

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE GENERAL SPECIFICATIONS**

TREE /SHRUB ESTABLISHMENT

**Acres
Code 612**

GENERAL CRITERIA

Trees can be planted for a number of reasons including wood production, to produce fruit and nuts, to enhance wildlife habitat, to protect riparian areas, to reduce the impacts of wind, to improve aesthetics and many other reasons.

The objectives of the landowner and the location of the property will aid the selection of the appropriate tree species adapted to the site and soils. See Table 1 for a list of potential tree species. Also, the NRCS website under the Forestry tab has a list of trees and shrubs for each zone.

When establishing hardwoods, consideration will be given to planting a mixture of at least 3 species. Use species of similar wetness and soil tolerances (See Table 1).

Avoid planting any invasive species.

If planting or seeding of shade intolerant species such as pine, cherrybark oak, southern red oak, water oak or willow oak is done under an existing canopy; the overtopping trees must be removed within the first 2 years.

Comply with applicable laws and regulations, including the Texas Best Management Practices (BMPs).

1. PLANTING SEEDLINGS

Planting is an artificial regeneration system that uses growing stock that originates off-site and is planted on-site using bare root seedlings, containerized trees or seedlings, or cuttings. The advantages of planting include species determination, density control, uniformity of composition and growth, and the ability to take advantage of genetic improvements

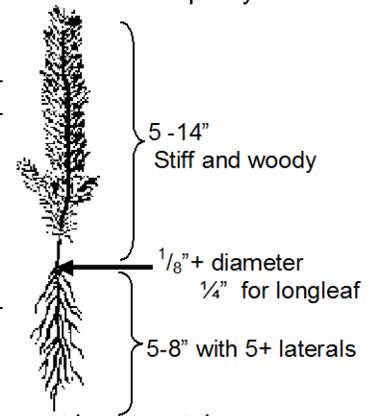
Seedling Sources. Priority will be given to plant materials that have been selected and tested in tree/shrub improvement programs. Care must be taken that the seed sources come from the same geographic area in which the seedlings will be planted. Seedlings grown by the Texas A&M Forest Service and local industry nurseries will be acceptable. Seedlings obtained from other sources such as commercial nurseries must be from sources within a 150-mile North-South zone of the planting site. Balled or containerized stock from commercial nurseries must be suited for the "Hardiness Zone" of the site. This information is generally provided on a tag attached to the tree. Seedlings should be ordered at least 6 months prior to the planting season to ensure selection. A list of potential tree nurseries is located on the Texas NRCS website under the Forestry tab.

Conservation practice specifications are reviewed periodically, and updated if needed. To obtain the current version of this specification, contact the Natural Resources Conservation Service.

Seedling / Cutting Quality. Only quality seedlings should be planted. General standards for quality seedlings are given below:

CRITERIA	PINE	HARDWOOD
• Minimum root collar diameter	1/8"*	1/4"*
• Preferred height	5-14"	16-30"
• Root length	5-8"	8-10"
• Minimum number of lateral roots	5	5
• Seedling stems	Stiff and woody	
• Terminal bud	Inactive and "hardened off".	

*Minimum root collar diameter for longleaf pine is 1/4"



In addition to the criteria above, containerized (tubes, plugs, blocks) seedlings must have containers that are firm, moist and durable enough to withstand the planting process.

Planting hardwood cuttings will be limited to cottonwood, hybrid poplar, willow and their varieties. Cuttings should be about 18" long and no less than 3/8" in diameter.

Seedling Care. Proper care of seedlings from pickup to planting is critical to the success of tree planting. Every effort must be made to plant immediately after receiving the seedlings. If planting will occur within one week, the seedlings must be kept cool and moist – between 32°F to 40°F. Seedlings should be kept no longer than two weeks out of cold storage. If storage will be longer, heel in the seedlings until ready to plant. Seedlings that are "heeled in" should be planted within 4 weeks.

Only as many seedlings as will be planted that day should be taken to the site. These must be kept cool and shaded. Keep the seedling roots thoroughly moist at all times. Cuttings must be soaked in water. Keep bags closed and tape any tears or breaks.

Prune roots only if it is necessary to ensure proper planting. Pruning will be done with sharp shears or knives. Roots will not be torn.

Pine taproots will not be pruned any shorter than 8 inches.

Hardwood taproots may be pruned to a minimum of 8 inches to facilitate planting. If lateral roots are pruned, pull the roots down along the tap root and cut at the length of the tap root. The top should also be pruned to maintain the original root-to-shoot ratio.

Cull all seedlings that do not meet the quality criteria above.

Spacing and Stocking. A survival of 60% or more of the original planting density at the end of the first growing season is considered acceptable. Pines planted for timber products will be spaced so that the trees will grow normally until the first thinning. The spacing for planting pine seedlings is:

TREES PER ACRE FOR SPACING OF:						
FEET BETWEEN ROWS	FEET BETWEEN TREES IN ROW					
	4	5	6	7	8	9
8					681	
9				691	605	538
10			726	622	545	484
11		792	660	566	495	440
12		726	605	519	454	
13		670	558	519		
14		622	519	444		
15	726	581	484			
16	681	545	454			

Hardwood seedlings planted for timber production are generally spaced 10' X 10' (436 trees/acre) or 12' X 12' (303 trees/acre) for wildlife habitat purposes. This spacing may be altered as appropriate. For example, if little or no weed control will be applied, if rodent damage is expected to be high, or if high value timber products are expected, the spacing may be closer. Never plant hardwoods closer than 6' X 6' (1210 trees/acre).

Spacing for Christmas trees should be based on the size of the equipment that will be used for cultural practices and the size of the harvested trees. A rule of thumb is to add at least 3 to 4' to the width of the largest piece of equipment that will be used.

Site Preparation. The purpose of site preparation is to:

- control competing vegetation that will interfere with the survival and growth of the new stand,
- improve the soil conditions for seedling survival,
- improve the effectiveness and success of the planting operation.

Site preparation may include the whole field, strips, or individual treatments such as mulching where the tree is to be planted. Prepare the site mechanically, by prescribed fire, or by applying approved herbicides. When necessary, water conservation measures such as scalping, v-ditching and / or mulching should be included. In addition, subsoiling may be needed on soils that are compacted, have a hardpan or dense clay subsoil within 10 inches of the surface. Conditions such as the potential for excessive erosion must be considered when planning site preparation. Refer to the **Tree/Shrub Site Preparation**, 490, practice standard and specification.

Planting Specifications.

- **Bare Root Stock, Small Containerized Seedlings, and Cuttings.** Machine or hand planting with any tool that will accomplish satisfactory results is acceptable. Furrows and holes must be free of litter and large enough to adequately accommodate the roots. Soil around the roots must be firmed and free of air pockets.

Planting Conditions: Seedlings should be planted when the weather and soil conditions are optimum. Critical planting days will be avoided.

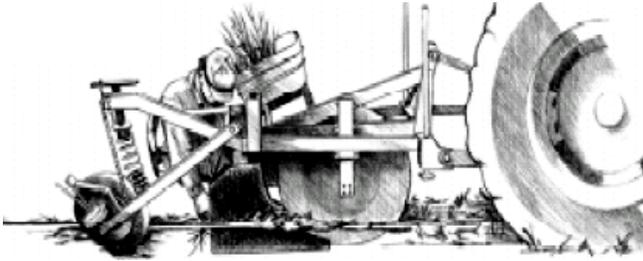
Planting Depth.

- Bareroot seedlings. (pine and hardwoods). Plant about 1" deeper than they grew in the nursery bed (evidenced by the root collar). In deep sands, plant seedlings about 2-4" deeper.
- Longleaf bareroot seedlings. Plant with the root collar at or slightly below the soil surface so that the bud will be exposed after the soil has settled.
- Small containerized seedlings. Plant with the top of the soil plug at or slightly above the soil surface.
- Hardwood cuttings. Plant about 15" deep.

DAY CLASS	WEATHER - SOIL CONDITIONS
Good	Temperature: 35° - 60° Relative Humidity: >40% Wind Speed: <10 mph Soil Moisture: Abundant
Marginal	Temperature: 60° - 75° Relative Humidity: >40% Wind Speed: 10 – 15 mph Soil Moisture: Marginal
Critical	Temperature: >75° Relative Humidity: <40% Wind Speed: Any Soil Moisture: Low to Absent Soil Temperature: Freezing

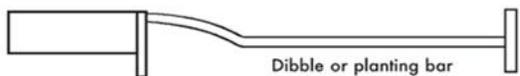
Planting Methods:

A **machine planter** is pulled behind a tractor or bulldozer and makes a narrow slit or furrow with a modified subsoiler point. A person riding on the planter places one seedling at a time in the slit. The furrow is then closed tightly around the seedling by two rollers or packing wheels to lock the seedling in place. Keep seedlings in planter box until planted. Check planting performance frequently to ensure proper planting quality, particularly when soil type, texture, moisture or debris changes on the site.



Condition	Result
Soil too dry	Poor compaction
Improper seedling release	L or U Roots, Angled or too shallow seedling
Inadequate weight or pressure	L or U Roots, Poor compaction
Packing wheels not set correctly	Too far: Poor compaction, Too close: Damaged seedlings

Hand planting with a planting bar or "dibble" is suited for small acreage, most hardwood planting, and/or where site prep has left the ground too heavily littered for machines. The dibble blade must be both long and wide enough to achieve the needed planting depth without "J-" or "L" rooting. Pack seedlings loosely into planting bags and keep them in the bags until planted – do not carry in the hand. Minimize tearing of the roots when removing seedlings from the bag. Do not ball or twist the bare roots to facilitate planting, lateral roots should be placed in a more or less natural position. Soil must be firmly packed around the planted seedling, eliminating air pockets. The following illustration shows the proper hand planting technique:

With Dibble or Planting Bar

1. Insert dibble at angle shown, and push straight up.



2. Remove dibble, and place seedling at correct depth.



3. Insert dibble 2 inches toward planter from seedling.



4. Pull handle toward planter, firming soil at bottom of roots.



5. Push handle forward from planter, firming soil at top of roots.



6. Insert dibble 2 inches from last hole.

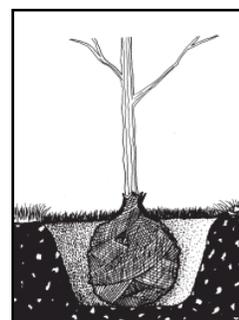


7. Push forward, then pull backward to fill hole.



8. Fill in last hole by stamping with heel.

- **Balled or Container Stock.** Plant when soils are moist. Do not handle trees when temperature is below freezing. Dig the hole twice as wide as the root ball and roughen the sides and bottom to facilitate root penetration. If necessary, loosen root mass. In well drained soils, plant at or slightly above the depth the stock grew in the nursery or container. In poorly drained soils, position the tree with the root collar slightly above the soil surface. Pack soils around the roots firmly by tamping and watering. Form a ridge around the tree large enough to catch and hold water.

**Planting Dates.**

- Bare Root Stock
 - Optimum: January through mid-March
 - Maximum: Mid-December through March
- Small Containerized Seedlings (Plugs, tubes, blocks)
 - October through March.
- Large balled or containerized stock may be planted year-round if watered frequently.

Certification. Ideally, certification plots should be completed within 2 weeks of planting in order to address potential deficiencies associated with planting. A maximum tolerance of 30% error (70% planted correctly) is acceptable regarding spacing and planting technique, in order to justify certification. In addition to plots, the planting perimeter will be measured by GPS according to Texas' policy for practice certification.

Replanting. Survival counts will be conducted at the end of the first growing season. Replanting will be recommended when survival is inadequate (< 60% of original planting density). Considerations for replanting will include the landowner's objectives, specific site conditions, difficulty associated with replanting the site and the availability of resources. If unsure, seek professional forestry advice.

2. DIRECT SEEDING.

The alternate method of artificial regeneration is direct seeding. Direct seeding is useful on sites where access, terrain, or drainage makes planting seedlings impossible. While the results are usually less predictable and more time is required for stand establishment, the initial cost of direct seeding is less than that of planting seedlings. Disadvantages of direct seeding may be: unfavorable climatic conditions following planting may cause complete failure, longer rotations are needed, lower yields are typically reported from direct seeding, and stand density is uncontrollable.

Site Size. Site will be 2 acres or larger.

Seed Storage.

- Acorns. Prior to collecting acorns, test their soundness by cutting into the acorns to test for fullness or by floating in water. Sound acorns will usually sink. Exception: All acorns from overcup oak float. White oak acorns will not store well beyond a few months. If possible, plant soon after collection. Red oak acorns can be stored moist in 4ml. polyethylene bags at 35°F.
- Pecan and Hickory. These nuts can be stored moist for several years at 40°F.
- Ash. Store cleaned seeds dry at about 40°F.
- Pine. Store seeds from loblolly, shortleaf and slash pines dry at temperatures between 0°F and 32°F. Longleaf seed do not store well and are best planted in the fall after collection.

Site Preparation. The purpose of site preparation is to expose mineral soil for seed germination. It can also control vegetation that will compete with the new stand and will provide cover for rodents. Prepare the seedbed by disking, prescribed burning, applying approved herbicides or furrowing, depending on site conditions. Be especially mindful of the potential for soil erosion. See **Forest Site Preparation**, 490, standard and specification.

Seed Treatment

Seed Testing Prior to Sowing. Test seed viability prior to planting. Germination of pine seed must be at least 80% (on a sound seed basis). Float or cut acorns to ensure planting only the sound seed.

Seed Treatment Prior to Sowing.

- Repellants. Treat pine seed with approved bird and rodent repellent prior to planting.
- Seed stratification:

SPECIES	STRATIFICATION METHOD
Longleaf Pine	Not required
Loblolly Pine	60 days at 35°F
Shortleaf Pine	45-60 days at 35°F
Slash Pine	30 days at 35°F
"White Oaks"	Not necessary
"Red Oaks"	Soak 1-2 days
Hickories	Not necessary if planted in the fall; otherwise, 30 - 90 days at 33° - 40°F
Ash	Room temperature for 30 days, then cold (40°F) stratification for 60 days.

Seeding Dates.

SPECIES	SEEDING DATES
Longleaf Pine	October through November
Loblolly, Slash and Shortleaf Pine	Mid-February. through mid-April
"White Oaks"	Fall through winter
"Red Oaks", Pecan, Hickory	November through May
Ash	Fall through spring

Seeding Methods. Seed can be planted/sown by hand or mechanically. Small seed, such as pine, must be in contact with mineral soil and left uncovered. Large seeds such as acorns can be planted at any depth down to 6 inches, but 2-3 inches is more practical and seems to favor germination.

- **Hand Planting of Small Seed.** Broadcast hand seeding methods for small seed include hand sowing and the use of "cyclone" type seeders. An extender such as sawdust may be useful in keeping seeding rates within rough limits. Spot seeding of pine seed is an alternative to broadcast sowing on small tracts. It requires no special equipment and uses one-third to one-half the seed used in broadcasting seeding. Spot seeding: Clear a one-foot-square spot with a rake or hoe, drop 3-6 seed per spot and lightly press the seed into the soil. About 1000 spots per acre (spaced 6'x7', 5'x8' or 4'x10') are needed to have adequate stocking.
- **Hand Planting of Large Seed.** Plant large seeds using a sharpshooter, dibble, or commercially available acorn planter.
- **Mechanical Planting.** Broadcast sowing of light seed such as pine using aerial or ground equipment. Specially designed row planters or modified soybean planters can be used for sowing of acorns and other large seeds in strips or furrows.

Care of Seed.

- **Hardwoods (acorns and nuts).** Transfer from storage to the planting site only as much seed as can be planted in a day (smaller amounts are even better). Pack the seed in ice for transport and temporary storage. Supply the planter(s) in small batches so that the seed stays cool as long as possible.
- **Pine.** Keep seed cool during transport from storage to the planting site.

Seeding Rates

Pine.

SPECIES	SEED/LB.	POUNDS PER ACRE FOR:			
		Broadcast	Disked Strips	Rows	1000 Spots/Ac
Loblolly	18,500	1	3/4	1/2	1/3
Longleaf	4,500	3	2	1 1/2	1 1/2
Shortleaf	45,000	1/2	1/4	1/4	1/4
Slash	13,000	1	3/4	3/4	1/2

Hardwoods (acorns and nuts). Plant about 1,200 to 1,500 seed/acre. Best spacing is from 10' x 3' to 12' x 2.5' Approximate lbs./ac for this rate are:

SPECIES	SEEDING RATE
Willow, cherrybark, southern red, or laurel oak	2-3 lbs./ac
Water oak	4 lbs./ac
Overcup oak	8 lbs./ac
Sawtooth oak	10 lbs./ac
Nuttall, white, or shumard oak	12 lbs./ac
Pecan or Hickory	10-12 lbs./ac
Swamp chestnut oak	15-20 lbs./ac

3. NATURAL REGENERATION

Natural regeneration is a regeneration system that relies on starting a new forest from either natural seed fall (either from sources on-site or nearby) or sprouting. Although natural regeneration is typically less expensive than artificial methods it can have disadvantages that include the inability to regulate species composition and seedling density, and of using genetically improved stock.

Natural Regeneration Methods

- **By Seed.** Natural seed fall from on-site sources can be achieved by silvicultural measures that include seedtree, shelterwood and clearcut (patches or strips) systems. The method used will depend on landowner objectives, availability of a desirable seed source, existing stand and site conditions, and desired composition of the future stand. Refer to Forest Stand Improvement, 666.

Site preparation will be planned as part of any system. Methods may include prescribed burning, mechanical site preparation, and/or application of herbicides. Site disturbance as a result of harvesting may provide an adequate level of site preparation. Refer to Forest Site Preparation, 490.

- **By Sprouting (Coppice).** This system relies on the re-sprouting of hardwoods from the stump after cutting. It cannot be relied on (and will not be planned) from stands with tree diameters larger than 12" dbh. When the coppice system is used to regenerate hardwood stands, clearcutting will be required at least in small openings to allow the sprouting seedling exposure to full light.
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4. FRUIT OR NUT TREE RE-ESTABLISHMENT OR RESTORATION

Re-establishment

- **Site Preparation.** Remove existing non-viable trees by pulling, pushing, or cutting. Dead trees should be stacked and burned or otherwise removed from the site. Perform leveling or planning to establish or re-establish optimum grade for irrigation efficiency which is 0 to 0.05% slope.
- **Planting Rates.** Plant new seedlings at the rates recommended by the industry. Acceptable rates range from 100 to 300 trees per acre depending on tree variety, soil type, and intended management practices.
- **Management.** Apply pesticides and nutrients as necessary at planting to insure adequate seedling survival. Refer to Nutrient Management standard, 590, and Pest Management standard, 595, for additional guidance. Irrigate as necessary to insure survival.

Restoration of Existing Trees

- **Pruning.** Prune trees whose branches have adequate viable wood, or sweetwood, above the bud union to allow the tree to develop into a healthy fruit-bearing tree after pruning. Remove dead or undesirable limbs from existing trees using hand or power tools. Stack and burn cuttings or remove them from the field. Paint the cut areas with wound dressing to protect the tree from insects and disease.
- **Budding in Place.** Use this method where there is viable rootstock but no live wood above the bud union. Carefully remove the existing dead wood to allow re-growth of the shoot from the original rootstock. Train selected shoot and re-bud to the desired citrus or nut species. Apply pesticides and nutrients as necessary to newly budded trees to insure adequate survival. Refer to Nutrient Management standard, 590, and Pest Management standard, 595, for additional guidance. Irrigate newly budded trees as necessary for survival.

Citrus Trees. Damage to citrus trees due to freezing conditions is not always readily apparent. The full extent of the damage and the best method for renovation cannot be determined until sufficient time has elapsed to evaluate the full extent of the damage. The time involved may be up to one year or more.

To reduce the potential for wind erosion, consider planting a cover crop or other high residue crop in the field if existing trees are removed and nursery stock is not immediately available to replant the first year.

Consider the size of mature citrus trees, space needed for management and harvesting equipment when deciding on planting rate or tree spacing of citrus trees.

Protect citrus trees from freeze, wind and animal damage by applying protective wraps or banking soil around the tree trunks. Take care when applying the wraps to achieve a good soil-wrap contact to exclude air from entering below the wrap.

Citrus are normally grown on sandy soils, which have been leveled for irrigation. Quality of the irrigation water is a concern.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

The trees and shrubs will be inspected periodically and protected from adverse impacts including insects, diseases or competing vegetation, fire and damage from livestock or wildlife.

Protect planted tree seedlings from grazing by domestic livestock at least one year after planting. See Access Control, 472, standard. The terminal bud must be well above maximum grazing heights of livestock species (6 feet high for cattle) before those animals are allowed back into the field(s) where tree planting has occurred.

Protect tree plantings from wildfires. Applicable practices such as Firebreaks, Code 394, and Access Control, 472, may be needed.

Control of leaf-cutting ants and gophers may be necessary, particularly on sandy sites.

Control of rodents should be a consideration during site preparation.

Control grass and weed competition until the woody plants are established. Control may be accomplished using approved chemicals or by mowing or shredding between rows. Noxious weeds will be controlled.

If needed, adequate protection against wind damage will be provided with the use of fabric screens, protective barriers, shingles, shakes, cones or shade cards.

Table 1*

Species	Site	Soil	Drainage**	Tolerance***		pH Range
				Flooding	Shading	
Ash						
Green	Bottomlands including frequently flooded	Not demanding	SWP	MT	I – M	3.6 – 7.5
White	Uplands and terraces	Deep, moist, well drained loams	MW	WT	M	4.5 – 6.2
Dogwood						
Flowering	Uplands	Most but poorly drained clays	W	I	T	6.0 – 7.0
Roughleaf	Bottomlands to uplands	Loamy to sandy	MW	WT – MT	M	6.1 – 7.8
Elm						
American	Well drained bottomlands	Not demanding but does best on moist soil	MW	I – WT	I – M	5.5 – 8.0
Cedar	Poorly drained bottomlands to uplands	Not demanding	P	MT	M – T	5.2 – 8.0
Lacebark (Chinese)	Uplands	Not demanding	W	I	I	6.6 – 8.4
Siberian	Streambanks to uplands	Clayey to coarse, dry	W	I	I	6.1 – 8.4
Slippery	Well drained bottoms, terraces, uplands	Not demanding	MW	I	I – M	5.2 – 8.0
Winged	Dry uplands to moist bottomlands	Not demanding	W	MT	I	5.5 – 7.0
Hickory/Pecan						
Bitternut, Pignut	Moist uplands to well drained bottomland	Silty to sandy soils	MW	WT	M – T	4.5 – 5.5
Mockernut, Black	Uplands	Not demanding except poorly drained soils	W	I	I – M	4.5 – 5.5
Shagbark, Shellbark	Uplands to well drained bottomlands	Not demanding except poorly drained soils	W	I - WT	M	4.5 – 5.5
Bitter pecan (water hick.)	Bottomlands	Fine textured soils	P	MT – T	I	4.8 – 6.0
Sweet pecan	Well drained bottomlands to uplands	Silty and loamy soils	MW	WT	I – M	4.8 – 7.5
Black walnut	Well drained stream bottoms to uplands	Moist loamy soils	MW	I	I	4.6 – 6.2
Little walnut	Well drained bottomlands	Silty to sandy soils	W	I	I	6.5 – 7.5
Locust						
Black	Uplands	Not demanding	MW	I	I	4.8 – 8.2
Honey	Bottomlands to uplands	Silty to loamy	P	WT – MT	I	5.1 – 7.3
Maple						
Bigtooth	Along streams to uplands	Clayey to loamy	W	I - WT	I	5.3 – 7.5
Boxelder	Moist bottomlands and terraces	Silty to sandy	P	WT – MT	M	4.0 – 7.5
Florida sugar	Small well drained bottoms & toe slopes	Moist loamy	P	WT – MT	T	5.5 – 7.0
Red	Bottomlands and wet sites	Not demanding	P	MT	T	4.5 – 7.5
Silver	Bottomlands, depressions	Not demanding	P	T	I	4.0 – 5.2

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Species	Site	Soil	Drainage**	Tolerance***		pH Range
				Flooding	Shade	
Oak (White Oak Group)						
Bur	Well drained bottomlands to uplands	Clayey to loamy	P	WT	I	6.0 – 6.3
Chinquapin	Well drained bottomlands to uplands	Loamy	W	I – WT	I	6.6 – 7.4
Lacey	Riparian zones and uplands	Dry clayey to limestone	W	I	I	6.6 – 8.4
Live	Uplands	Not demanding	SWP	I – WT	M	5.0 – 7.0
Monterrey (Mexican white)	Riparian zones and uplands	Loamy	W	I	I	5.1 – 7.8
Overcup	Bottomlands	Clayey to loamy	P	MT – T	M	4.5 – 7.3
Post	Uplands	Loamy, sandy to gravelly	W	I	M	5.1 – 7.3
Swamp chestnut	Small bottomlands to terraces	Clayey, wet sands to loamy	W	WT	I – M	3.6 – 6.2
White	Well drained bottomlands, to uplands	Not demanding	W	WT	M	4.5 – 6.2
Oak (Red Oak Group)						
Black	Uplands	Loamy to gravelly	W	I	I	5.6 – 6.5
Cherrybark	Well drained bottomlands and terraces	Loamy	W	WT	I – M	4.5 – 6.2
Graves	Uplands	Not demanding	W	I	I	7.0 – 8.5
Laurel	Well drained bottomlands	Loamy to sandy	SWP	MT	M	3.6 – 5.6
Nuttall	Bottomlands	Clayey to loamy	P	MT	I – M	3.6 – 6.8
Sawtooth	Uplands	Clayey to sandy loams	W	I	M	5.0 – 8.0
Shumard	Well drained bottomlands to uplands	Loamy to clayey	MW	WT	I	4.4 – 7.3
Southern red	Uplands	Not demanding	W	I	M	5.0 – 7.3
Texas red	Uplands	Gravelly	W	I	I – M	7.4 – 8.0
Water	Well drained bottomlands to uplands	Not demanding	SWP	WT	I	3.6 – 6.3
Willow	Bottomlands	Clayey to loamy	P	MT	I – M	3.6 – 6.3
Plum						
American	Uplands	Loamy to sandy	W	I	I – M	5.5 – 7.5
Chickasaw	Well drained bottomlands to uplands	Loamy to sandy, moist	W	I	I	5.1 – 7.3
Creek	Well drained bottomlands, streambanks	Calcareous clay soils or limestone outcrops			I	7.3 – 8.4
Mexican	Well drained bottomlands to uplands	Clayey to loamy	W	I	I	6.1 – 7.8
Oklahoma	Uplands	Sandy	W	I	I	
Sumac						
Evergreen	Uplands	Gravelly soils	W	I	M	6.2 – 7.8
Flameleaf						
(Shining, Winged)	Well drained bottomlands to uplands	Loamy, sandy, gravelly	W	I	I	
Skunkbush	Riparian areas to uplands	Not demanding	W	I	I	6.6 – 8.5
Smooth	Uplands	Loamy, sandy, gravelly	W	I	I	6.1 – 7.3

Species	Site	Soil	Drainage**	Tolerance***		pH Range
				Flooding	Shade	
Willow						
Black	Water edges	Not demanding	P	T	I	4.5 – 9.0
Golden	Water edges, wet sites	Not demanding	P	MT – T	M	5.5 – 8.0
Sandbar	Well drained bottomlands	Silty to sandy	SWP	MT	I	5.5 – 7.8
Conifers						
Aborvitae	Uplands	Not demanding except very wet or very dry	MW	WT	T	5.5 – 7.5
Cypress						
Arizona	Uplands	Not demanding	W	I	T	7.0 – 8.5
Bald	Bottomlands, wet sites, moist uplands	Not demanding	P	T	I	4.6 – 7.5
Leland	Uplands	Clayey to loamy, avoid shallow	W			
Juniper						
Ashe	Uplands	Loamy, sandy, to gravelly	W	I	I	7.0 – 8.0
Eastern redcedar	Uplands	Not demanding	MW	I	M	5.1 – 8.0
Rocky mountain	Uplands	Coarse textured to gravelly	W	I	M – T	5.0 – 8.4
Pine						
Afghan (Mondell)	Uplands	Loamy	W	I	I	7.0 – 8.5
Austrian	Uplands	Not demanding	W	I	I	4.6 – 7.8
Loblolly	Well drained bottomlands to uplands	Not demanding except poorly drained soils	MW	WT	I	4.5 – 7.0
Longleaf	Uplands	Loamy to sandy	W	I	I	4.5 – 6.5
Pinyon	Uplands	Not demanding	MW	I	I	6.1 – 8.4
Ponderosa	Uplands	Clay loams to gravelly > 30" deep	W	I	I	4.9 – 7.8
Scotch	Uplands	Sandy to gravelly	W	I	I	4.5 – 7.0
Shortleaf	Uplands	Silty to sandy	W	I	I	4.5 – 6.5
Slash	Flatwoods	Not demanding except droughty	P	WT	I	4.5 – 6.5
Virginia	Uplands	Not demanding except droughty	MW	I	I	4.6 – 7.9
Spruce, blue	Uplands	Deep, moist loamy	MW	I	M	6.0 – 7.5
American beech	Well drained bottomlands, along streams	Loamy	P	WT	VT	4.1 – 6.0
American holly	Bottomlands to uplands	Not demanding	MW	WT	T	5.6 – 6.5
Autumn olive		Not demanding			I	5.5 – 8.0
Blackgum	Bottomlands and uplands	Silty to loamy	P – MW	MT	M – T	4.6 – 7.0
Birch, River	Stream banks, well drained bottomlands	Not demanding	MW	WT	M	4.5 – 6.0
Buttonbush	Bottomlands, wet sites	Not demanding	P	T	I – M	5.1 – 7.8
Carolina buckthorn	Well drained bottomlands to uplands	Loamy	W	WT	I – M	4.5 – 7.3
Catalpa	Uplands	Loamy to sandy	W		I	5.5 – 7.5
Cottonwood	Well drained bottomlands to uplands	Not demanding	SWP	WT – MT	I	5.5 – 7.5
Cherry, black	Well drained bottomlands to uplands	Not demanding	SWP	I – WT	I – M	4.5 – 7.3

Species	Site	Soil	Drainage**	Tolerance***		pH Range
				Flooding	Shade	
Cherry, escarpment	Creek bottoms to hillsides	Clay to gravelly but does best on moist	W	I	I	6.5 – 8.5
Crabapple, blanco	Upland	Clay to sand but does best on moist loamy	W	I	I	
Fourwing saltbush	Upland	Silty to sandy	W	I	I	6.6 – 8.5
Fringetree	Well drained bottomlands to uplands	Not demanding	W	I	M	5.6 – 6.5
Hawthorne, spp						
Hybrid poplar	Well drained bottomlands to uplands	Deep, moist loamy	MW	I	I	6.0 – 7.0
Littleleaf leadtree	Upland	Not demanding	W	I	I – M	6.2 – 8.5
Magnolia, southern	Well drained bottomlands, terraces	Not demanding	W	WT	M – T	6.1 – 7.3
Mayhaw	Bottomlands, wet flats	Clayey to loamy	P	MT – VT	I	4.0 – 7.3
Mulberry, red	Well drained bottomland ridges to upland	Silty to sandy	MW	I – WT	M – T	4.4 – 7.5
Osage orange (Bois D'arc)	Well drained bottomlands to uplands	Not demanding	MW	I – WT	I	4.4 – 7.8
Paulownia	Uplands	Moist, well drained	W	I	I	6.0 – 8.0
Pawpaw	Well drained and uplands	Not demanding	W	I – WT	M – T	6.1 – 7.5
Persimmon, common	Uplands to bottomlands	Not demanding	P	MT	T	4.4 – 7.3
Possumhaw	Bottomlands to uplands	Not demanding	P	MT – T	M	4.5 – 7.8
Redbud, eastern	Well drained bottomlands to uplands	Silty to loamy	W	I	T	6.1 – 7.5
Redbud, Texas	Uplands	Not demanding	W		I	6.0 – 7.5
Rusty blackhaw	Well drained bottoms, streams, upland	Not demanding	W	I – WT	M	5.5 – 8.4
Sparkleberry	Upland	Loamy to gravelly	MW	I	M	6.1 – 7.8
Sugarberry	Bottomlands to uplands	Not demanding except droughty	P	MT	M – T	5.0 – 7.8
Sweetgum	Bottomlands to uplands	Not demanding except poorly drained	P	MT	I – M	5.1 – 7.5
Sycamore	Well drained bottomlands, along streams	Silty, to sandy	MW	MT	I – M	4.5 – 7.5
Texas mountain laurel	Riparian areas to uplands	Clayey to loamy	W	I	I	6.0 – 9.5
Texas pistache	Streambeds to uplands	Not demanding	W	I	I – M	6.1 – 8.5
Texas sophora	Uplands	Sandy	MW	I	I – M	5.6 – 8.5
Water Tupelo	Low flats, sloughs, swamps	Clayey to loamy	P	T	I	5.1 – 6.0
Western Soapberry	Uplands	Not demanding	W	I	M	7.0 – 8.5
Yellow poplar	Along streams to uplands	Loamy	W	I	I	4.5 – 7.0

* When wetness is a consideration, most hardwoods will grow well on sites somewhat drier than those listed above, but should never be planted on sites that are wetter.

** Drainage (Soil drainage classes)

- W - Well
- MW - Moderately well
- SWP - Somewhat poorly
- P - Poorly

*** Tolerances (Mature Trees)

- Flooding: I - Intolerant of flooding
 - WT - Able to tolerate saturated or flooded soils for short periods (weakly tolerant)
 - MT - Able to tolerate saturated or flooded soils for several months, but mortality is high if flooding persists during the growing season (moderately tolerant)
 - T - Able to tolerate saturated or flooded soils for long periods during the growing season
- Shading: I - Intolerant of shading
 - M - Moderately tolerant of shading
 - T - Tolerant of shading
 - VT - Very tolerant of shading