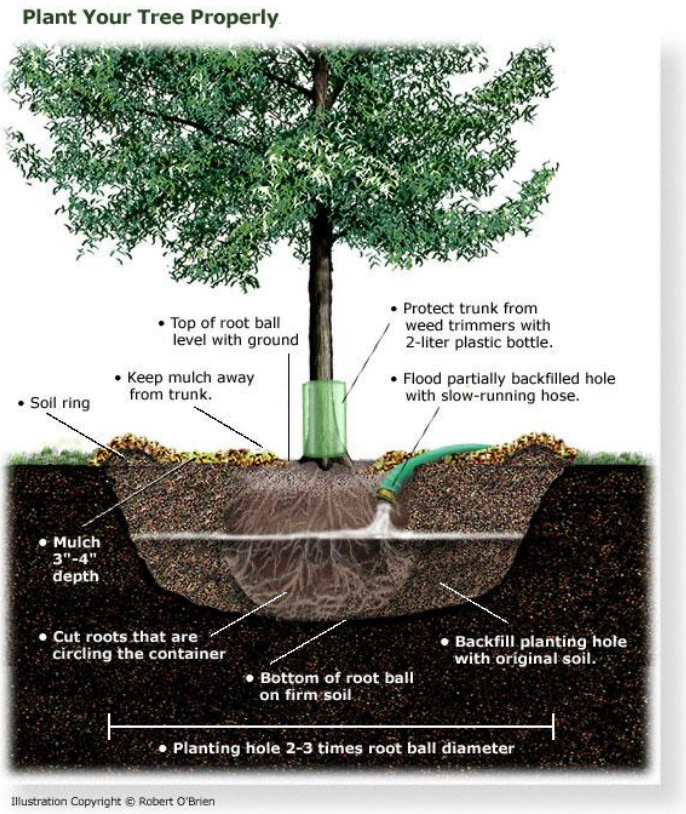


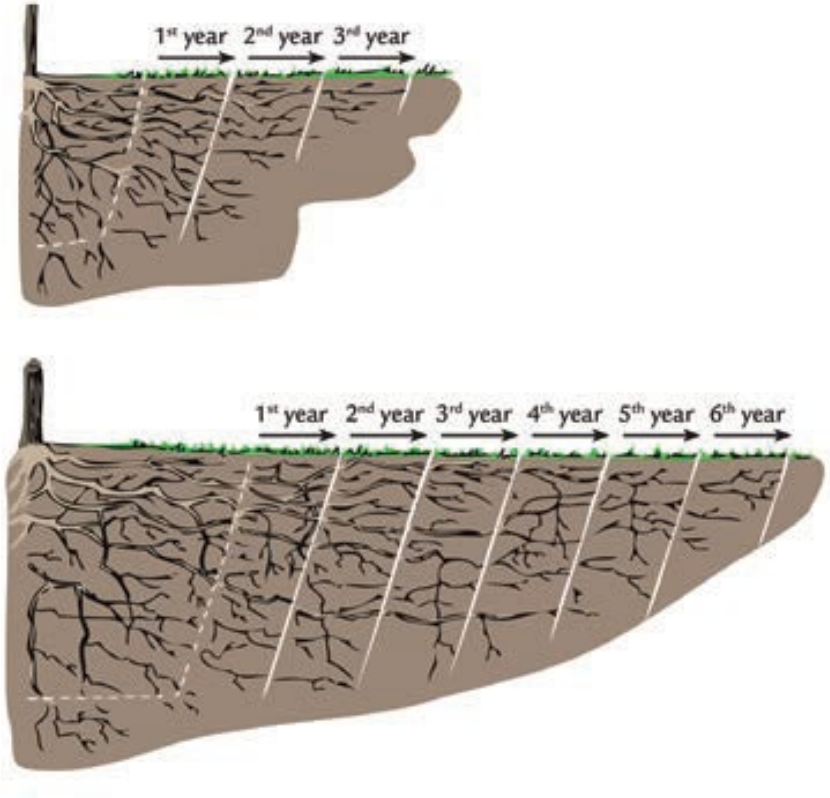
Image provided by Texas A&M Forest Service

4.5 Tree Maintenance After Planting

The Establishment Period: A tree is fully established when its roots have grown out of the original planting pit and into the surrounding undisturbed soil. Obviously, this is impossible to observe directly, so we must estimate the length of the establishment period. The establishment period will vary depending on several factors, including age of the tree at planting, the quality of care it receives after planting, and its species.

Small young trees establish more quickly than larger older trees of the same species. For example, a 2" caliper Shumard oak receiving good care may be fully established in one year. An 8" caliper Shumard oak may require several years to establish. Fast growing species establish somewhat more quickly than slow growing ones. Extremes of weather, especially drought, lengthen the establishment period.

The establishment period is not the same as the warranty period. The warranty period is a contractual matter regarding tree mortality and replacement, and is not directly related to establishment.



Several years of root growth are required for a newly planted tree to fully reestablish its root system. Roots grow at a similar rate regardless of tree size, but for a larger tree, roots must grow over a longer distance to redevelop a normal root spread after transplanting. This requires more years of growth and results in a longer establishment period for a large tree.

Images provided by the Morton Arboretum

Irrigation

After proper planting, the single most important factor in tree survival is proper watering. Over-watering is surprisingly common, and is more quickly fatal to the tree than under-watering. Trees may be irrigated by hand watering, automatic irrigation, or temporary tree watering devices like Gator Bags or Ooze Tubes. You must not assume that the water needs of a newly planted tree are the same as those of the surrounding landscape. Each tree must receive separate individual irrigation customized to its needs, based on soil moisture in the root ball, planting pit, and surrounding soil. The use of a simple soil probe to determine soil moisture is strongly recommended.

In north central Texas, we should water our trees deeply but infrequently, using the most efficient method available. Overhead spray irrigation is least efficient, whether from automatic systems or hose-end sprinklers. Drip irrigation, tree bubblers, and irrigation bags are much more efficient. All irrigation methods are made more efficient with the use of mulch.

Duration of Irrigation: This depends on the rate at which water is applied by the method used. Hand watering usually applies a large amount of water in a short time. Overhead spray methods require longer periods. Run time for bubblers and drip irrigation may need to be an hour or longer. Irrigation bags are designed to slowly release water over as much as 24 hours, and allow the deepest penetration of water into the soil.

Frequency of Irrigation: This is affected by weather, with no irrigation at all during wet weather and much less frequent irrigation during the dormant season. Newly planted trees may need to be watered every two days during hot, dry weather. For very young (small at planting) trees, one to two gallons of water are usually sufficient. Soil type also affects frequency of irrigation. The heavy clay soils typical of Dallas County need water less often, and the guidelines in this manual assume this soil type. If your site has the uncommon sandy or very gravelly soils found in some parts of Dallas County, you may need to water more often. See **Section 5.0 Soils** for more information about soil types in north central Texas

Where do I put the water? Location of application depends on how long the tree has been planted. New trees need moisture in the original root ball; the soil that came with the tree in the container or inside the wrapper of balled and burlapped trees. **It is possible for soil in the root ball to be dry even when soil in the planting pit is moist, and vice-versa.** The use of a soil probe becomes critical here.

Use the probe to determine moisture in the root ball, and adjust irrigation accordingly. Use this method until the end of the first growing season (March through October).

As trees become established, the most active roots are located under the outer edge of the canopy. In the second and third growing season, apply water to the planting pit and beyond to encourage root growth into the surrounding soil.

How do I water mature trees? The roots of fully established, mature trees extend into surrounding soil for a distance of two to three times the height of the tree. The most active roots are under outer edge of the canopy and far beyond it. Dropping a hose next to the trunk of a mature tree may water the ground cover, but does little good for the tree.

Most of the root system of a mature tree is in the top 12 to 16 inches of soil. This is especially true in the clay soils of north central Texas. When we water a mature tree, we want the water to soak in to this depth. This requires slow, deep watering. Similarly, soil at this depth dries slowly, so we do not need to water often. A soil probe is very helpful in determine soil moisture at this depth. **Water your trees deeply but infrequently.**

Always follow City of Dallas and Dallas Water Utility rules and restrictions on irrigation schedule. Permitted schedule for irrigation varies with time of year and drought status. Typical water needs of established north central Texas trees under normal weather and soil conditions are shown below.

Water Need of Species	Summer Watering Interval	Examples of Tree Species
LOW	<90°, twice per month >90°, once per month	Texas red oak, cedar elm, Texas persimmon, American smoketree, Texas mountain laurel, desert willow, mesquite, Texas ash
MODERATE	<90°, once per week >90°, twice per week	American elm, chinquapin oak, Shumard oak, southern live oak, Eve's necklace, buckeye, green ash, bald cypress
HIGH	<70°, check soil for dryness, water only when soil is dry 70° - 80°, once a week 80° - 90°, twice per week >90°, three times per week	Southern magnolia, Japanese maple, flowering dogwood

Proper Pruning

"The wrongs done to trees, wrongs of every sort, are done in the darkness of ignorance and unbelief, for when the light comes, the heart of the people is always right."
--John Muir (1838 - 1914), My First Summer in the Sierra, 1911

Next to watering, the maintenance task most often performed on newly planted trees is pruning. Before you start, know why you are pruning and the effect it will have on the tree. In general, never remove more than 25% of the total leaf surface area during a single growing season. Always prune to the next larger or same size limb. Never leave stubs, and do not make flush cuts. Cut back to the branch collar and no further. This will produce a smaller wound which heals more quickly.

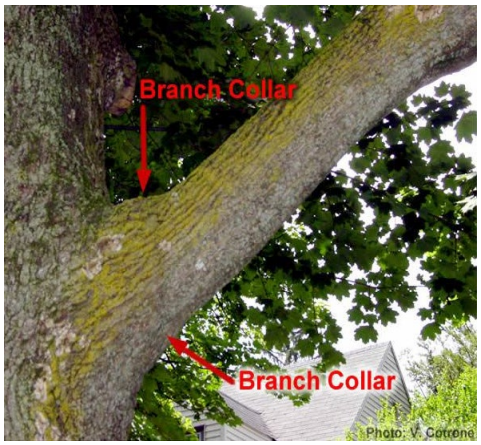
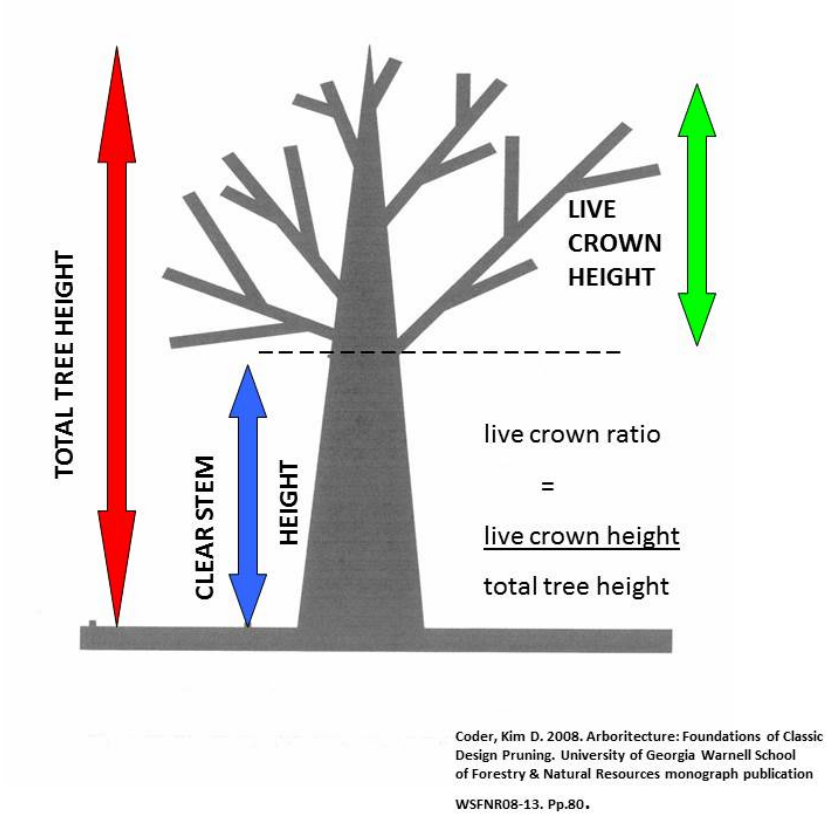


Image provided by Vincent Cotrone and
Dr. William Elmendorf, Penn State School of Forest Resources

Reasons why new trees need pruning include crown cleaning, crown raising or pruning for clearance, crown thinning, and training for structural integrity. Pruning of large, mature trees or any pruning that requires use of ladders or climbing equipment is dangerous and difficult work, and must be performed by personnel with the proper safety training and only under the direction of an arborist certified by the International Society of Arboriculture (ISA). Refer also to the latest addition of American Standard for Nursery Stock (ANSI Z60.1-2014). The diagram below illustrates the relationship of a tree's crown to its total height, and to ground clearance.



Coder, Kim D. 2008. Arboritecture: Foundations of Classic Design Pruning. University of Georgia Warnell School of Forestry & Natural Resources monograph publication WSFNR08-13. Pp.80.

The live crown is the top part of a tree, the part that has green leaves (as opposed to the bare trunk, bare branches, and dead leaves). The ratio of the size of a tree's live crown to its total height is used in estimating its health and its level of competition with neighboring trees

Pruning Newly Planted Trees

If nursery stock has been carefully selected, a new tree should need little pruning. See **Nursery Stock**, above. In the first year after planting, only remove broken or dead limbs or if severe clearance issues are found, removing no more than 25% of the total leaf surface area. It is important to leave as much healthy foliage on the tree as possible, even small branches low on the trunk that will be removed later. The more leaves a new tree has, the more food it can make, and the faster it can grow roots and establish itself. For a new tree, a "trashy trunk" is beneficial--resist the impulse to clean it.

Pruning Large or Mature Trees

As noted above, pruning that requires the use of ladders or climbing equipment must be done by trained professionals under the direction of a certified arborist. Sometimes large limbs accessible from the ground need to be removed from established trees. This is most commonly done to increase clearance for maintenance, walks, or streets. Large limbs should be removed using the three cut method, illustrated below.

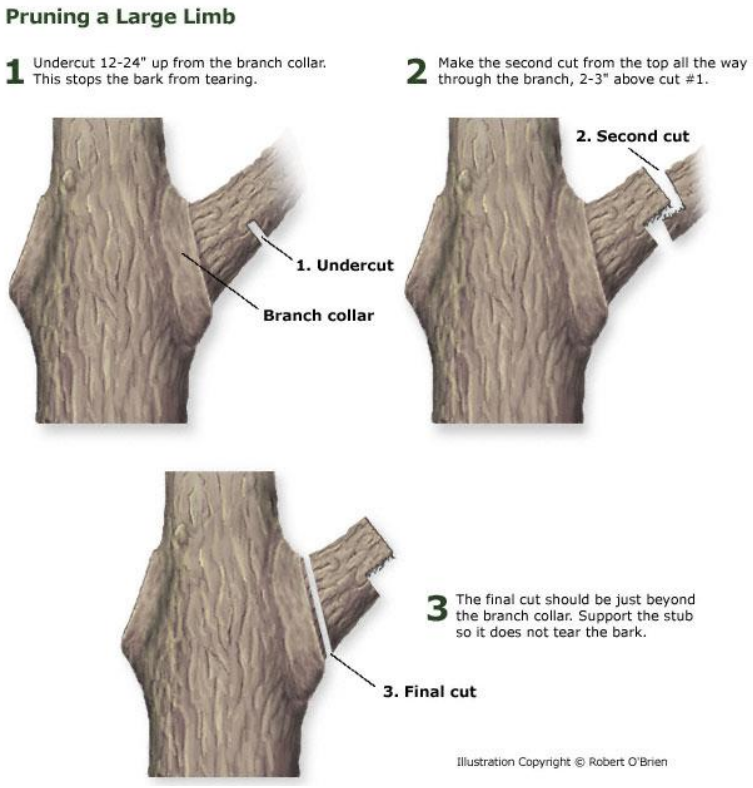


Image provided by Texas A&M Forest Service

In general, wound paints and sealers are unnecessary and may even slow healing of pruning cuts. The exception is wounds on oaks at risk of infection by oak wilt. The Texas Forest Service recommends painting all wounds on all oaks at all times. For more information of the cause and prevention of oak wilt, see the Texas Forest Service website at http://texasforestservice.tamu.edu/OakWiltFAQS/

Fertilization

Fertilization for trees should be approached with caution. Compared to many other landscape plants, trees have low requirements for soil fertility. And there is a fine line between nutrient deficiency and toxicity. If you think your trees need fertilization, the best course of action is to have a soil test done and follow the recommendations based on that soil test. More information on soil tests is available from the Texas A&M AgriLife Extension, http://soiltesting.tamu.edu/ If trees are located in well-maintained lawn or landscape areas, it is unlikely that they need additional fertilization.

High pH soils (alkaline or basic soils) common in north central Texas pose special difficulties for tree species not adapted to these conditions. Although nutrients may be present in sufficient amounts in the soil, the high pH prevents such trees from absorbing the nutrients. Supplemental fertilization to supply greater amounts of the deficient nutrient may be necessary. Or soil acidifiers may be applied to reduce pH and make existing nutrients available to the tree. Changing the pH of soil is very difficult, and is usually impractical for a large, long-lived tree. It is far better to select a tree that is well adapted to the soil in which it must grow in the first place.

If a soil test recommends fertilization during the first growing season, do not fertilize with high nitrogen quick release fertilizer. Use slow release organic fertilizer at the recommended rate recommended by the test. During the second growing season, fertilize 3-4 times a year using a slow release fertilizer, when the average daily temperature is below 85° but above 65° F.

Tree grown primarily for fruit or nut production (orchard crops) may have different requirements for fertilization and other maintenance practices. See the Texas A&M AgriLife Extension at http://agrilifeextension.tamu.edu/ and search for the tree crop that interests you.

Insects and Disease

A full discussion of tree pests is beyond the scope of this manual. For the most part insects and diseases that affect trees are opportunistic, only attacking trees that already are stressed from environmental conditions.

Common causes of tree stress are soil compaction and other construction damage, extremes of weather, inadequate soil volume for the size of the trees, and improper maintenance of any type. Selecting a tree that is not well adapted for its site conditions is a guaranteed way to produce a tree

that is chronically stressed and susceptible to pests. Insect and disease problems often go away if the cause of stress can be identified and eliminated.

An exception to stress related pest problems occurs when an exotic insect or disease is introduced to our region and our trees have no resistance to it. Such pests can have catastrophic effects. The best known example is the infectious fungus that causes oak wilt. In May 2016, the Asian emerald ash borer was found in Texas for the first time. All species of ash trees are believed to be susceptible, including the seven species native to Texas and several exotic ash species commonly planted here. At this time it is unknown if emerald ash borer will cause the same level of destruction in Texas as it has in 26 other states. It is prudent to limit or avoid planting new ash trees until the extent of the threat is known. More information about emerald ash borer is available from the Texas Forest Service, http://texasforestservice.tamu.edu/content/article.aspx?id=24246

Whenever valuable trees are seriously threatened by any pest or disease, we recommend seeking the advice of an ISA certified arborist.

Root Pruning Large or Mature Trees: Just as branches may need to be pruned for specific reasons, the roots of established trees may need pruning. Root pruning is almost always done to reduce damage to the root system by construction within the drip zone (protection zone?) of the tree. Root pruning must be done carefully and must be limited as much as possible or the tree may die or become unsafe. Acceptable reasons to prune roots include:

- Trenching to install utilities or irrigation
- Excavation for grading and drainage
- Construction of structures or pavement
- Repair and prevention of damage done by root growth to paving or other construction
- Preparation for transplanting an established tree
- Correction of defects in the root system such as circling or girdling roots.

Root pruning is never a substitute for good design that protects the root systems of trees. Nor is it an excuse for violating accepted tree protection practices as described elsewhere in this manual. Trenching or excavating without proper root pruning greatly increases damage to the root system and decreases survival of trees. Root pruning is when tree roots are cleanly severed from the tree in order to prevent damage which would be caused by trenching or excavation. For all root pruning of large trees, consultation with an ISA certified arborist is necessary.

Root Pruning Must Be Minimized: Several guidelines have been developed for how much root pruning can be done without endangering a tree. Two critical questions are how close to the trunk may roots be cut, and how much of the total root system may be removed safely.

We should root prune no closer to the trunk than a distance equal to 3 times the trunk diameter, preferably 5 times the trunk diameter. This area is called the structural plate of the tree, and is largely responsible for anchoring the tree and preventing blow-over damage from wind. For a 12" caliper (diameter at breast height, DBH) no root may be cut closer than 36" from the trunk, and 60" is better. **Note:** this does not mean that **all** the roots at 36" (or 60") from the trunk may be cut, only that no root may be cut **closer** than this distance. Girdling roots on existing trees are an exception, and usually need to be cut close to the trunk.

Root pruning must not remove more than 30% of the root system. This is similar to 25% maximum recommended for branch pruning.

Response of Trees to Root Pruning: The impact from pruning roots depends on several factors (see table below). Damage typically increases with more cuts, bigger cuts, and cuts made closer to the trunk. Root pruning, trenching, and other construction activities close to the trunk result in more injury on shallow, compacted soils or on soils that drain poorly than on well drained soils. This is due to the shallow roots common on sites with shallow soils or high water table. Trees that are leaning are poor candidates for root pruning. Prune roots only with sharp tools to avoid tearing behind the cuts.

Factors affecting response of trees to root pruning

- root size: larger roots may generate few new roots
- number of cut roots: more roots cut means more tree stress
- proximity of cuts to the trunk: the closer cuts are to the trunk the bigger the impact
- species: some species tolerate it better than others
- tree age: old trees are more likely to stress and die
- tree condition: trees in poor health should not be root pruned
- tree lean: leaning trees should not be root pruned
- Soil type and site drainage: shallow soils mean stay farther from the trunk.

Alternatives to root pruning: Design for tree protection is described in detail elsewhere in this manual. But it is worth considering some alternatives to root pruning:

- to reduce tripping hazard in lawns, add a shallow layer of soil over the roots and re-sod
- curve the sidewalk around the surface roots
- elevate the walk over the roots
- suspend the footing on pilings
- add more steel reinforcing to new concrete to resist root heaving of pavement
- for tripping hazards in walks, grind the concrete down
- raise the walk by injecting grout under it
- build the structure elsewhere
- dig under roots with trench-less technology
- live with the problem

Root Pruning Procedures: Root pruning is when tree roots are cleanly severed from the tree in order to prevent damage which would be caused by excavation. The soil around the roots is removed by hand or utilizing an air knife so the roots can be seen before pruning. This is called making a "root pruning trench". Once exposed, the roots are cleanly cut, then top soil is put into the root pruning trench to encourage root regrowth in that area. This system prevents future problems with the tree by minimizing damage to its roots

When to Root Prune

- When digging beneath the dripline of a tree you will need to root prune
- If you will be digging near the truck of the tree, you may affect the trees stability.
- The most important stability roots are found at 3x the diameter of the tree. This is called a tree's "structural root plate". For example, a 2 foot diameter tree will have a 6 foot structural root plate holding it up. For some trees, this structural root plate is even larger.

How to Root Prune

- Before digging, consult with certified arborist to decide where the root pruning trench will be located and mark the location of the trench.
- A certified arborist must be onsite to perform or supervise the root pruning.
- If major roots will be pruned, or a large percentage of the roots will be pruned, the tree may require other types of care. For mature trees, no more than 30% of roots may be pruned.

- The pruning trench should be cleared in a way that exposes the roots while leaving them intact. Use hand tools or an air knife (air spade). Do NOT use an excavator, as this will pull on the roots and possibly damage the trunk.
- If a root larger than 2" is exposed, leave this root intact and contact arborist.
- Once the roots are exposed, use a SHARP tool to cleanly cut all roots which are between 1-2" diameter, to the depth of the proposed disturbance. Appropriate tools include sharp lopping shears, handsaws, a sharpened ax, a root pruner, a stump grinder, a reciprocating saw (Sawsall or similar) and any other sharp tool which leaves a clean cut
- Do not use a chainsaw or chain trencher to make the final cuts. All roots shall be left with a clean, smooth ends and no ragged edges.
- Cut tree roots must be kept moist. If roots ends will be left exposed for more than 8 hours, cover the hole with moist burlap.
- Fill the hole with high quality top soil, mulch the area with triple shredded hardwood to a depth of 3", and water well.

University of Florida http://hort.ufl.edu/woody/root-prune-guidelines.shtml

Trenching and digging in the soil near trees can cut roots, and this can damage the tree resulting in tree decline or the tree falling over (See: fallen tree from cutting roots). This can cause liability and safety concerns. Root pruning is more injurious to old mature trees than it is for younger more vigorous trees. Cutting roots greater than about one inch diameter during trenching and digging can mean problems for the tree. In some cases roots of one to three inches diameter represent the major structural roots holding the tree upright.

The impact from pruning roots depends on several factors (see table below). Damage typically increases with more cuts, bigger cuts, and cuts made closer to the trunk. Root pruning, trenching, and other construction activities close to the trunk result in more injury on shallow, compacted soils or on soils that drain poorly than on well drained soils. This is due to the shallow roots common on sites with shallow soils or high water table. Trees that are leaning are poor candidates for root pruning. Prune roots only with sharp tools to avoid tearing behind the cuts.

Factors affecting response of trees to root pruning

- root size: larger roots may generate few new roots
- number of cut roots: more roots cut means more tree stress
- proximity of cuts to the trunk: the closer cuts are to the trunk the bigger the impact
- species: some species tolerate it better than others
- tree age: old trees are more likely to stress and die
- tree condition: trees in poor health should not be root pruned
- tree lean: leaning trees should not be root pruned
- soil type and site drainage: shallow soils mean stay farther from the trunk

How close to the trunk can roots be cut?

Well, the answer appears to depend on who you ask. For mature trees, some experts recommend not cutting roots closer than 6 to 8 inches from the trunk for each inch in trunk diameter. That means stay at least 10 feet away from a 20 inch tree! Others are more realistic and state that we should root prune no closer to the trunk than a distance equal to 3 times the trunk diameter, preferably 5 times the trunk diameter. Dr. Tom Smiley at the Bartlett Tree Research Laboratory in Charlotte showed that roots on one side of very young trees can be pruned off completely at a distance equal to 5 times the trunk diameter without any impact on tree stability. Whichever rule-of-thumb you decide to use, do so knowing that pruning roots on trees can result in trees falling over or dying. While root pruned large trees on well drained soil may not fall over because of deeper sinker roots under the trunk, they can and have. There are fewer deep roots holding the tree up on poorly drained and compacted soils.

Alternatives to root pruning

- add soil over the roots and re-sod
- curve the sidewalk around the surface roots
- elevate the walk over the roots
- suspend the footing on pilings
- re-pour the walk with steel in the concrete
- grind the concrete down
- raise the walk by injecting grout under it
- build the structure elsewhere
- dig under roots with trench-less technology
- live with the problem

ANSI A300 (Part 8) - 2013 Root Management Standard

- Trenching near a tree
- Root pruning to mitigate tripping hazards and infrastructure damage
- Managing stem-girdling and stem-circling roots

Root Pruning Standard Operating Procedure
For step by step instructions, see Root Pruning Recommended Practices

1) Root pruning is when tree roots are cleanly severed from the tree in order to prevent damage which would be caused by excavation
2) The soil around the roots is removed by hand or utilizing an air knife so the roots can be seen before pruning. This is called making a "root pruning trench"
3) Once exposed, the roots are cleanly cut, then top soil is put into the root pruning trench to encourage root regrowth in that area
4) This system prevents future problems with the tree by minimizing damage to its roots

How to Root Prune
When
1) When digging beneath the dripline of a tree you will need to root prune
2) If you will be digging near the truck of the tree, you may affect the trees stability.
a) The most important stability roots are found at 3x the diameter of the tree. This is called a tree's "structural root plate"
    i) For example, a 2 foot diameter tree will have a 6 foot structural root plate holding it up. For some trees, this structural root plate is even larger.
How
1) Before Digging
    a) First, contact Landscape Services and arrange a site visit to discuss logistics
        i) During the site visit, you will decide where the root pruning trench must be dug
        ii) The location of the root pruning trench will be marked on the ground
    b) Decide if you will perform root pruning yourself under the supervision of an arborist, or have an arborist perform the pruning for you.

i) A certified arborist must be onsite to perform or supervise the root pruning

c) If major roots will be pruned, or a large percentage of the roots will be pruned, the tree may require other types of care

i) For mature trees, no more than 30% of roots may be pruned.

2) Digging Process

a) The pruning trench should be cleared in a way that exposes the roots while leaving them intact.

i) Use hand tools or an air knife

ii) Do NOT use an excavator, as this will pull on the roots and possibly damage the trunk

iii) If a root larger than 2" is exposed, leave this root intact and contact Landscape Services

b) Once the roots are exposed, use a SHARP tool to cleanly cut all roots which are between 1-2" diameter, to the depth of the proposed disturbance

i) Appropriate tools include sharp lopping shears, handsaws, a sharpened ax, a root pruner, a stump grinder, a reciprocating saw (sawsall) and any other sharp tool which leaves a clean cut

ii) You may not use a chainsaw or chain trencher to make the final cuts

iii) All roots shall be left with a clean, smooth ends and no ragged edges

3) Post Pruning

a) Tree roots must be kept moist. If roots ends will be left exposed for more than 8 hours, cover the hole with moist burlap.

b) Fill the hole with high quality top soil, mulch the area with triple shredded hardwood to a depth of 3", and water well.

Duke University

https://fmd.duke.edu/construction/design/Root%20Pruning%20Standard%20Operating%20Procedure.pdf