

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE GENERAL SPECIFICATION**

**TREE/SHRUB ESTABLISHMENT**

(Ac.)

CODE 612

**GENERAL SPECIFICATIONS**

Procedures, technical details, and other information listed below provide additional guidance for carrying out selected components of the named practice. This material is referenced from the conservation practice standard for the named practice and supplements the requirements and considerations listed therein.

**The mechanical tree planting components of this practice may adversely impact significant cultural resources and should be submitted to a cultural resource specialist for a determination of impacts before the practice commences.**

**PLANTING MATERIALS**

Tree and shrub establishment may be accomplished through planting bareroot or containerized planting stock, balled and burlapped material, cuttings, and seeds or through natural regeneration techniques. Only healthy, high-quality planting material will be planted.

**Material Source and Adaptation**

Care must be taken so that the planting materials come from a local and appropriate seed source. Local seed is always best.

For pine, care should be taken to use seedlings originating from an area having an average annual minimum temperature within 5 degrees Fahrenheit of the planting site's average annual minimum temperature (USDA Plant Hardiness Zone Map gives average annual minimum temperatures). USDA Forest Service Southern Research Station General Technical Report SRS-44, "Southern Pine Seed Sources", will be used to determine appropriate pine seed sources.

For hardwood, plant material should be from seed gathered within 150 miles north or south of the planting site. Certain species and periodic seed shortages may make this impossible. Always try to use the plant material whose origin is closest to the

planting site. Planting material originating outside the 150 mile limit can make up a minor component of the planting job. The planting job should be canceled if more than half of the planting material violates the 150 mile restriction.

Species planted will be adapted to the soil-site conditions. Drainage adaptation is especially important as well as soil pH. See Table 1 for a listing of pH requirements and flood tolerance levels for various tree and shrub species in Arkansas.

**Planting Stock Specifications**

Size specifications depend upon the type of planting stock to be used. Bareroot seedlings, containerized seedlings, and cuttings are expected to meet the specifications below.

All planting stock **MUST** be disease-free with no physical damage. This includes but is not limited to: no signs of heat damage (including sour smell, discoloration, and/or slimy feel); no root rot; cambium must be green; no dieback in the top; and no breaks or scrapes.

Roots of bareroot seedlings must be moist and treated with anti-desiccant.

Planting stock not meeting specifications **MUST** be approved by a NRCS Forester **BEFORE** planting.

**Specifications for bareroot pine seedlings:**

- A minimum root collar of 1/8-inch diameter.
- A minimum root length of 5 inches below the root collar.
- Ratio of the length of the shoot to the length of the tap root should be 1.5 to 2.5. Tops should be proportional to the root length even if top pruned at the nursery (7½ to 12½ inches above the root collar for 5 inch root).
- Healthy first order laterals and fibrous roots must be present.

**NRCS AR**

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Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State Office](#) or visit the [electronic Field Office Technical Guide](#).

**Specifications for bareroot hardwood seedlings:**

- A minimum root collar diameter of ¼ inch above the swell is required for all oak species and desired for all other hardwood species. Non-oak species may be smaller so long as all other specifications are met.
- A minimum tap root length of 6 inches below the root collar.
- Ratio of the length of the shoot to the length of the tap root should be 1.5 to 2.5 unless top pruned at the seedling nursery. Seedlings top pruned at the seedling nursery are acceptable. No top pruning should be done at the planting site. Tops should be proportional to the tap root length (9 to 15 inches above the root collar for 6 inch root).
- Healthy first order laterals and fibrous roots must be present.
- Roots must be moist, not moldy, with NO overabundance of lenticels, and not discolored (inside or out). The outside of the roots should not be black, the cambium cannot be discolored, and the internal part should be white or creamy in color,

For pine and hardwood seedlings root pruning at the planting site is strongly discouraged. Seedlings need all the roots they can get. The tap and lateral roots will not be pruned unless the length of the roots prohibits the proper planting of the seedling. It is better to leave the tips of lateral roots exposed after planting than to prune. Tap roots will not be pruned to less than the minimum required root length. Laterals will not be pruned less than 5 inches.

Where survival is critical or planting must be done outside the normal planting season, containerized trees and/or shrubs (tubes or pots) can be used. Containerized seedlings help insure survival but do not increase growth. Using containerized seedlings extend the planting season. Containerized seedlings can be planted earlier or later than normal bare root seedlings.

The size of the containerized tree seedlings and shrubs grown in tubes will vary in size by species.

Ideally, a shoot to root ratio of 1½ to 2½ should be maintained.

**Specifications for hardwood cuttings:**

- Cuttings should be collected during dormancy from one-year growth.
- Hardwood cuttings will be 18 - 20 inches long with a minimum diameter of .25" and a maximum diameter of 1.5 in diameter. (Longer cuttings may be necessary for sandy or droughty sites).

**PLANTING****Planting Density**

Spacings for bareroot or containerized material will be as follows:

SIZE AT 20 YEARS	SPACING
Trees > 20 ft. in height	8 - 12 ft.
Shrubs 10-20 ft. in height	5 - 8 ft.
Shrubs < 10 ft. in height	3 - 6 ft.

Final planting densities for these will vary from 436 to 681 pine seedlings per acre and 302 to 436 hardwood seedlings per acre. Distance between planted rows must be at least 10 feet.

For pine, planting areas with a history of poor survival and survival is expected to be below 70% can plant up to 726 seedlings per acre. This exception is only for those "special" sites and is the exception to the rule.

Planting densities for Silvopsture systems should be between 200 and 400 seedlings per acre.

Shrub planting densities are highly variable and will be planned to meet landowner objectives.

Large potted material will be planted at a spacing that will accomplish the intended purpose and be economically feasible. For purposes of wildlife habitat enhancement or wetland restoration, spacing of 70 to 100 feet are appropriate.

**TABLE 1. Soil pH Ranges\* and Flooding Tolerances for Some Arkansas Tree Species**  
(Adapted from *Species Suitability and pH of Soils in Southern Forests*, USDA Forest Service).

Common Name	Scientific Name	Range in	Flood Tolerance
Ash, Green	<i>Fraxinus pennsylvanica</i>	3.6-7.5	Moderately Tolerant
Baldcypress	<i>Taxodium distichum</i>	4.6-7.5	Tolerant
Beech, American	<i>Fagus grandifolia</i>	6.0-7.0	Weakly Tolerant
Birch, river	<i>Betula nigra</i>	4.5-6.0	Moderately Tolerant
Blackgum	<i>Nyssa sylvatica</i>	4.6-7.0	Weakly Tolerant
Buckeye	<i>Aesculus species</i>	6.0-8.0	Intolerant
Catalpa	<i>Catalpa species</i>	6.0-8.0	Intolerant
Cherry, black	<i>Prunus serotina</i>	4.6-6.2	Intolerant
Cottonwood	<i>Populus deltoides</i>	3.6-7.5	Weakly to Moderately
Dogwood, flowering	<i>Cornus florida</i>	6.0-8.0	Intolerant
Elm	<i>Ulmus species</i>	5.2-8.0	Intolerant - Moderately
Hickory, water	<i>Carya aquatica</i>	4.8-6.0	Moderately Tolerant
Holly, American	<i>Ilex opaca</i>	5.0-6.0	Intolerant
Honeylocust	<i>Gleditsia triacanthos</i>	6.0-8.0	Moderately Tolerant
Locust, black	<i>Robinia pseudoacacia</i>	4.5-7.5	Intolerant
Magnolia, southern	<i>Magnolia grandiflora</i>	5.0-6.0	Weakly Tolerant
Maple, red	<i>Acer rubrum</i>	4.4-7.5	Moderately Tolerant
Mulberry	<i>Morus species</i>	6.0-8.0	Weakly Tolerant
Oak, black	<i>Quercus velutina</i>	4.0-5.0	Intolerant
Oak, bur	<i>Quercus macrocarpa</i>	6.0-6.3	Weakly Tolerant
Oak, cherrybark	<i>Quercus pagoda</i>	4.5-6.2	Weakly Tolerant
Oak, northern red	<i>Quercus rubra</i>	4.5-6.0	Intolerant
Oak, Nuttall	<i>Quercus nuttallii</i>	3.6-6.8	Moderately Tolerant
Oak, overcup	<i>Quercus lyrata</i>	3.6-5.5	Moderate to Tolerant
Oak, pin	<i>Quercus palustris</i>	6.0-7.0	Moderately Tolerant
Oak, shumard	<i>Quercus shumardii</i>	4.4-7.5	Weakly Tolerant
Oak, swamp chestnut	<i>Quercus michauxii</i>	3.6-6.2	Weakly Tolerant
Oak, Southern red	<i>Quercus falcata</i>	5.0-6.0	Intolerant
Oak, water	<i>Quercus nigra</i>	3.6-6.3	Weakly Tolerant
Oak, white	<i>Quercus alba</i>	4.5-6.2	Intolerant
Oak, willow	<i>Quercus phellos</i>	3.6-6.3	Moderately Tolerant
Pecan	<i>Carya illinoensis</i>	4.8-7.5	Weakly Tolerant
Persimmon	<i>Diospyros virginiana</i>	4.4-7.0	Moderately Tolerant
Pine, loblolly	<i>Pinus taeda</i>	4.5-6.0	Weakly Tolerant
Pine, shortleaf	<i>Pinus echinata</i>	4.5-6.0	Intolerant
Plum	<i>Prunus species</i>	5.0-8.0	Weakly Tolerant
Red cedar, Eastern	<i>Juniperus virginiana</i>	6.0-7.5	Intolerant
Redbud, Eastern	<i>Cercis canadensis</i>	6.0-8.0	Intolerant
Sassafras	<i>Sassafras albidum</i>	4.7-7.0	Intolerant
Sugarberry	<i>Celtis laevigata</i>	5.0-7.0	Moderately Tolerant
Sumac, shining	<i>Rhus copalina</i>	4.2-7.0	Intolerant
Sweetgum	<i>Liquidambar styraciflua</i>	3.6-7.5	Moderately Tolerant
Tupelo, water	<i>Nyssa aquatica</i>	3.6-5.6	Tolerant
Walnut, black	<i>Juglans nigra</i>	5.0-7.5	Intolerant
Willow, black	<i>Salix nigra</i>	4.6-7.5	Tolerant
Yellowpoplar	<i>Liriodendron tulipifera</i>	4.5-7.0	Intolerant

Spacing for timber production will result in a higher density per acre than that for other objectives of tree establishment. Wider, less dense, spacing is generally better for wildlife habitat management.

### Site Preparation

Site preparation shall be sufficient for establishment and growth of the selected species and type of planting stock. The type and intensity of site preparation will vary according to ground cover, soils, and the species to be planted (See Tree/Shrub Site Preparation, Code 490).

Seedling planters must have good enough access to allow the seedlings to be planted properly at the recommended spacing. Prescribed burning should be considered when planter access is an issue.

Herbaceous control is recommended and should be enough to allow seedlings to be free to grow till they are above the competition. Herbaceous competition must be controlled when seedlings are planted in improved pasture.

Subsoiling to a depth of 12 to 18 inches (the deeper the better) is optional but recommended in all areas. Areas with a plow pan or compacted soils must be subsoiled (deep enough to break through the compacted area of the soil profile).

### Care During Storage and Planting

Bareroot seedlings must be stored and planted according to the Arkansas Forestry Commission's, "Seedling Care and Planting Guidelines" ([http://www.forestry.state.ar.us/manage/Seedling\\_care.pdf](http://www.forestry.state.ar.us/manage/Seedling_care.pdf)).

Protect planting stock from desiccation and freezing during temporary storage and delivery to the planting site. Seedlings will be kept moist during the planting process. Opened bundles of trees will be re-closed while on the planting site. Best to not transport partially used bundles between planting sites.

Planting bags or similar devices are required for all planters.

Planters will not carry more than one tree in their hand at a time.

Keep all planting stock in a cool environment (preferably < 50 degrees F) out of direct sunlight and wind. Internal bag or box temperatures will not exceed 60 degrees F.

Seedlings should be stored in a working cold storage facility until they are delivered to the planting site. Ideally, only a one day supply of seedlings should be removed from the cold storage facility at a time.

Seedlings should be stored between 34 and 40 degrees F. Seedlings must not be stored above 50 degrees for more than a day.

Acceptable substitutes for a storage unit may be used when the air temperature at the storage site will be between 32 and 45 degrees F. The seedlings may not be stored at a substitute site longer than 3 days.

Container grown stock will be kept in the container with the soil kept moist. Thoroughly water plants two days before planting. This will facilitate removal from containers during planting.

Balled-and-burlapped plants will be kept moist by watering slowly from the top. Wet the foliage occasionally. Balled planting stock can be stored temporarily by placing soil or mulch around the entire ball and keeping it moist.

### Planting Season

Ideally, bareroot seedlings will be planted from January 1 to March 31. Seedlings can be planted in December IF special care is taken during the lifting and storing process. Seedlings lifted in December MUST be planted as quickly as possible and not stored in coolers for extended periods. Sites planted in December should be those that are too wet to routinely be planted January through March. It is better to plant wet sites early than to be forced to extend the planting season into April. Trees planted late in the planting season are at a greater risk for mortality.

Containerized trees may be planted from *October* 1 through April 30 so long as adequate soil moisture is present at the time of planting.

### Planting Bareroot Seedlings

Trees and shrubs may be planted by either mechanical or hand planting. Method used will accommodate local site and soil conditions. On sloping land, planting by machine will be done on the contour whenever possible. Do not machine plant through ephemeral stream channels. Machine planters should be raised out of the ground when crossing ephemeral stream channels.

Planting will be done when the soil is neither too dry nor too wet. Planting will be avoided during freezing weather and when the ground is frozen. Avoid planting on hot (>70 degrees F) and/or windy days.

No planting will be done when air or soil temperatures fall below 32 degrees F or rise above 70 degrees F.

Exception will be made when air temperatures drop to as low as 28 degrees but will rise to 32 degrees within 2 hours.

No exception will be made when air temperatures drop below 28 degrees.

Only baldcypress, water tupelo, overcup oak, bitter pecan and green ash seedlings may be planted in standing water up to 6 inches deep. Other tree species may be planted in water up to 2 inches deep, but only in water that is temporarily ponded.

Plant each seedling (hardwood or pine) slightly deeper (1 - 2 inches) than it grew in the nursery in all soils except deep sands. In deep sands, trees will be planted deeper. Hardwood seedlings must be planted so as the swelling at the root collar is below ground the ground line. Seedlings must not be planted with root collar above the ground line.

So long as the roots are properly oriented in the planting hole, there is virtually no limit to how deep pine seedlings may be planted (terminal buds should be at least 2 inch above the ground line). However, the root collar of hardwood seedlings should not be planted more than 2 inches below the ground line.

Planting furrows or holes should be free of trash to ensure proper closure.

Roots must be planted straight down and not twisted, balled, L-shaped or U-shaped. Tap root will not exceed 30 degrees from perpendicular. See the Arkansas Forestry Commission's, "Seedling Care and Planting Guidelines" ([http://www.forestry.state.ar.us/manage/Seedling\\_care.pdf](http://www.forestry.state.ar.us/manage/Seedling_care.pdf)) for common planting errors.

The soil must be packed firmly around planted seedlings with no air pockets left in machine furrows or planting holes. Properly planted seedlings should resist gentle tugging pressure.

Minimal lateral roots may be exposed after planting. No part of the taproot will be exposed

### **Planting Containerized Stock**

Containerized nursery plugs are generally planted by hand with specialized planting equipment. Planting requirements are the same as for bareroot seedlings.

Larger potted materials (2 ½ gallon pots) require planting holes wide enough and deep enough to allow the trees to be planted so their root collars are no more than 1 inch below ground level. Soil additives may be placed in the loose soil around each hole if desired. Fertilizer should NOT be placed in the planting hole to prevent injury to the roots.

### **Planting Cuttings**

Planting of hardwood cuttings will be limited to cottonwood, or willow on appropriate soils for the species.

### **The following specifications must be met for all plantings containing cottonwood:**

1. Suitable Soils – See suitable soils list below for cottonwood and map (Figure 1).
2. Competition control is necessary for cottonwood; and light seeded and soft mast hardwood survival. Minimum site preparation will consist of double disking and deep ripping to a depth of 18 inches. Additional competition control practices such as chemical spraying, supplemental disking, fertilization, and bush hogging may be required.
3. There should be no cultivation within 35 feet of a stream bank; therefore only mixed hardwoods, not cottonwood, should be planted within 35 feet of the stream.

### **Cottonwood Establishment - Planting Material.**

Use cuttings prepared during the dormant season from the previous season's growth. The cuttings should be taken from healthy, moderately vigorous stock plants growing in full sunlight. At least two nodes should be included in the cutting. Cuttings should be at least 1/4 inch and preferably 3/8 to 3/4 inches in diameter. They should be at least 12 inches long; 15 to 20 inches preferred. The top should be horizontal and the bottom should be beveled at a 45-degree angle.

### **Cottonwood Establishment - Planting Method.**

Herbaceous competition MUST NOT overtop the planted cuttings. Band or broadcast chemical control, and/or disking may be required in the first year depending on the existing competition. If cross disking is used to control herbaceous competition, the cuttings must be planted precisely in a grid pattern at wide enough spacing to allow cross disking without damaging the cuttings. Additional treatment may also include adding nitrogen to the subsoil trench according to soil test recommendations.

Cuttings should be soaked in water 2-3 days prior to planting and kept cool during the planting operation. They should be hand planted at the grid intersections of subsoil trenches leaving 2 inches of the cutting above ground level. Soil should be packed firmly around cuttings with no air pockets remaining in the planting hole. Plant cuttings at optimum moisture conditions; between Dec. 1 and March 15; and avoid freezing

weather and frozen soil. Planting spacing and density should be 12'x12' and 302 stems per acre.

Mixed hardwoods may be inter-planted with cottonwood in a nurse crop system to increase oak survival and growth.

Usually cottonwood will be planted on a precise 12 ft. by 12 ft. spacing yielding approximately 302 stems per acre in a grid pattern. Mixed hardwoods may be inter-planted up to two years after the cottonwood cuttings to allow for cross disking between the cottonwood cuttings. Mixed hardwoods can be inter-planted at either a 12 ft by 12 ft or a 12ft by 24 ft spacing. A 12 by 12 planting of cottonwood and a 12 by 12 planting of mixed hardwood will yield approximately 604 stems per acre with alternating species in each row (6 ft. by 12 ft spacing). This is usually planted in the same planting season. When mixed hardwoods are planted 2 years after the cottonwood, they usually are planted 12 ft. apart in the middle of every other row yielding approximately 150 hardwood stems (approximately 450 total stems per acre).

During early stand development cottonwood can act as a nurse crop for the mixed hardwoods but must be removed by natural mortality, deadening or cutting in a timely manner to maintain the hardwood stand's health and vigor. The cottonwood stocking must be reduced by 30 to 50% before age 12, reduced by an additional 30 to 50% by age 22, and all remaining cottonwood must be gone by age 30.

Cottonwood trees harvested while dormant will coppice, while cottonwood harvested while actively growing will not coppice. The cottonwoods in the nurse crop system will be cut during the dormant season at approximately age ten and allowed to coppice. The final cottonwood harvest will occur during the growing season at approximately age 20 to allow the oaks along with natural volunteer species to comprise the forest stand composition.

Planting design must be such to allow for the mechanical removal of the cottonwood component without causing significant damage to the residual stand of hardwood.

### **Selecting the Appropriate Soil for Cottonwood**

Cottonwood is the predominating species in the 302/302 hardwood planting design. Cottonwood soil mapping unit selection shall be based on hydrological and soil characteristics that are silviculturally appropriate for the long-term health and production of the cottonwood stand. Cottonwood can survive on deep, infertile sand and clay but its best growth is on moist, well drained, loamy soils close to streams.

### **Best to Mediocre Sites for Cottonwood:**

Soil Texture (surface horizon) – sand separate less than 70% and clay separate less than 60%

Drainage - somewhat poorly to well drained;

pH (surface horizon) - between 5.0 and 8.5;

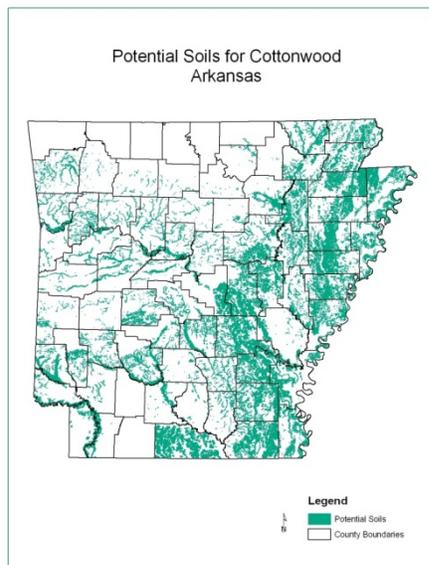
Apparent Water Table depth – from 30 cm and 183 cm; and

### **Arkansas cottonwood suitable soils:**

Acadia silt loam, Alligator clay, Amagon silt loam, Amy silt loam, Arkabutla silt loam, Arrington silt loam, Askew fine sandy loam, Barling silt loam, Beulah fine sandy loam, Bibb soils, Billyhaw clay, Bismarck channery silt loam, Bonn silt loam, Bosket fine sandy loam, Bowdre silty clay loam, Bowie fine sandy loam, Britwater gravelly silt loam, Bruno fine sandy loam, Bulltown loamy fine sand, Calhoun silt loam, Calloway silt loam, Cane loam, Captina silt loam, Caspiana silt loam, Cherokee silt loam, Clarksville extremely gravelly silt loam, Collins silt loam, Commerce loam, Commerce silt loam, Convent silt loam, Coughatta silt loam, Crevasse soils, Crowley silt loam, Dardanelle silt loam, Desha clay, Dexter silt loam, Dubbs fine sandy loam, Dundee fine sandy loam, Dundee silt loam, Earle clay, Earle silty clay, Egam silt loam, Enders fine sandy loam, Enders stony fine sandy loam, Enders stony silt loam, Falaya silt loam, Fatima silt loam, Foley silt loam, Foley-Bonn complex, Foley-Calhoun complex, Foley-Calhoun-Bonn complex, Foley-Calhoun-McCrory complex, Forestdale silt loam, Forestdale silty clay loam, Fountain silt loam, Gallion and Pulaski fine sandy loams, Gallion silt loam, Gore silt loam, Grenada silt loam, Grubbs silt loam, Guthrie silt loam, Guyton silt loam, Harleston fine sandy loam, Hayti soils, Healing silt loam, Hebert silt loam, Henry silt loam, Hillemann silt loam, Hontas silt loam, Houston clay, Immanuel silt loam, Iuka soils, Jackport silty clay, Jackport silty clay loam, Jeanerette silt loam, Kamie fine sandy loam, Keo silt loam, Kiamitia loamy fine sand, Kirvin-Sacul association, Kobel silty clay loam, Lafe silt loam, Latanier clay, Latanier silty clay, Latonia loamy fine sand, Leadvale silt loam, Leadvale stony silt loam, Linker fine sandy loam, Linker gravelly fine sandy loam, Loring silt loam, Marvell fine sandy loam, McCrory fine sandy loam, McGehee silt loam, McKamie silt loam, Memphis silt loam, Mhoon fine sandy loam, Midland silty clay loam, Millwood silt loam, Moreland silty clay, Morse clay, Mountainburg stony fine sandy loam, Muskogee silt loam, Myatt-Kalmia complex, Natchez silt loam, Nella gravelly fine sandy loam, Newellton clay, Newellton silty clay, Nixa very gravelly silt loam, Norwood silty clay loam, Oaklimer silt loam, Ochlockonee fine sandy loam (ouachita), Oklared fine sandy loam, Oktibbeha silty clay loam, Ouachita soils, Overcup silt loam, Patterson fine sandy loam, Peanutrock gravelly fine sandy loam, Perry clay, Perry silty clay, Pickwick silt loam, Portland clay,

Portland silty clay, Prentiss very fine sandy loam, Rexor silt loam, Rilla silt loam, Robinsonville soils, Roellen silty clay, Roellen silty clay loam, Roxana silt loam, Ruston fine sandy loam, Sacul fine sandy loam, Sardis silt loam, Sawyer loam, Sawyer very fine sandy loam, Secesh gravelly silt loam, Sequatchie loam, Severn silt loam, Sharkey clay, Sharkey silty clay, Sharkey silty clay loam, Sidon fine sandy loam, Sidon silt loam, Smithdale fine sandy loam, Spadra fine sandy loam, Staser silt loam, Steele silty clay loam, Stough very fine sandy loam, Stuttgart silt loam, Sumter silty clay loam, Taft silt loam, Taylorbay silt loam, Teksob loam, Tichnor silt loam, Tipp silty clay loam, Tuckerman loam, Tuckerman silty clay loam, Tunica clay, Tunica silty clay, Tuscumbia clay, Una silty clay loam, Wabbaseka-Latanier complex, Waben very gravelly silt loam, Waverly silt loam, Wiville fine sandy loam, Wrightsville silt loam, Yancopin silty clay loam, Yorktown silty clay, Zachary silt loam

Figure 1. Arkansas cottonwood suitable soils



### **Bottomland Hardwood Restoration for Wildlife Habitat**

Bottomland hardwood restorations addressing general wildlife habitat considerations typically are plantings with more species richness and diversity than those used to establish stands that benefit a specific objective such as: timber production or a single wildlife species. These more diverse plantings should include a mixture of hard mast, soft mast, and light seeded species. Tree species with different growth characteristics can provide variation in vertical structure desirable for bird habitat. Rapidly

developing, pioneer species such as cottonwood, black willow, sweetgum, sycamore and green ash planted on appropriately prepared sites can provide vertical structure faster than hard mast species.

Seedling planting density should be no less than 300 TPA (trees per acre), and no more than 453 TPA. The hard mast component of the tree planting plan should comprise of less than 30% of the total stand and no more than 60% of the total stand. The non hard mast component should be evenly divided between light seeded and soft mast species. Only species suited to the planting site will be established. Species mixes will be adjusted to match the soil and site conditions. Examples of soft mast species are: persimmon, red mulberry, sugarberry, black cherry, locust, water tupelo and blackgum. Examples of light seeded species are: cottonwood, black willow, sweetgum, sycamore, green ash, red maple and baldcypress. Wildlife habitat within bottomland hardwood restorations will be considered established when planted seedling survival is 50% or greater at the end of the first, second or third growing season. If operationally possible, surviving seedlings should be evenly distributed across the planting site in a random species mix. Potential seedling planting spacing and densities for general bottomland hardwood wildlife habitat establishment are:

12' x 8' = 453 seedlings per acre  
 14' x 7' = 435 seedlings per acre  
 12' x 12' = 302 seedlings per acre  
 12' x 10' = 363 seedlings per acre  
 10' x 10' = 435 seedlings per acre

Site preparation shall be sufficient for establishment and growth of the selected species and type of planting stock. The type and intensity of site preparation will vary according to ground cover, soils, and the species to be planted (See Tree/Shrub Site Preparation, Code 490). All site preparation activities must be done in a timely manner. Planting should be delayed if the site preparation is not completed properly.

Adequate herbaceous control either mechanical, chemical, or a combination is required. The plan should take in account the existing competition and soils on the planting site and prescribe adequate control to allow light seeded species to be free to grow till they are above the competition. Care should be taken to prescribe only what is necessary to insure survival. (See Tree/Shrub Site Preparation, Code 490).

### **Eastern Cottonwood, Wildlife Habitat, Carbon Sequestration, and Trainer Tree Considerations**

In addition, general wildlife habitat establishment carbon sequestration concerns may be addressed by establishing a cottonwood /hardwood inter-planting at

604 trees per acre when the cottonwoods will be removed. This planting will consist of 302 cottonwoods on a 12' X 12' spacing and 302 mixed hardwoods on a 12' X 12' spacing. This stand will be planted at spacing of 12' X 6' with cottonwood and hardwood alternating within every planted row. The hardwood component (non cottonwood component) will be a species mix of 30% to 60 % hard mast and remaining composition will be evenly divided between light seeded and soft mast hardwood species. Stand will be considered established when there are at least: 200 cottonwood and planted hardwood seedling survival is 50% or greater at the end of the first, second or third growing season. If operationally possible, surviving hardwood seedlings should be evenly distributed across the planting site in a random species mix. Seedling planting spacing and for the enhanced carbon sequestration hardwood wildlife habitat establishment is:

12' x 6' = 604 seedlings per acre

### Direct Seeding

Both pine and hardwood stands can be established by planting seeds. Direct seeding is generally not recommended. Most efforts to do so have failed due to depredation by birds and rodents and drought stress shortly after germination. Direct seeding usually results in uneven stand densities that vary between being too thick to too thin.

Seeds will be carefully hand-collected or obtained from a reputable dealer for direct seeding purposes.

Acorns should be collected as soon as possible after falling from the tree and refrigerated to control weevil damage. White oak acorns have to be refrigerated to help control germination

Acorn viability can be tested by floating in water. Stir the acorns once or twice during the floating period. Unsound acorns float and will be discarded (except overcup oak acorns which generally float as a dispersal method).

Acorns of the white oak group have little or no dormancy and will germinate almost immediately after falling. Acorns of the red oak group do exhibit embryo dormancy and will germinate the following spring after fall sowing. If sown in the spring, the red oak acorns require a pre-treatment consisting of 30-90 days at 33-41 degrees F. Do not freeze.

Acorns of the white oaks cannot be stored for long term, but red oak acorns can be stored up to 3 years. Viability is decreased under longer storage time. Adequate moisture content of the acorns is critical during the storage period.

Oak acorns and pecan nuts will be planted from October 31 to April 1. The best germination results are generally achieved with December plantings.

The acorns will be machine or hand planted at a spacing of 10 X 3 feet or 12 X 2.5 feet (1,250 to 1,500 seeds per acre). Depth of planting will be 1 to 2 inches.

Approximate pounds of seed per acre required for various oak and pecan species are as follows:

Common Name	Group	Lbs./Acre
Cherrybark oak	Red	3 - 4
Cow Oak	White	20 - 25
Hickory species	-	8 - 20
Nuttall oak	Red	12 - 15
Overcup oak	White	8 - 10
Pin oak	Red	4 - 5
Sawtooth oak	White	10
Shumard oak	Red	12 - 15
Southern red oak	Red	3 - 4
Sweet Pecan	-	10 - 12
Water oak	Red	4 - 5
Willow oak	Red	3 - 4
White oak	White	12 - 15

Pine seeds may be aerially sown or distributed by hand from February 15 to April 15. Hand sowing can include use of a "cyclone" type seeder.

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 broadcast seeding. Clear an area approximately one-foot square with a rake or hoe, drop 3-6 seeds per spot, and lightly press the seed into the soil. About 1000 spots per acre (spaced 6' X 7', 5' X 8', or 4' X 10') are needed to have adequate stocking.

Seeding rates for pines will be as indicated below:

Common Name	Seed / lb	Lbs /Acre Broadcast	Lbs/Acre for 1000 Spots
Loblolly	18,500	1.0	<sup>1</sup> / <sub>3</sub>
Shortleaf	45,000	<sup>1</sup> / <sub>2</sub>	<sup>1</sup> / <sub>4</sub>

### Natural Regeneration

The use of a natural seed source may be used under any of the following circumstances:

- Sufficient seed trees and/or shrubs of the desired species and size are available to meet reasonable expectations for natural regeneration.
- Sites for potential natural regeneration are within 200 feet of existing seed sources.
- Sites are generally too wet or flooded during the planting season to facilitate proper tree planting procedures or make planting unlikely to succeed.
- Sites are likely to be invaded by soft mast hardwood species which will out-compete planted hard mast species.
- Sufficient advance hardwood reproduction is present at the time of timber harvest. Do not base evaluation on expected stump and root sprouts. Some site preparation may be necessary to promote natural regeneration (See Forest Site Preparation, Code 490).

Three harvest types can be used to naturally regenerate pine (See Forest Stand Improvement, Code 666):

- Seed tree
- Shelterwood
- Clearcut

The clearcut method depends upon using trees within 400 feet of the clearcut area for the seed source. The clearcut will be oriented perpendicular to prevailing winds.

Only light-seeded hardwoods (such as green ash, sweetgum, maple, sycamore, elm, cottonwood, and willow) will benefit from the seed tree method. Generally oaks are regenerated through advance reproduction at the time of harvest.

Seeds of species such as overcup oak, water hickory, baldcypress, and tupelo gum will be dispersed by floatation in floodwaters. Scope of dispersal depends upon the extent of backwater flooding.

#### **Protection of Newly Established Areas**

Newly planted pine stands may be susceptible to Pales weevils if planted less than six months after a pine harvest (Rule of Thumb = harvested after July 1). Pine seedlings should not be planted where pine has been harvested after July 1. If planted during this time frame, the seedlings or the area surrounding the newly planted seedling will be treated with an insecticide solution. See Pest Management, Code 595, for further planning requirements.

Exclude fire from all young plantations (See Firebreak, Code 394). Exclude grazing from all hardwood plantations and from pine plantations where the trees are shorter than six feet (See Use Exclusion, Code 472).

Use of tree protection devices may be necessary for adequate survival in areas with heavy animal depredation.