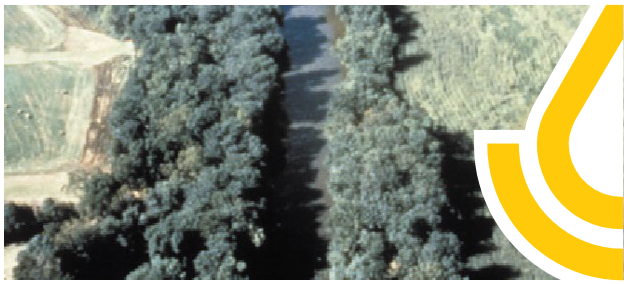
Tree/Shrub Establishment Planting Guide

Wisconsin Guidance Document 612



INTRODUCTION

This guidance document is intended to be used by resource professionals as a guide for planting and direct seeding tree and shrub species for reforestation and afforestation, primarily for Conservation Practice Standard Tree and Shrub Establishment (612). The general principles in this guidance document can also be applied to Alley Cropping (311), Windbreaks (380), Silvopasture (381), Riparian Forest Buffer (391), Upland Wildlife Habitat Management (645), and other conservation practices that include the establishment of trees and/or shrubs. More specific Conservation Practice Standards and guidance documents should also be consulted for these practices.

WISCONSIN TREE AND SHRUB GUIDE BY COUNTY

The “Wisconsin Tree and Shrub Guide by County” document (found in Section III of the Field Office Technical Guide in Planning Tools>Forestry) includes most, but not all, of the native tree and shrub species for Wisconsin. Other native species may be planted if they serve the intended purpose of the planting and are approved by the Wisconsin NRCS state forester. Species selection should be based on local site conditions, professional judgment, and availability of planting stock/seed.
The Major Land Resource Area (MLRA) and county- specific tables provided in the “Wisconsin Tree and Shrub Guide by County” document can be modified by the NRCS state forester with concurrence from WI DNR Division of Forestry and local resource professionals.

SPACING AND LAYOUT REQUIREMENTS

Tree/shrub spacing, and density vary depending on the purpose of the planting and the type ofstock being planted. Typical density ranges are listed below.

Seedlings (bare root-plugs-cuttings):
» Timber production:
- Hardwoods - 545-900/ac.
- Conifers - 600-1000/ac.

» Wildlife Plantings: 302-1200/ac.
» Christmas Trees: 726-1200/ac.
» Supplemental Underplanting: 200-300 / ac. evenly distributed over the area needing treatment.
» Erosion control: 1000-1200 /ac.

For other applications or approval of planting densities outside these listed ranges, contact the Wisconsin NRCS state forester or state biologist, depending on planting purpose.
Larger stock (generally stock taller than deer browse height, or 6 – 8’):
» 20+ per acre if natural regeneration is expected.
» 50+ trees per acre if natural regeneration is unlikely (exact number depends on objectives).

Plan the minimum setback distance from the outside tree or shrub row to adjacent property line or contrasting land use areas to be equal to the 20-year height of the tree or shrub, unless the 20-year height is greater than 20 feet in which case use a minimum setback of 20 feet. Consult with your local forestry experts or the state forester to determine 20-year height of selected species.

Where subsurface drains (tile lines) cross through a tree/shrub planting, and where these drains will remain functional, to prevent root damage to the drain install a sealed conduit through the planting. Extend the conduit a minimum of 100' beyond trees that attain large mature size and 75' beyond small to medium sized trees and shrubs (at maturity).

Additional Information for Supplemental Underplanting
Ensure that there is adequate sunlight available for the species to be planted. Forestry experts should be consulted to determine suitable species for the site.

» Intolerant tree/shrub species (suitable for Open Exposure sites) require full sun, with minimum openings of ½ to ⅔ acre in size (diameter of opening: 160-200 feet, measured from crown drip line to drip line).

» Species with intermediate shade tolerance (suitable for Partial Shade Exposure sites) require canopy closure of 30-50%, which can also be achieved with openings ¼ to ½ acres in size (diameter of opening: 120-160 feet, measured from crown drip line to drip line).

» Shade tolerant species (suitable for Shade Exposure sites) should be used where there is 60-80% canopy closure to accelerate growth and development. Small openings of 1/10th acre or less (diameter of opening: 80 feet or less, measured from crown drip line to drip line)) will favor regeneration of shade tolerant species.

All underplanted seedlings will benefit from additional removal of overstory trees two or more years after establishment to maintain or increase the amount of light reaching the ground.

MINIMUM PLANTING STOCK SIZE

Bare-root Stock

Stock Type	Minimum Shoot Length	Minimum Root Length
1-0 Conifer	2.5”	6”
2-0 Conifer	3 – 4”	6 – 8”
3-0 Conifer	5 – 6”	8”
1-0 Hardwood	5 – 6”	8”
2-0 Hardwood	8”	8”

Containerized Stock (Plugs)

One-year old plug container seedlings must have root volumes of at least 3 cubic inches for conifers and 7 cubic inches for hardwoods.

Containerized Potted Stock

Small: 1 quart up to 2 gallons

Large: 2 gallons or larger

Cuttings (Willow, Cottonwood, etc.)

Minimum 10 inches in length

Balled and Burlapped Stock

Conifers:

Tree Height	Minimum Diameter Ball
18-24 in.	10 in.
2-3 ft.	12 in.
3-5 ft.	16 in.
5-6 ft.	19 in.

Hardwoods:

Tree Height	Minimum Diameter Ball	Caliper*
5-6 ft.	12 in.	½ in.
6-8 ft.	14 in.	¾ in.
8-10 ft.	16 in.	1 in.

* Caliper shall be measured 6" above the ground.

CONSIDERATIONS FOR SPECIES SELECTION

Site information such as climate, soil type, soil drainage class and moisture regime, aspect, and purpose of the planting must be collected. Projected climate change within the next decades should also be considered (see Climate Change section of this document). References include the "Original Vegetation Cover of Wisconsin" map that can be found by entering the map title into the search function on the WI DNR website. Also refer to "Forest Communities and Habitat Types of Central and Southern Wisconsin" and "Forest Communities and Habitat Types of Northern Wisconsin" (see reference section) for information on natural forest communities and their typical succession patterns. These references along with the "Wisconsin Tree and Shrub Guide by County" (FOTG Section III) will allow the planner to develop sound planting/seeding species recommendations. In most cases a forester's recommendations should be followed for tree plantings.

» Identify the Major Land Resource Area (MLRA) and the county where the practice will be applied. The NRCS WI Soil Science webpage has MLRA information.

» Identify the soil type(s) and the drainage class of the site. This information can be found in the County Soil Survey or on the NRCS Web Soil Survey (this can be found by doing an internet search for "Web Soil Survey"). Manipulations of the natural drainage class identified in the soil survey must also be considered. Keep in mind the scale of the soil survey and recognize that stand-level soil differences will not be captured by the survey, especially for woodland soils. On-site soil tests will help determine soil types if necessary.

» Consider the intended and potential uses of the planting.

» Determine whether the planting will be in the open (cropland or pastureland conversion), partial shade (under-stocked existing stand or shelterwood), or shade. Also consider aspect and its effects on heat and soil moisture.

» Select species based foremost on the recommendations of a forester in a forest plan. Use scientific names of plants to avoid confusion with common names that may differ between regions.

For 612 Tree/shrub establishment, only native species should be planned for establishment. There may be exceptions to this that can be approved by the state forester (e.g., phytoremediation, biomass). Non-native, non-invasive species may be planned for agroforestry practices; however, this should be done using the planning documents specific to these practices (311 Alley cropping, 380 Windbreak, 381 Silvopasture, 391 Riparian Forest buffer).

METHOD OF ESTABLISHMENT

Direct Seeding

Direct seeding, if successful, allows the establishment of a stand with a natural appearance. It can be particularly useful on sites that otherwise are difficult to plant due to difficult terrain or shallow soils. Areas with very shallow topsoil are easier to seed because seeding depth is shallower than planting depth for seedlings. The seeding method encourages good root development and avoids transplant shock. In hardwoods, stem quality may be improved due to higher densities than seedling plantings. The cost may be less expensive than planting for conifer seedings or small area seedings. Cost of hardwood seeding may be more expensive than planting depending on how much seed is used.

Direct seeding may not be a viable option every year. Many species only periodically produce good seed crops and seed may not be available when the crop is poor. This is especially true for hardwood species, as their seed generally does not store well and cannot be stockpiled for future use in good years. Direct seeding should not be used on slopes steeper than 6% without considering a cover crop or other measure for erosion control. Direct seeding is not well suited for sites that will be used for specialty plantings (Christmas trees, windbreaks).

The direct seeding method is best suited to sites being converted from intensive agricultural production. Weed control is critical to establishment of trees and shrubs using the direct seeding method and intensive agriculture provides this control. Competition must be controlled for a minimum of 3 years after seeding and should be checked for follow-up control measures until tree crowns are above the competition. Direct seeding is not recommended for sites with severe competition from existing vegetation (e.g., dense sod, reed canarygrass).

The large number of seeds per acre increases the chance that trees will benefit from the best available micro- sites. Enough trees will generally escape deer and rabbit browse to develop a stand of trees when heavily planted. However, squirrels and other rodents can destroy much of the seed in years when snow cover is light. Areas smaller than two acres can also experience heavy seed predation due to high amounts of edge habitat.

Locally collected seed is typically recommended to ensure compatibility with local conditions. This recommendation is sound; however, seed may be collected from sources better adapted to future climate if desired (see Climate Change section of this document). Seed should only be collected from high-quality source trees and at the right time of year. If unsure about seed collecting techniques, check with local forestry professionals.

Nursery Stock

Planting of nursery stock allows for better density control (important for specialty plantings) and is desirable for sites that require intensive weed control, especially where mechanical control is the preferred option. By using seedlings, several years of development are realized with a new planting. Planting of seedlings is also a more efficient use of genetically improved seed.

Sites that are excessively well drained are usually more successful if planted with nursery stock as the developed root systems of seedlings have a better chance of obtaining sufficient moisture (plugs are a good option in these situations). Nursery stock is better suited to slopes greater than 6% than is direct seeding. When planting fields being converted from intensive agriculture on these slopes, additional conservation practices such as cover crops and planting on the contour should be considered to prevent soil erosion.

For sites that have existing grass/herbaceous cover, planting seedlings is a better choice than seeding if the competing vegetation is controlled by herbicide and/or by mulching. Nursery stock plantings produce a more uniform stand and are well suited for under-planting in the shelterwood system or in poorly stocked stands. Planting spacing can be designed with future management activities in mind, ensuring there is sufficient spacing to accommodate equipment.

SITE PREPARATION

The single most important part of planting trees is protecting them from competing vegetation. All plants compete for light and water and many grasses produce natural chemicals that suppress tree and shrub growth. If not managed, competition from weeds, grasses and unwanted woody vegetation will cause a planting failure. Mechanical and/or chemical site preparation techniques can be used depending on site conditions and client objectives. See Conservation Practice Standard 490-Tree/shrub site preparation for more information and to plan site preparation treatments.

Mechanical Site Preparation

A variety of methods are available for mechanical site preparation. The method used will depend on site conditions and limitations. In forested settings, equipment is often used that can be attached to logging machinery and creates areas of bare ground with different levels of soil mixing. In agricultural settings, a common practice is to reduce the competition from thick grass sod by plowing, disking, and establishing a cover crop the year prior to planting. To prevent erosion when using tillage equipment on slopes greater than 6%, leave strips of sod between 6-foot tilled strips and till on the contour. For sites with an existing clean tilled crop, address any weed problems and see 340-Cover Crop for planning a cover crop. Winter rye, winter wheat, and white clover perform well as cover crops for tree planting purposes. Cover crops or sod strips should also be used on sandy soils where there is the potential for windblown sand to damage seedlings.

Chemical Site Preparation

Weed and/or grass competition can be controlled with herbicide use. On sites with slopes greater than 6%, band spraying of the row is preferable over broadcast spraying of the entire site to maintain some vegetation on site to prevent soil erosion. Effective control is target-species dependent and is influenced by four factors:

» Timing of application,

» Herbicide selected,

» Weather conditions,

» Application rate.

A combination of chemical and mechanical site preparation may be required on difficult, heavy sod sites. Very dry conditions will limit the effectiveness of most herbicides. Be sure to follow all label directions for application rates, timing, proper weather conditions, and safety precautions.

NURSERY STOCK PLANTING TIMELINE

August/September

For nursery stock planting in the spring of the following year, complete site preparation now on sites with existing vegetation (on crop fields site preparation may begin after the crop is harvested). Site preparation will be specific to the site and species to be established.

October/November

For a spring planting of nursery seedlings, order nursery stock now. To determine number of seedlings to order, create a planting design. Chapter 15 of “Wisconsin Forest Management Guidelines” (DNR PUB-FR-226 2018) has comprehensive instruction on designing a planting. This publication is available as a free download from the WI DNR website. Density of plantings will vary by species, objective, soil site conditions, and other factors. Seedling mortality should be estimated and accounted for in the plan. At a minimum plan for 25-30% mortality three years after planting. On difficult sites (high water table, reed canarygrass, droughty site, unable to implement site preparation, herbivory, limited ability for post-planting weed control, etc.) it may be prudent to plan for up to 50% mortality three years after planting. The surviving stocking level should be within the range listed (according to landowner objective) in the “Spacing and Layout Considerations” section after accounting for estimated mortality. ***Specific program requirements (CRP, Managed Forest Law, etc.) may dictate the amount of stock needed and spacing***. For most plantings, use the following table when planning the amount of nursery stock required.

Spacing (feet)	Plants Per Acre
7 x 6	1,037
7 x 7	889
8 x 6	908
8 x 7	778
8 x 8	681
9 x 6	807
9 x 7	691
9 x 8	605
9 x 9	538
10 x 6	726
10 x 7	622
10 x 8	545
10 x 10	436

For specialty plantings (e.g., windbreaks, Christmas trees) consult specific standards or factsheets.

The need for seedling protection should also be planned for at this time and materials obtained as needed. Consult the 612-Tree/Shrub Establishment-Protection Guidance Document for information on different protection methods.

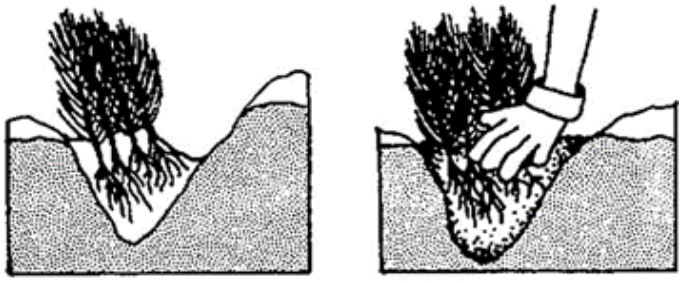
March/April/May

Inspect sites to be planted for weed problems and apply chemical or mechanical weed control as needed prior to planting.

Seedlings may be planted by hand using a shovel, planting bar, or hoedad. Hiring professional tree planters will likely improve results. Seedlings may also be machine planted. Planting machines and equipment may be available for rent in some counties.

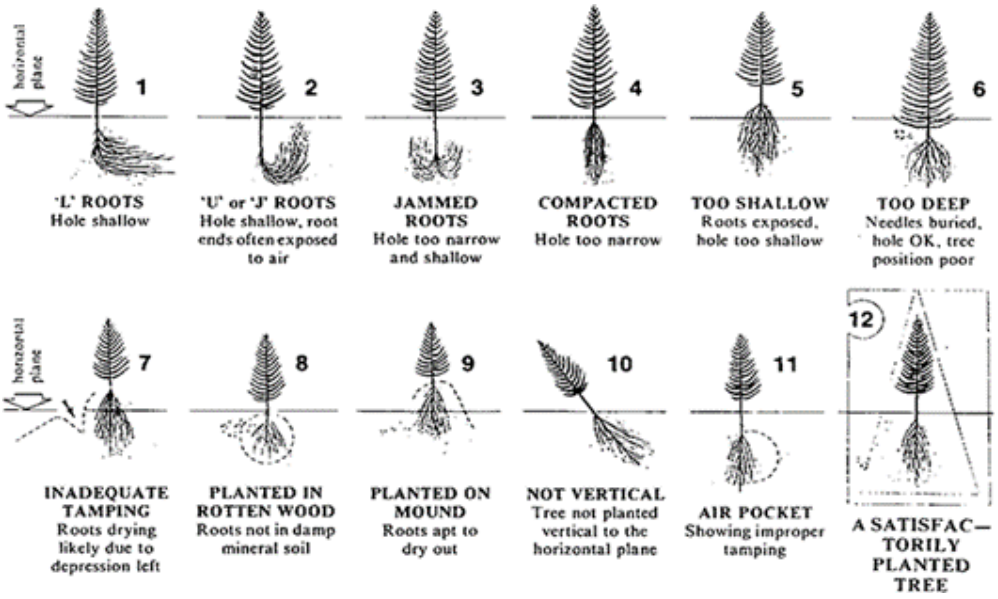
Time seedling arrival for shortly after the ground thaws (this will be the time of maximum soil moisture for seedling establishment). Seedlings can be planted until about May 15th in the southern part of the state and June 1st in the northern part of the state. Plant seedlings as soon as they arrive. Do not allow seedlings to lay in the sun or dry out. Do not take large amounts of seedlings to the field where they will dry out before planting. Take small amounts and store the rest in a cool, shaded location and keep moist, but not wet, until planted. Do not open the shipping containers until ready to plant. If stock in bundles has been exposed to warm temperatures, the bundles should be opened to prevent heating. Wet roots only if the soil particles attached to them have dried out. Do this by misting water on the roots, taking care not to wash the protective soil particles off the roots. Keep tops dry. Stock to be available for planting in two to three days can be stored in a cool spot that does not receive wind or sunlight. Ensure that the containers are spread out and well-ventilated to prevent heating. Stock held longer than two to three days should be stored in a cooler at a temperature of 33-40° F. If trees that have been placed in a planting bag with the intention of planting that day are unable to be planted, they may be temporarily stored by “heeling-in” to the ground until they can be planted. To use the heeling-in technique, roots must be packed tightly in soil and kept moist, and the heel-in trench must be shaded and protected from the wind. This technique is not for long-term storage or large numbers of seedlings. See Figure 1.

Figure 1. Heeling-in Technique for Temporary Seedling Storage



Proper planting is crucial. Seedlings that develop "J" roots from improper planting will die. Seedling roots should hang free and just touch the bottom of the hole with the root collar of the seedling at or slightly below soil level. Figure 2 has examples of improperly planted bareroot seedlings that are commonly encountered. Note that “J”-roots are seldom a concern with container (plug) stock.

Figure 2. Improperly Planted Bareroot Seedlings (#1-11) and Properly Planted (#12)



When the root length on bare-root seedlings exceeds the depth of the planting tool being used, roots may be pruned to the tool length. This is best done in a cool environment where roots are not exposed to wind or sunlight. Use a sharp cutting tool such as a large scissors, pruning shears, or machete. Root systems can be pruned to a length of 8-10 inches below the root collar. Roots should not be cut shorter than 8 inches. Keep the roots moist after pruning by misting with water, and re-pack into original container. Moisture enhancers or root gels may also be used to keep roots moist. Removal of any part of the root system will have an adverse impact on seedling vigor so pruning should only be done if absolutely necessary. It is better to modify the depth of planting rather than prune roots if possible.

If cuttings are used, they must be kept moist and cool until planted. Plant within two days of arrival or collection. Cuttings should be buried with buds pointed up, with an exposed tip with at least two buds above ground.

For larger container stock, dig a hole 3 to 4 times wider than the container diameter and about the same depth as the container. Gently remove plants from containers. If roots are compacted or circling, use a knife to slice an “X” across the bottom of the root ball and four vertical slices on the sides of the root ball. Position tree in hole, making sure the root collar is level with the ground surface. Firmly pack soil around roots to eliminate air pockets. Water should be applied generously, and soil added if settling occurs.

For ball and burlap stock, dig a hole 2 to 3 times as wide as the root ball and about the same depth as the root ball. When handling stock, do not lift a tree at the stem or trunk to avoid damage. Handle stock at the root ball if possible. Carefully place the tree in the hole. When positioned, remove any rope, wire, or plastic twine from the tree. Pull the burlap back and cut away loose burlap. Burlap may remain in place underneath the root ball (vinyl or treated burlap should be removed). Firmly pack soil around roots to eliminate air pockets. Water should be applied generously, and soil added if settling occurs.

DIRECT SEEDING TIMELINE

August/September

For direct seeding in autumn of the current year, complete site preparation now on sites with existing vegetation (on crop fields site preparation may begin after the crop is harvested). Site preparation will be specific to the site and species to be established.

Seed Collection and Sowing

For direct seeding, identify commercial or local seed sources. For commercial seed, make sure the supplier confirms the seed is purchased from a desired source area.

» For commercial seed, order the seed in season and plant as soon after delivery as possible. Use the supplier's listing of percent sound seed to determine final seeding rates. Most seed is difficult to store and storage is not recommended. Keep seed cool and shaded until planted.

» For locally collected seed, collect enough to meet the desired seeding rate while accounting for defective seed. Visually inspect seed for proper color and form, insect damage, and mechanical damage. Remove debris, caps, and wings from seed.

» Float testing may be used to identify viable acorns and walnuts. Nuts that sink are viable, while floaters are discarded. Consider cutting a sample of floaters and sinkers to ensure effectiveness of the test.

» A cut test should be used to determine the amount of sound seed being collected for other species. Inspect 10 or more randomly selected seeds per 3,000 seeds for each species collected. Cut open the seed and check it is filled, moist, and normal colored.

The direct seeding rate varies by species and site conditions. Generally, the seeding rate for mixed species seedings should be at least 4,000 – 6,000 seeds per acre. A combination of drilled and broadcast seed methods can be used. The following table has single species rates for common species to seed at 4,000 – 6,000 seeds/acre.

Species	Planting Method	Collect	Bushels Per Acre	Pounds Per Acre
Northern Red Oak	Drilled	Sept - Oct	1 - 2	30 - 60
White Oak	Drilled	Late Aug - Sept	0.5 - 1	20 - 30
Bur Oak	Drilled	Aug - Sept	2 – 2.5	50 - 80
Swamp White Oak	Drilled	Sept – Early Oct	N/A	30 - 50
Black Walnut	Drilled	Oct	4 - 6	100 - 150
Shagbark Hickory	Drilled	Sept - Oct	0.75 - 1	40 - 60
Sugar Maple	Broadcast	Late Sept – Early Nov	N/A	0.25 - 1
Basswood	Broadcast	Sept - Dec	N/A	1 – 1.25
Black Cherry	Broadcast	Aug - Sept	N/A	2 -3
Yellow Birch	Broadcast	Sept - Oct	N/A	0.1
Paper (White) Birch	Broadcast	Aug - Sept	N/A	0.1
Jack Pine	Broadcast	Oct	N/A	0.1
Eastern White Pine	Broadcast	Sept – Early Oct	N/A	0.1 – 0.25

The following chart shows the row and seed spacing combinations that will result in 4,000 seeds per acre for drilled seed. Adjust planting rate based on sound seed percentage from seed inspection.

Row Spacing (Feet)	Spacing Within Row (Feet)	Row Spacing (Feet)	Spacing Within Row (Feet)
4	2.7	8	1.4
5	2.2	9	1.2
6	1.8	10	1.1
7	1.6	12	0.9

Heavy seeded species are most suitable for drilling and will likely make up the bulk of the seeding in former agricultural settings where a seed drill can be used. Lighter seeded species are more suited for broadcast seeding and work best in woodland settings where agricultural machinery cannot operate, although they can also be used to diversify seedings on former agricultural land.

Drill acorns 1-3 inches deep and nuts 2-5 inches deep. If rodent predation is a concern, planting acorns slightly deeper to 4 inches in depth may reduce predation. However, planting acorns deeper than 4 inches will likely reduce germination. Generally, guidance is to plant to a depth that is twice the diameter of the seed. For light seeded species that are broadcast on former agricultural land (after heavy seed has been drilled), drag the site lightly to work the seed into the soil. Alternatively, the heavy seed may be broadcast with a fertilizer spreader and disked in to a 1-2 inch depth. Light seed may then be broadcast on top and lightly dragged into the soil.

For direct seeding in woodland settings, broadcast seeding is most effective. Typically, this can be done with attachments (seed dribblers, mechanical broadcast seeders) to mechanical site preparation equipment, accomplishing both site preparation and seeding at the same time. It may also be done by hand, although this is a slower process and should only be used for smaller seeding projects. Generally, it is not recommended to seed acorns or nuts in woodland settings due to high predation from rodents.

It is extremely important that the site is prepared for planting before seed is received or collected so that the seed can be planted immediately. In particular white oak, bur oak, and swamp white oak acorns must be planted as soon as possible after collection. These acorns sprout in the fall and begin growing before the ground freezes and do not require the cold stratification that the red oak family, the walnuts, and the hickories require. Stratification is a period of cold and moist conditions that must occur before the seeds of some species will germinate.

Immersing acorns in water prior to planting will restore moisture lost during collection. Soak from 4 to 24 hours. If seeding is delayed more than a few days, place seed in porous bags (e.g., onion bags) and place in cold storage (35-40^{o} F). Keep heavy seeded species moist by spraying with a mist of water until they can be planted. Keep light-seeded species dry until planting. Do not place seed in direct sun or expose to heat. Inspect seed for storage losses prior to planting.

October/November

If this is the period when seed is collected or commercially available, seed immediately upon receiving. Follow the same general guidance provided above.

April/May

Inspect sites direct seeded the previous fall for weed problems and treat as necessary.

MAINTENANCE AFTER PLANTING OR SEEDING

Planting sites should be inspected regularly to assess seedling survival, competition from other vegetation, and browsing damage.

Survival surveys are typically done the first and third years after planting, with an additional fifth year survey for seeding. Survival surveys can be done using a fixed plot. A 1/100th acre fixed plot is recommended (11.8' radius). Install one plot per acre for stands that are ten acres or less in size. For stands larger than ten acres, install an additional plot for every five acres over ten acres, spreading the plots evenly over the stand (e.g., 16-acre stand = 10 plots + [6 acres/5acresper plot] = 10 plots + 1.2 plots = 11.2 plots, round up to 12 plots total). All desirable tree regeneration should be tallied on each plot. Trees per acre are calculated by multiplying the number of trees on the plot by the plot expansion factor (multiply by 100 in the case of a 1/100th acre plot). Average trees per acre across all plots to determine overall stocking survival. If survival falls below desired stocking levels, the site should be re-planted, either partially or completely depending on the level and spatial pattern of survival (record approximate plot locations, labeled by plot number, on a stand map to determine spatial variability in survival).

Browsing damage can be controlled with several methods. This is best planned for prior to planting, however protection measures can be added after the planting if browse becomes a problem. Consult the 612 Tree/shrub Establishment-Protection Guidance Document for more information.

Competing vegetation should be controlled until seedlings have grown higher than the height of the competition, typically for at least three years following planting. There should be at least a 3' diameter circle or 3'x3' square zone clear of competition around each seedling.

Chemical methods are most effective at controlling competing vegetation. Carefully choose the chemical and/or application technique to ensure it will not harm the seedlings.

Other methods of competition control include mulches and weed fabric/mats. These are generally less effective than chemical control. Note that mulch may attract rodents to the planting. Mulch depth should be at least 2-3", thickest around the outside of the mulched area and thinner as it nears the seedling stem. Mulch should not make contact with the stem.

Weed fabric and tree mats may show variable results regarding effectiveness. They are constructed to let water and air through without letting light through, smothering the competing vegetation while allowing the seedling to access moisture and oxygen. They seem to be most effective in droughty soils as they tend to trap moisture in the soil, and with moderate grass or weed competition previously controlled with site preparation. They may not be effective in woodland settings or where aggressive grasses/forbs are well established. They may also make seedlings easier for deer to sense and should be paired with browse protection if planting palatable species in areas with high deer populations. It is important to place fabric/mats

correctly, as only one side is usually pervious to water and air. Mats are typically 3'x3' squares designed for individual tree placement and are secured with garden or ground staples. Specialized equipment has been designed for use with weed fabric rolls in agricultural settings, making the process faster. A minimum roll width of 3' should be used. When using this equipment, the fabric should be immediately slit over the seedlings and seedlings pulled throughto prevent heat damage. Care should also be taken to ensure the fabric does not contact the seedling stem as it can cause damage to the stem in windy conditions, and that soil does not accumulate on the fabric and provide a substrate for weed growth.

Note that mowing should not be used to control vegetation immediately around seedlings, as the mowing will stimulate root production of grasses and increase competition with seedlings. Mowing may be done between tree rows to improve access and to reduce habitat for rodent populations.

CLIMATE CHANGE AND CARBON CONSIDERATIONS

In general, having a diversity of native tree species in the planting will increase the likelihood that several species will be well-adapted to the changing climate in the area. This is the simplest way to make a planting resilient to future climate conditions.

The U.S. Forest Service has developed a Climate Change Tree Atlas for the eastern United States that shows changes in habitat suitability for each tree species under different climate change emissions scenarios. This information can be used to choose species for planting that are predicted to have good habitat conditions in the future. The Tree Atlas can be found by searching for "Forest Service Climate Change Tree Atlas" in a web browser. Results from the Tree Atlas also inform the publications "Climate Change Field Guide for Northern Wisconsin Forests" and "Climate Change Field Guide for Southern Wisconsin Forests". These publications can be found by searching their titles in a web browser. The publications are organized by ecological sections (seven in northern Wisconsin and three in southern Wisconsin) and forest communities (similar to forest types) to show tree habitat predictions at a site level scale. The information in the Tree Atlas has also been localized to latitude/longitude in one-degree grids and is available at: 1 x 1 Degree Grid Summaries - Climate Change Atlas - Northern Research Station, USDA Forest Service. Consult with the NRCS state forester for questions on interpreting this information.

The Seedlot Selection Tool can be used to find out which geographic areas currently have climate conditions similar to predicted future climate conditions for your area. You can then attempt to procure seed or stock from that geographic area to have plantings better suited to future climate conditions. Search for "Seedlot Selection Tool" in your web browser to access the tool. This tool should be used cautiously. Suitable seed areas within Wisconsin or adjacent states are preferred to avoid getting too far ahead of climate conditions. Consult with the NRCS state forester for questions on using the tool. Seedlot requests for locations outside of Wisconsin and immediately adjacent states require NRCS state forester approval.

Where carbon sequestration and/or storage are a primary purpose of planting, use the following chart to choose species for carbon sequestration (fast growth), carbon storage (long-lived, generally average lifespan of 150 years or greater), and durable wood products (e.g., structural lumber, furniture, flooring, etc.). The table assumes good site and growing conditions for the seedlings, suitable predicted habitat under future climate conditions, protection against browse where needed, and the most common wood product markets available.

Tree Species	Sequestration	Storage	Durable Wood Products
Conifers			
Black Spruce		X	X
Eastern Hemlock		X	
Eastern Redcedar		X	
Eastern White Pine	X	X	X
Jack Pine	X		
Northern White-cedar		X	X
Red Pine	X	X	X
Tamarack (Eastern Larch)		X	
White Spruce		X	X
Hardwoods			
American Basswood	X	X	
American Elm - Disease Resistant	X	X	
American Sycamore	X	X	
Aspen (Bigtooth, Quaking)	X		
Black Cherry	X		
Black Oak		X	X
Black Walnut	X	X	X
Black Willow	X		
Bur Oak		X	X
Eastern Cottonwood	X		
Hackberry	X	X	
Honeylocust	X		
Northern Red Oak	X	X	X
Paper Birch (White Birch)	X		
Red Maple	X		
River Birch	X		
Shagbark Hickory		X	X
Silver Maple	X		
Sugar Maple		X	X
Swamp White Oak	X	X	X
White Oak		X	X
Yellow Birch	X	X	X

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